## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welcome Message from the President of the IEEE Computational Intelligence Society</td>
<td>6</td>
</tr>
<tr>
<td>Welcome Message from the General Chair of IEEE SSCI’15</td>
<td>7</td>
</tr>
<tr>
<td>2015 Frank Rosenblatt Award</td>
<td>9</td>
</tr>
<tr>
<td>Organizing Committee</td>
<td>10</td>
</tr>
<tr>
<td>Symposium Chairs</td>
<td>13</td>
</tr>
<tr>
<td>ADPRL</td>
<td>13</td>
</tr>
<tr>
<td>CCMB</td>
<td>14</td>
</tr>
<tr>
<td>CIASG</td>
<td>15</td>
</tr>
<tr>
<td>CIEH</td>
<td>15</td>
</tr>
<tr>
<td>CIIM</td>
<td>16</td>
</tr>
<tr>
<td>CIA</td>
<td>16</td>
</tr>
<tr>
<td>CICARE</td>
<td>17</td>
</tr>
<tr>
<td>CICS</td>
<td>17</td>
</tr>
<tr>
<td>CIComms</td>
<td>18</td>
</tr>
<tr>
<td>CIIM</td>
<td>18</td>
</tr>
<tr>
<td>CIPE</td>
<td>19</td>
</tr>
<tr>
<td>CIAA</td>
<td>19</td>
</tr>
<tr>
<td>CIFS</td>
<td>20</td>
</tr>
<tr>
<td>CIPE</td>
<td>21</td>
</tr>
<tr>
<td>CIHIL</td>
<td>21</td>
</tr>
<tr>
<td>CIPLS</td>
<td>22</td>
</tr>
<tr>
<td>CHIPAT</td>
<td>22</td>
</tr>
<tr>
<td>CISched</td>
<td>23</td>
</tr>
<tr>
<td>CIWTS</td>
<td>23</td>
</tr>
<tr>
<td>EAE</td>
<td>24</td>
</tr>
<tr>
<td>FOCH</td>
<td>24</td>
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<tr>
<td>IA</td>
<td>25</td>
</tr>
<tr>
<td>ICES</td>
<td>26</td>
</tr>
<tr>
<td>IntECS</td>
<td>26</td>
</tr>
<tr>
<td>MCDM</td>
<td>27</td>
</tr>
<tr>
<td>RiSS</td>
<td>27</td>
</tr>
<tr>
<td>SDE</td>
<td>28</td>
</tr>
<tr>
<td>SIS</td>
<td>28</td>
</tr>
<tr>
<td>WCTI</td>
<td>29</td>
</tr>
<tr>
<td>Technical Program Committee</td>
<td>30</td>
</tr>
<tr>
<td>General Information</td>
<td>34</td>
</tr>
<tr>
<td>Cape Town International Convention Center</td>
<td>34</td>
</tr>
<tr>
<td>SSCI Mobile App</td>
<td>36</td>
</tr>
<tr>
<td>Oral Presentation Arrangements</td>
<td>36</td>
</tr>
<tr>
<td>Instructions to Session Chairs</td>
<td>37</td>
</tr>
<tr>
<td>Instructions to Plenary and Keynote Speakers</td>
<td>37</td>
</tr>
<tr>
<td>Welcoming Reception</td>
<td>37</td>
</tr>
<tr>
<td>Lunches</td>
<td>40</td>
</tr>
<tr>
<td>Banquet and Awards Function</td>
<td>40</td>
</tr>
<tr>
<td>Hotels Near the CTICC</td>
<td>40</td>
</tr>
<tr>
<td>Airport Transfers</td>
<td>40</td>
</tr>
<tr>
<td>Local Information</td>
<td>41</td>
</tr>
<tr>
<td>IEEE Event Photography Statement</td>
<td>43</td>
</tr>
<tr>
<td>IEEE Non-Discrimination Policy</td>
<td>43</td>
</tr>
<tr>
<td>Program Summary</td>
<td>44</td>
</tr>
<tr>
<td>Date and Time</td>
<td>Event Description</td>
</tr>
<tr>
<td>----------------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Tuesday, December 8, 08:00–10:00</td>
<td>Plenary Talk: Marco Dorigo</td>
</tr>
<tr>
<td>Tuesday, December 8, 10:00–12:20</td>
<td>SSCI 15 Keynote Talk: Simon Lucas</td>
</tr>
<tr>
<td></td>
<td>CIFEr 15 Keynote Talk: Olivier Scaillet</td>
</tr>
<tr>
<td></td>
<td>CICA 15 Session 1</td>
</tr>
<tr>
<td></td>
<td>CIVTS 15 Session 1</td>
</tr>
<tr>
<td></td>
<td>CIICS 15 Session 1</td>
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<td>CCMPE 15 Session 1</td>
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<td>RiiSS 15 Session 1</td>
</tr>
<tr>
<td></td>
<td>CIDM 15 Session 1</td>
</tr>
<tr>
<td></td>
<td>CIBIM 15 Session 1</td>
</tr>
<tr>
<td>Tuesday, December 8, 13:00–15:00</td>
<td>CIDM Keynote Talk: Barbara Hammer</td>
</tr>
<tr>
<td></td>
<td>CICS Keynote Talk: Robert Abercrombie</td>
</tr>
<tr>
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<td>CICA Keynote Talk: Er Meng Joo</td>
</tr>
<tr>
<td></td>
<td>13:00 Tutorial: Marde Hellag</td>
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<tr>
<td></td>
<td>13:00 Tutorial: Ed Keedwell, Jonathan Mwaura</td>
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<tr>
<td></td>
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<tr>
<td></td>
<td>RiiSS 15 Session 2</td>
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<tr>
<td></td>
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<tr>
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<td>15:20 Tutorial: Hologer Hoffmann, Harald Traue, Stefan Walter, Friedhelm Seuhrenker, Sascha Meudt</td>
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<tr>
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<td>15:20 Tutorial: Abolfazl Mehbodnia, Fumiyuki Adachi</td>
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<td>CIVTS 15 Session 2</td>
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<td>CIICS 15 Session 2</td>
</tr>
<tr>
<td>Wednesday, December 9, 08:00–09:30</td>
<td>Plenary Talk: Xin Yao</td>
</tr>
<tr>
<td>Wednesday, December 9, 09:50–12:20</td>
<td>CIFEr 15 Keynote Talk: Erwin Pesch</td>
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<tr>
<td></td>
<td>IEEE ALIFE'15 Keynote Talk: Terry Bossojaier</td>
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<tr>
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<td>IntECES'15 Session 1</td>
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<td>CICARE'15 Session 1</td>
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<td>Wednesday, December 9, 13:00–15:00</td>
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<td>CIASC'15 Keynote Talk: Om Malik</td>
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<td>ICES'15 Keynote Talk: Lukas Sekanina</td>
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<td>13:00 Tutorial: Vladik Kreinovich</td>
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<td>13:00 Tutorial: Gary Pampara, Filipe Nepomuceno</td>
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<td>FOCT'15 Session 1</td>
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<td>Wednesday, December 9, 15:20–17:20</td>
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<td>15:20 Tutorial: Dimitar Kazakov, Zhivko Georgiev</td>
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<tr>
<td>15:20 Tutorial: Claude Touzet</td>
<td></td>
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<tr>
<td>15:20 Tutorial: Paolo Rocca</td>
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<tr>
<td>CIPLS'15 Session 1</td>
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<td>ICES'15 Session 1</td>
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<td>IEEE ALIFE'15 Session 1</td>
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<td>SIS'15 Session 2</td>
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<tbody>
<tr>
<td>Plenary Talk: Paulo Lisboa</td>
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<table>
<thead>
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<th>Thursday, December 10, 09:30–12:20</th>
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<tbody>
<tr>
<td>CIHLI'15 Keynote Talk: Tristan Cazenave</td>
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<tr>
<td>CIES'15 Keynote Talk: Ralf Mikut</td>
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<td>CIEL'15 Keynote Talk: Ke Tang</td>
</tr>
<tr>
<td>CIComms'15 Session 1a</td>
</tr>
<tr>
<td>CIComms'15 Session 1b</td>
</tr>
<tr>
<td>ICES'15 Session 2</td>
</tr>
<tr>
<td>CIASC'15 Session 2</td>
</tr>
<tr>
<td>SIS'15 Session 3</td>
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<td>CICARE'15 Session 2</td>
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<td>CIDM'15 Session 5a</td>
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<td>CIDM'15 Session 5b</td>
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<td>FOCT'15 Session 2</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Thursday, December 10, 13:00–14:00</th>
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<tbody>
<tr>
<td>Panel Discussion 2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thursday, December 10, 14:00–15:00</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIComms'15 Keynote Talk: Andrea Massa</td>
</tr>
<tr>
<td>CIHLI'15 Session 1</td>
</tr>
<tr>
<td>ICES'15 Session 3</td>
</tr>
<tr>
<td>SDE'15 Session 1</td>
</tr>
<tr>
<td>CIASC'15 Session 3</td>
</tr>
<tr>
<td>CIDM'15 Session 6</td>
</tr>
<tr>
<td>CIDM'15 Session 7</td>
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<td>CIES'15 Session 1</td>
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<th>Thursday, December 10, 15:20–17:00</th>
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<td>CIHLI'15 Session 2</td>
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<td>CIDM'15 Session 3</td>
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<td>CIES'15 Session 2</td>
</tr>
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<td>SIS'15 Session 4</td>
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<th>Thursday, December 10, 15:20–17:00</th>
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<tr>
<td>CIHLI'15 Session 2</td>
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<tr>
<td>SIS'15 Session 4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Plenary Talks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keynote Talks</td>
</tr>
<tr>
<td>Abstracts</td>
</tr>
</tbody>
</table>

Tuesday, December 8, 10:00–12:20 |
-----------------------------------|
| CICA'15 Session 1                 |
| CIVTS'15 Session 1                |
| CICS'15 Session 1                 |
| CCMB'15 Session 1                 |
| RiiSS'15 Session 1                |
| CIDM'15 Session 1                 |
| CIBIM'15 Session 1                |

Tuesday, December 8, 13:00–15:00 |
-----------------------------------|
| SIS'15 Session 1                    |

Tuesday, December 8, 13:00–15:00 |
-----------------------------------|
| SIS'15 Session 1                    |
Tuesday, December 8, 15:20–17:20

CICA'15 Session 2
CIDM'15 Session 2a
CIDM'15 Session 2b
CIBIM'15 Session 2

Wednesday, December 9, 09:50–12:20

CIBD'15 Session 1
ADPRL'15 Session 1
IntECS'15 Session 1
CIASG'15 Session 1
CIFEr'15 Session 1
CIDM'15 Session 3
CICA'15 Session 2
CIVTS'15 Session 2
CICS'15 Session 2

Wednesday, December 9, 13:00–15:00

MCDM'15 Session 1
CIFEr'15 Session 2
CIDM'15 Session 4
FOCI'15 Session 1

Wednesday, December 9, 15:20–17:20

CIPLS'15 Session 1
ICES'15 Session 1
IEEE ALIFE'15 Session 1
SIS'15 Session 2

Thursday, December 10, 09:30–12:20

CIComms'15 Session 1a
CIComms'15 Session 1b
ICES'15 Session 2
CIASG'15 Session 2
SID'15 Session 3
CICARE'15 Session 2
CIDM'15 Session 5a
CIDM'15 Session 5b
FOCI'15 Session 2

Thursday, December 10, 14:00–15:00

CIHLI'15 Session 1
ICES'15 Session 3
SDE'15 Session 1
CIASG'15 Session 3
CIDM'15 Session 6
CIDM'15 Session 7
CIES'15 Session 1

Thursday, December 10, 15:20–17:00

CIHLI'15 Session 2
CIEL'15 Session 1
SDE'15 Session 2
CIPLS'15 Session 2
CIFEr'15 Session 3
CIDM'15 Session 8
CIES'15 Session 2
SIS'15 Session 4

Call for Papers 145

Index of Authors 149
Welcome Message from the President of the IEEE Computational Intelligence Society

Dear SSCI’2015 friends,

What a wonderful time and place to meet for a major IEEE CIS (Computational Intelligence Society) event!

This is the first time ever that CIS has organised a major event in Africa. It is a region with huge potentials in the future in terms of growth in economy, education, science and technology. Computational intelligence (CI) can play an important role in supporting such growth. Some of these opportunities of using CI to solve challenging real-world problems are reflected by the papers presented at SSCI’15. As in previous editions of SSCI, SSCI’15 includes a number of specialist symposia and workshops related to CI and its innovative applications. They cover established as well as emerging topics of increasing importance.

2015 has been a very good year for CIS. Our membership has increased to more than 7,200, the highest ever for our society. Our major journals, including IEEE Transactions on Neural Networks and Learning Systems, IEEE Transactions on Fuzzy Systems, and IEEE Transactions on Evolutionary Computation, have continued to do extremely well, in terms of the number of submissions to the journals and the journal impact factors. I would encourage all participants of SSCI’15 to submit their best papers, including substantially revised and improved SSCI’15 papers, to CIS journals.

CIS is an international society run by volunteers. Our conference activities spread over different regions of the world. In addition to SSCI’15 in Africa, we held CEC’15 in Asia (Japan), IJCNN’15 in Europe (Ireland), and FUZZ-IEEE’15 in the intersection between Asia and Europe (Turkey). If you are interested in organising or hosting one of CIS conferences, please talk to us. We are always looking for new and enthusiastic volunteers to lead and participate in future CIS activities.

Conferences provide time away from one’s normal working place, which can stimulate new ideas, especially by talking to colleagues in an informal setting. I hope SSCI’15 will be one of those events that spark new ideas for your next research paper or project. Enjoy SSCI’2015!

Xin Yao

President (2014-2015)
IEEE Computational Intelligence Society
Welcome Message from the General Chair of IEEE SSCI'15

Dear SSCI’2015 Delagates,

It is my pleasure to welcome you to the Mother City of South Africa, Cape Town, for the 2015 IEEE Symposium Series on Computational Intelligence. For most of you, it had been a very long, tiring flight to Cape Town. However, I am sure that you will soon forget the long flights and enjoy what Cape Town and South Africa have to offer.

This year, the event has brought together 30 symposiums with a focus on Computational Intelligence (CI) research. We have 15 free tutorials presented by experts in the field, three very exciting plenary talks, and 15 keynote speakers. In addition to these, we have two panel discussions, one on problem niches for CI, and the other on how to ensure repeatable and reliable CI. In total, 256 papers will be presented during the three days of this symposium series. The papers presented are part of the 261 papers which were accepted after a rigorous peer-review by experts in the field. In total, 429 papers were submitted for review, resulting in an acceptance rate of 60.84%. Note that a decision on acceptance or rejection of a paper were made after at least three reviews were received.

The technical program committee of the 2015 IEEE SSCI consists of the program committee members of all of the symposiums, totalling 590 experts. The reviews of all conflict of interest papers were handled by the conflicts of interest program chair. Only the conflict of interest chair, and the reviewers of these papers, were allowed access to the reviews, review scores, and the final decisions on these papers.

The proceedings of the 2015 IEEE SSCI contains papers covering a wide range of CI topics, applications, and issues. These papers will be of interest to graduate students, the CI research community, and CI practitioners.

The authors of accepted papers span over five regions, with 488 (61.0%) of the authors from Europe, the Middle East, and Africa. A total of 291 (23.9%) of the authors are from Asia/Pacific, 87 (10.8%) are from the United States, 20 (2.5%) from Canada, and 14 (1.8%) from Latin America. The 800 authors of accepted papers are from 45 countries, with demographics as below:

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7
Putting together a conference that consists of so many symposiums is quite a challenge. It would not have been possible to have done this without the help of the many volunteers involved, including the organizing committee, our technical program committee, our conference organizer (Grosvenor Tours), and the support of the IEEE Computational Intelligence Society. The conference had to be planned under severe budget constraints, and therefore the tutorial presenters are specially thanked for presenting their tutorials without receiving any financial support. Also, a big thanks to the Big Data Institute for sponsoring the CIDM'15 keynote speaker and the conference bags.

I hope that you will have a rewarding experience, and that your stay in Cape Town will be one to remember.

Andries Engelbrecht

General Chair
IEEE Symposium Series on Computational Intelligence
2015 Frank Rosenblatt Award

Sponsored by the IEEE Computational Intelligence Society

Marco Dorigo

For contributions to the foundations of swarm intelligence

Marco Dorigo’s groundbreaking research on biologically inspired intelligent methods for solving optimization problems has helped launch the discipline of swarm intelligence. Swarm intelligence studies distributed systems whose problem-solving abilities derive from self-organized local interactions between their constituent components. Prof. Dorigo is most known for his work on the ant colony optimization (ACO) methodology, inspired by the foraging behavior of ants, which is used by researchers worldwide and has generated many high-performance algorithms. He is also a leading contributor to swarm robotics, which applies swarm intelligence principles to coordinate large groups of autonomous robots without relying on any external infrastructure or on any form of centralized control. This holds promise for performing tasks too difficult or dangerous for humans.

An IEEE Fellow, Dr. Dorigo is an F.R.S.-FNRS research director and a co-director of IRIDIA, the artificial intelligence lab of the Universit Libre de Bruxelles, Brussels, Belgium.
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Adaptive dynamic programming (ADP) and reinforcement learning (RL) are two related paradigms for solving decision making problems where a performance index must be optimized over time. ADP and RL methods are enjoying a growing popularity and success in applications, fueled by their ability to deal with general and complex problems, including features such as uncertainty, stochastic effects, and nonlinearity.

ADP tackles these challenges by developing optimal control methods that adapt to uncertain systems over time. A user-defined cost function is optimized with respect to an adaptive control law, conditioned on prior knowledge of the system and its state, in the presence of uncertainties. A numerical search over the present value of the control minimizes a nonlinear cost function forward-in-time providing a basis for real-time, approximate optimal control. The ability to improve performance over time subject to new or unexplored objectives or dynamics has made ADP successful in applications from optimal control and estimation, operation research, and computational intelligence.

RL takes the perspective of an agent that optimizes its behavior by interacting with its environment and learning from the feedback received. The long-term performance is optimized by learning a value function that predicts the future intake of rewards over time. A core feature of RL is that it does not require any a priori knowledge about the environment. Therefore, the agent must explore parts of the environment it does not know well, while at the same time exploiting its knowledge to maximize performance. RL thus provides a framework for learning to behave optimally in unknown environments, which has already been applied to robotics, game playing, network management and traffic control.

The goal of the IEEE Symposium on ADPRL is to provide an outlet and a forum for interaction between researchers and practitioners in ADP and RL, in which the clear parallels between the two fields are brought together and exploited. We equally welcome contributions from control theory, computer science, operations research, computational intelligence, neuroscience, as well as other novel perspectives on ADPRL. We host original papers on methods, analysis, applications, and overviews of ADPRL. We are interested in applications from engineering, artificial intelligence, economics, medicine, and other relevant fields.
Computational Intelligence (CI) has for many years drawn inspiration from the brain to produce data and signal processing techniques and systems which are capable of learning, evolving, adapting, self-organizing, communicating effectively with humans and machines and controlling complex systems. Brain-inspired methods are now widely used to process data produced by the brain with the aim of improving our understanding of how the brain functions and produces the remarkable intelligence exhibited by humans, which is yet elusive for computational systems.

This Symposium focuses on several core topics associated with cognitive algorithms, mind and brain, which are deemed to be of critical importance as we progress into the 21st century.

Brain-Computer Interfaces (BCIs): BCI technology enables communication from brain to computer. It would help to those who require alternative communicatory mechanisms because of neuromuscular deficiencies and speed up communicating with computers for everybody. There is a significant progress in translating speech to text, and extracting cognitive signals from EEG. Still the problem is not solved.

Computational models of brain and mind: Mathematical and neurocomputational models are contributing to the understanding of the brain-mind relations, psychological mechanisms, and unsolved mysteries. Cognitive algorithms based on these models significantly improve classical engineering solutions, and solve problems that could not be solved previously. These models can be helpful in therapy.

Cognitive Robotics: Developing robots for assistive devices and industrial applications is a key area of Computational Intelligence research. How the robot develops its own understanding of the world. Brain-inspired cognitive robotics become increasingly popular and lead to various breakthroughs in the field of autonomous systems designs and implementations.

Language and Cognition: Progress in many key areas of modeling the mind critically depends on understanding of interaction between language and cognition. Does language serve for communicating complete thoughts? Or do we think with words and phrases? If learning language and cognition depend on each other, why a child learns language early in life, but learning cognition takes much longer? We should build BCI and Cognitive Robots by taking advantage of human mechanisms of interacting language and cognition.
Computational Intelligence (CI) evolves computational models and tools of intelligence capable of handling large raw numerical sensory data directly, processing them by exploiting the representational parallelism and pipelining the problem, generating reliable and just-in-time responses, and having high fault tolerance. Smart grid is basically the embedding of intelligence to enable bidirectional power flows with traditional sources of power generation, renewable sources and energy storage. CI deployment is essential in smart grid to make it a success. Research and deployment of smart grid technologies are being promoted by governments of many countries as a way of addressing energy independence, emission reductions, and bringing resilience to electricity infrastructures. The Symposium on CI Applications in Smart Grid (CIASG) aims at bringing researchers and engineers from academia and industry together to present, interact and review the latest progresses in this emerging field, and to explore future research directions to address its challenges.

IEEE CIBD2015 will bring together scientists, engineers, researchers and students from around the world to present recent advances, explore challenges and opportunities in the application of Computational Intelligence (CI) techniques to the emerging and exciting field of Big Data and data sciences. This conference will provide a forum to present recent results in CI algorithms, software and systems for big data analytics, discuss the practical and theoretical challenges in big data, and explore CI solutions to tackle these challenges and issues.

IEEE CIBD2015 solicits papers that report new research results that apply CI technologies, such as deep learning, neural networks and learning algorithms, fuzzy systems, evolutionary computation, and other emerging techniques to Big Data, ranging from theory, methodologies and algorithms for handling the 3Vs (Volume, Variety, and Velocity) of big data, to their applications to the development of big data analytics systems. Successful applications of big data in industries are also encouraged to participate in this event.
The 2015 IEEE International Symposium on Computational Intelligence in Biometrics and Identity Management (CIBIM 2015) will be held within the 2015 IEEE Symposium Series on Computational Intelligence (SSCI 2015).

Biometric technology is the technology of the 21st century which uses measurable physiological or behavioural characteristics to reliably distinguish one person from another. The technology is fast gaining popularity as means of personal identification and verification for different commercial, government and law enforcement applications. However, most existing biometric systems could only perform well with high quality samples of the biometric trait from cooperative users. Computational intelligence (CI), primarily based on neural networks (NN), fuzzy systems (FS), evolutionary computation (EC), etc., is a suitable approach for solving challenging real-world biometric applications.

The main objective of this symposium is to bring researchers from academia and industry together to exchange the latest theoretical and experimental CI solutions in biometrics and identity management. This event will provide an interdisciplinary forum for researchers, developers and practitioners especially in the CI field to present state of the art biometric research and technology, as well as the potential problems in real applications.

In the last two decades, Computational Intelligence has achieved the significant progress. The purpose of the IEEE Symposium on Computational Intelligence in Control and Automation (CICA 2014) is to bring together researchers, engineers, practitioners, and students from around the world to discuss and present their latest advances in the theory and application of computational intelligence in control and automation.

Topics covered include theories and applications of computational intelligence technologies, such as neural networks, fuzzy systems, evolutionary computation, and other emerging techniques in the following areas (but not limited to): Control and decision, system modeling and learning, and hybrid control.
CICARE 2015 is the first Symposium of its kind, and will bring together leading research and clinical scientists, engineers, practitioners, technology and solution providers in healthcare and e-health from around the world to discuss latest advances in the field of computational intelligence applied to solving the growing scale and complexity of problems in these inter-disciplinary domains. This symposium will provide a forum for the presentation of recent results in the theory and practice of computational intelligence in healthcare and e-health systems and services, and there will also be Panel discussions to outline future research directions and challenges.

Computational Intelligence constitutes an umbrella of techniques, has proven to be flexible in solving dynamic and complex real-world problems. These techniques typically include Fuzzy Logic, Evolutionary Computation, Intelligent Agent Systems, Neural Networks, Cellular Automata, Artificial Immune Systems, Game Theory and other similar computational models. These techniques are now being widely used in different cyber security applications such as online behavior monitoring, e-fraud detection, robust decision support modules, etc. In order to protect Internet users from Identity Theft, Phishing, Spam and other cyber infrastructure threats, we need flexible, adaptable and robust cyber defense systems, which can make intelligent decisions (in near real-time) in detecting wide variety of threats and attacks, including active and passive attacks, external attacks and internal misuses, known and unknown attacks, viruses and spam, etc. Computational Intelligent (CI) techniques have demonstrated to enhance cyber security measures, and have been increasingly applied in the area of information security and information assurance. Moreover, the multi-faceted CI approaches appear to provide a new security paradigm to deal with influx of new threats in a large network of computers. These approaches can also be used to augment defense-in-depth architectures and to add necessary security enhancements to the design, implementation and operation of legacy and future cyber-enabled systems.
Computational Intelligence (CI) is arguably one of the most powerful approaches for the optimization and design of complex communication systems and networks in order to meet the ever more challenging requirements and needs of nowadays applications. In this framework, a wide number of CI methodologies and algorithms based on Fuzzy Logic Systems, Learning-by-Examples Techniques, and Evolutionary Computation have been developed and effectively applied to real problems as demonstrated by the many research publications as well as the number of meetings and symposia organized worldwide. The introduction of innovative designs and advanced optimization methodologies is fundamental to offer new capabilities to the next-generation communication services and applications.

Although the research on CI applications has reached an impressive state, there are still many new research topics for the applications of CI that are continually emerging, especially in the communications and networking area such as antenna systems, microwave devices and technologies, signal processing, design of computer networks. This symposium aims at bringing researchers and engineers from academia and industry together to report, interact and review the latest progress of CI applications in the field of communication systems and networks, to explore future directions of research and to publicize CI applications to a wider audience from diverse fields.
IEEE CIDU’2015 aims to bring together all researchers, practitioners and students to present and discuss the latest advances in the field of Computational Intelligence (CI), such as neural networks and learning algorithms, fuzzy systems, evolutionary computation and other emerging techniques for dealing with uncertainties encountered in evolutionary optimization, machine learning and data mining. Topics considered include evolutionary computation in dynamic and uncertain environments, learning in non-stationary and uncertain environments, mining of temporal patterns, and hybrid methodologies for dealing with uncertainties, interactions of evolution and learning in changing environments, benchmarks, performance measures, and real-world applications.

Ensemble learning attempts to enhance the performance of systems (clustering, classification, prediction, feature selection, search, optimization, rule extraction, etc.) by using multiple models instead of using a single model. This approach is intuitively meaningful as a single model may not always be the best for solving a complex problem while multiple models are more likely to yield results better than each of the constituent models. Although in the past, ensemble methods have been mainly studied in the context of classification and time series prediction, recently they are being used in algorithms in other scenarios such as clustering, fuzzy systems, evolutionary algorithms, dimensionality reduction and so on.

The aim of this symposium is to bring together researchers and practitioners who are working in the overlapping fields of ensemble methods and computational intelligence. Papers dealing with theory, algorithms, analysis, and applications of ensemble of computational intelligence methods are sought for this symposium.
Developments in Engineering are characterized by a growing complexity, which is balanced by an extensive utilization of computational resources. This complexity is not only a feature of engineering systems, processes and products, it is primarily a key attribute of the respective algorithms for analysis, control and decision-making to develop those engineering solutions. To cope with complexity in this broad spectrum of demands, Computational Intelligence is implemented increasingly in virtually all engineering disciplines. This emerging approach provides a basis for developments of a new quality.

This Symposium is focused on the utilization of Computational Intelligence in this context in the entire field of engineering. Examples concern the control of processes of various kinds and for various purposes, monitoring with sensors, smart sensing, system identification, decision-support and assistance systems, visualization methods, prediction schemes, the solution of classification problems, response surface approximations, the formulation of surrogate models, etc. The engineering application fields may comprise, for example, bioengineering with prostheses design and control, civil and mechanical engineering processes, systems and structures concerned with vehicles, aircraft or bridges, industrial and systems engineering with design and control of power systems, electrical and computer engineering with developments in robotics, etc. All kinds of approaches from the field of Computational Intelligence are welcome.

As a part of the Symposium special attention is paid to sustainable engineering solutions to address current and future challenges of environmental changes and uncertainty. This includes developments dealing with climate change, environmental processes, disaster warning and management, infrastructure security, lifecycle analysis and design, etc. Events, disasters and issues under consideration may be natural such as earthquakes or tsunamis, man-made such as human failure or terrorist attacks, or a combination thereof including secondary effects such as failures in nuclear power plants, which may be critical for systems, the environment and the society. Developments which include a comprehensive consideration of uncertainty and techniques of reliable computing are explicitly invited. These may involve probabilistic including Bayesian approaches, interval methods, fuzzy methods, imprecise probabilities and further concepts. In this context robust design is of particular interest with all its facets as a basic concept to develop sustainable engineering solutions.
The CIFEr Conference is the major collaboration between the professional engineering and financial communities, and is one of the leading forums for new technologies and applications in the intersection of computational intelligence and financial engineering and economics. Intelligent computational systems have become indispensable in virtually all financial applications, from portfolio selection to proprietary trading to risk management.

Symposium organizers welcome papers related to accomplishing human-like intelligence by artificial systems. In many research domains the existing state-of-the-art AI/CI solutions significantly differ from the human competence level. Even though it is generally not clear whether human-like approach would show its upper-hand over existing methods, the exploration of this research path seems to be advantageous and challenging.

The main goal of this symposium is to promote and advance research activities related to all facets of human-like intelligence. The organizers encourage submission of the papers describing application of various Computational Intelligence paradigms including neural networks, genetic/memetic computing, fuzzy logic, machine learning, and statistical methods to human-like intelligent behavior and problem solving.
The management of production and logistics systems in today’s fierce competition environment is a difficult task and has become progressively complex. Major changes in products, processes, technologies, and societies bring along remarkable challenges and increasing market demands. Modelling and optimisation of complex problems arising in production and logistics systems is of paramount importance in surviving and achieving competitive gains in productivity and quality.

In recent years, the advancements in computer technology have allowed researchers to tackle large-scale problems and to develop and integrate efficient optimisation techniques for solving them. Within this context, CIPLS aims to address issues related to the design, planning, control, and continuous improvement of production and logistics systems using computational intelligence, including local search methods, evolutionary algorithms and other nature-inspired optimisation techniques. The intention is to cover various aspects of production from aggregate planning to shop-floor execution systems and modelling, planning and control of logistics systems. Studies incorporating real-world applications are highly encouraged.

Millions of individuals experience impaired mobility usually accompanied by limited to no manual dexterity. The “cost” associated with these disabilities includes not only those incurred through medical and support services, but also less tangible costs, such as those due lost wages and non-productivity. The goals of rehabilitation are to ameliorate life-limiting disabilities and facilitate community re-entry. While restoration of function is the most positive outcome of rehabilitation, compensatory strategies are also employed when natural function cannot be restored. A particularly promising approach is the use of assistive technologies to extend an individual’s functionality and substitute for compromised functions. This symposium will highlight the latest results from world leading research labs and industry in the field of robotic rehabilitation and assistive technologies.
The 2015 IEEE Symposium on Computational Intelligence in Scheduling (IEEE CISched’15) invites research on all aspects of computational intelligence applied to scheduling problems. Due to their huge search spaces that have to be explored, scheduling problems cannot usually be solved by exact approaches. Therefore, significant research attention has been attracted on exploring techniques in Computational Intelligence (including evolutionary computation, neural networks, swarm intelligence, fuzzy logic, and their hybridizations, etc.). This symposium aims to explore recent advances in this area.

The 2015 IEEE IEEE Symposium on Computational Intelligence in Vehicles and Transportation Systems (IEEE CIVTS’15) invites research on all aspects of computational intelligence applied to scheduling problems. Due to their huge search spaces that have to be explored, scheduling problems cannot usually be solved by exact approaches. Therefore, significant research attention has been attracted on exploring techniques in Computational Intelligence (including evolutionary computation, neural networks, swarm intelligence, fuzzy logic, and their hybridizations, etc.). This symposium aims to explore recent advances in this area.
The EALS 2015 Symposium will be a focal point for presentation of the recent advanced research results and industrial applications in the emerging area of evolving and autonomously learning systems. We live in the era of Big Data and by that they mean high volume, high variability, versatility, veracity data streams generated by Internet, sensors, organisations and the society. Learning autonomously from this ocean of data and extracting meaningful knowledge which is not fixed, but dynamically evolving is one of the key challenges that the research community and the post-industrial societies are facing now and will face in the near future. The Symposium has established a track record of high quality meetings of a relatively compact community of advanced researchers and practitioners and aims to keep and build upon this with the current event, EALS 2015.

The 2015 IEEE Symposium on Foundations of Computational Intelligence (FOCI 2015) will take place in Cape Town, South Africa as part of the IEEE Symposium Series on Computational Intelligence (SSCI 2015).

Computational intelligence techniques are widely used to tackle real-world problems due to their numerous successful applications. However, the reasons behind these successes are often not well understood. A solid theoretical foundation of computational intelligence techniques explains the reasons behind the success of these methods. Furthermore, theoretical analyses lead to the understanding of which problems are solved efficiently by a given technique and which are not. Amongst the benefits to practitioners a solid theoretical understanding (a) provides guidance on the choice of the best technique for the problem at hand, (b) helps to identify optimal parameter settings and ultimately (c) aids the design of more effective techniques.

IEEE FOCI’15 will focus on fundamental theoretical foundations of (but not limited to) the three main branches of computational intelligence, Neural Networks and other machine learning methods, Fuzzy Logic and Evolutionary Computation. Although the symposium’s main interest is in theoretical foundations, computational studies of a foundational nature are also welcome.
As in the previous SSCI editions, accepted papers will be included in the Conference Proceedings Citation Index.

IEEE FOCI'15, provides an ideal forum for those who are interested in the foundational issues of computational intelligence to exchange their ideas and present their latest findings. Participants of FOCl15 will also benefit from the interaction at one location with the participants of the several other symposia running concurrently at IEEE SSCI 2015, each highlighting various aspects of computational intelligence. As a whole, this international event will attract top researchers, practitioners, and students from around the world to discuss the latest advances in the field of computational intelligence.

2015 IEEE Symposium on Computational Intelligence on Intelligent Agents
(IEEE IA’15)

Hani Hagras, UK
Vincenzo Loia, Italy

It is our pleasure to invite you to participate in the 2015 IEEE International Symposium on Intelligent Agents (IA’15).

The 2015 IEEE International Symposium on Intelligent Agents (IEEE IA’15) will be held within the 2015 IEEE Symposium Series on Computational Intelligence (SSCI 2015).

The intersection between Computational Intelligence and Agent technology opens new significant opportunities in many fields where the representation and management of complex systems play a fundamental role. In the formulation of Agent-based systems, the role of uncertainty is crucial for an efficient and coherent resolution of complex problems. Agents overcome classical programs thanks to their inner capabilities to be autonomous and to adapt their behaviour with the changing of the environment where agents live and interact. This means that inevitably they meet uncertainty during their work, or in many cases, for the high complexity of the problem, the information they handle is (or needs to be) approximate.

IA’15 will aim to provide a leading international forum to bring together researchers and practitioners from diverse fields, such as computer science, information technology, business, education, human factors, systems engineering, and robotics. The symposium will aim to examine the design principles and performance characteristics of various approaches in intelligent agent technology. In addition, the symposium will aim to increase the cross-fertilization of ideas on the development of autonomous agents and multi-agent systems among different domains. By encouraging idea-sharing and discussions on the underlying logical, cognitive, physical, and sociological foundations as well as the enabling technologies of intelligent agents, IA’15 will foster the development of novel paradigms and advanced solutions in agent-based computing.
The IEEE International Conference on Evolvable Systems (IEEE ICES) has been held, uninterrupted, since 1995 and in 2013 evolved from ICES to IEEE ICES. Following on from the success in 2013 & 2014, ICES will continue to be part of the successful IEEE Symposium Series on Computational Intelligence, providing the possibility for increased interaction between ICES and the other symposiums and workshops.

Evolvable systems encompass understanding, modelling and applying biologically inspired mechanisms to physical systems. Application areas for bio-inspired algorithms include the creation of novel physical devices/systems, novel or optimised designs for physical systems and for the achievement of adaptive physical systems. Having showcased examples from analogue and digital electronics, antennas, MEMS chips, optical systems as well as quantum circuits in the past, the IEEE ICES has become the leading conference for showcasing techniques and applications of evolvable systems.

Intelligent embedded systems, i.e., embedded processing systems with sensors, actuators and computational intelligence-based computing ability, permeate our daily life. This symposium aims at disseminating recent achievements in computational intelligence towards embedded systems highlighting intelligent behaviors. This symposium aspires at building a bridge between academic and industrial research, as well as among researchers working in different fields, with the specific purpose of designing systems and embedded systems able to adapt and interact with evolving environments.
IEEE MCDM’2015 aims to bring together scientists, engineers and students from around the world to discuss the latest advances in the field of CI applied to issues in MCDM. Topics covered include applications of computational intelligence technologies, such as neural networks and learning algorithms, fuzzy systems, evolutionary computation, and other emerging techniques in the following or similar areas: Multiobjective Search/Optimization (MOO), Multiobjective Machine Learning (MOML), Decision Making (DM) Techniques, Interactive Visualization (IV), and Integration of MOO, ML, DM, and IV to support Multicriteria Decision Making.
Differential Evolution (DE) is arguably one of the most powerful stochastic real-parameter optimization algorithms in current use. DE is a very simple algorithm, requiring only a few lines of code in most of the existing programming languages. Additionally, it has very few control parameters. Nonetheless, DE exhibits remarkable performance in optimizing a wide variety of optimization problems in terms of final accuracy, convergence speed, and robustness as evidenced by the consistently excellent performance in all of the CEC competitions (http://www3.ntu.edu.sg/home/epnsugan). The last decade has witnessed a rapidly growing research interest in DE as demonstrated by the significant increase in the number of research publications on DE in the forms of monographs, edited volumes and archival articles. Although research on and with DE has reached an impressive state, there are still many open problems and new application areas are continually emerging for the algorithm. This Symposium aims at bringing researchers and users from academia and industry together to report, interact and review the latest progress in this field, to explore future directions of research and to publicize DE to a wider audience from diverse fields joining the IEEE SSCI 2015 in Cape Town, South Africa and beyond.
Computational Intelligence methodologies have become a useful support for scientists and engineers working both in academia and business environments due to their capabilities to enable the design and development of systems able to adapt their behaviour to meet complex and dynamic goals in a range of application domains. As a consequence, during the last years, many software tools have been developed to speed up the implementation of frameworks for computational intelligence and enable a full interoperability among the different actors involved in the frameworks design. A large amount of these tools are developed by the scientific community as free and open source software, offering many benefits such as the quicker detection of errors, the development of innovative applications, the faster adoption of computational intelligence techniques in other scientific areas and in industry, and so on.

The goal of this workshop is to provide a leading international forum to bring together researchers and practitioners from diverse fields, in order to examine and improve the current state-of-the-art, original and recent research on Tools for Computational Intelligence.
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General Information

Cape Town International Convention Center

Venue:
The IEEE SSCI will be hosted in the Cape Town International Convention Centre (CTICC).

Physical address: Convention Square, 1 Lower Long Street, Cape Town, 8001, South Africa, Tel: +27 (0)21 410-5000.

Conference Organizer:
We have appointed Grosvenor Tours as our conference organizer. Their staff will gladly assist delegates with the following enquiries:

- Registration enquiries
- Sightseeing tour bookings and general tour/travel enquiries
- Restaurant recommendations and bookings
- General conference enquiries

Insurance and liability statement:
Participants and their guests are reminded that their participation in the IEEE SSCI 2015 CONFERENCE and all associated events is on a voluntary basis and entirely at their own risk. The Conference, and the organisers, Grosvenor Tours, will accept no responsibility in the case of accident, injury or the loss of personal property. Participants are responsible for their own loss of property, cancellation expenses and legal liability and it is recommended that participants arrange for the appropriate travel insurance, including medical coverage.

Business Center:
The CTICC Business Centre is located on the Ground Level next to the Reception Desk and offers the following services:

- Photocopying (colour and black/white up to A3 size)
- Printing (colour and black/white up to A3 size)
- Laminating (up to A3 size)
- Scanning
- Faxing
- Binding

They also sell basic stationery, international plugs and two-pin plugs. The centre is open Mondays to Fridays from 08:00 17:00. For any Business Centre enquiries contact: Tel: +27 (0)21 410 5000.

Internet:
Complimentary wireless internet is available throughout the CTICC. Simply click on the network CTICC to login.

Restaurants/Cafes at The CTICC :
The Marimba Restaurant (opposite Hall 4 on the Ground Level) has an A-la-Carte menu that includes a combination of African and Cosmopolitan cuisine. It is open for lunch and dinner and has a cigar bar. Tel: +27 (0)21 418 3366.

The CTICC Cafe on the Square (located in the Main Foyer) is open daily from 06:30 to 17:00 and serves refreshments, light meals, sandwiches and salads. Tel: +27 (0)21410 5053.

Parking:
Parking is available in P1 or P3 for delegates who arrive in their own cars. Please note that parking fees are for delegates own account.
SSCI APP: Conference Mobile App

For your convenience, we have developed a mobile application for the 2015 IEEE SSCI for Apple and Android devices. This delegate conference management system has the following key features:

- Personalized scheduler
- Abstract and presentation search facilities
- Conference program look up
- Venue guide
- Note taking functionality
- Push notifications
- Rating and feedback functionality
- Social media integration,
- and many more....

A video showing the app and how to use it can be found on

https://www.youtube.com/watch?v=HI2B9XMF5hQ

Where to get the App:

1. All in one link that redirects you to the appropriate store (when opened on device): [http://onelink.to/ssci2015](http://onelink.to/ssci2015)

Note: The IEEE-SSCI APP has been developed by University of Pretoria undergraduate students from the Computer Science department. Their company name went with title (4Bit+L). The group comprised of Anrich van Schalkwyk, Thinus Naude, Jaco-Louis Kruger, James Murray and Latham Van Der Walt. We highly acknowledge the awesome app they have created.

Oral Presentation Arrangements

All papers accepted for 2015 IEEE SSCI will be orally presented. We do not have any poster presentations. Please note that each paper presentation is allocated 20 minutes, which includes question time and transition time. In preparing your presentation, it is advised that you prepare for 15 minutes.

Note that laptops are not provided, and that speakers should bring their own laptops.

We also suggest that transitions between talks be done during question time, which will save some time.
**Instructions to Session Chairs**

The main task of the session chair/co-chair is to make sure that the papers allocated to a session are presented within the time allocated to that session. The session chair/co-chair introduces each speaker, facilitates the question and answers session after each paper presentation. Session chairs/co-chairs should adhere to the time slot to which a paper is scheduled, and make sure that a presenter does not exceed his/her presentation time. This is important because delegates move between sessions to listen to presentations at their scheduled time.

**Instructions to Plenary and Keynote Speakers**

All plenary and keynote presentations will be in the Audi 2. Speakers of the early morning session should, at least 30 minutes before the start of the session, go to the AV desk in Audi 2 for their presentations to be loaded and to see if all works well. Speakers of later sessions should do this during the breaks. Note that a laptop for presentations is provided in the Audi 2.

**Welcoming Reception**

The welcoming reception will be hosted on Monday, December 7, at the Two Oceans Aquarium from 19:00 to 22:30. The aquarium is close to the Cape Town International Convention Center (CTICC).

For entrance to the Aquarium, you will need a ticket, which you will receive in your delegate’s pack during registration. You will also receive drink vouchers for the welcoming reception. Note that the registration desk will be open from 13:00 to 18:00 in the Strelitzia Conservatorium of the CTICC. If you could not manage to register before the welcoming reception, you can obtain your ticket and drink vouchers at the entrance to the Aquarium if you have registered. Entrance to the welcoming reception will be granted only to those who have paid a registration fee, or who has ordered additional welcoming reception tickets.

You can either go to the aquarium using your own transport, public transport, or you may make use of the free bus shuttle service that we have arranged. Busses depart to the aquarium from the parking lot at the CTICC 18:45 to 19:00. Busses will return from the aquarium to the CTICC and official hotels every half hour from 21:00 until 22:30. Note that the last bus will depart at 22:30.

If you decide to use your own transport, here are directions from the CTICC: Enter the V&A Waterfront at the Walter Sisulu entrance (opposite CTICC, next to City Lodge Hotel). Continue straight until you get to a roundabout. Take the first exit to your left into Dock Rd. Follow this road until you see the Two Oceans Aquarium on your right side (just after the One & Only Hotel). To park, please continue straight past the Aquarium, until you see the Portswood Parking Garage on your left (short 5 min walk back to the Aquarium). Kindly note that parking is for your own account.

Your aquarium ticket will give you access to the entire aquarium (accept the penquins – they need to get their beauty rest), the finger dinner and welcoming drinks. A cash bar will also be available.
Two Oceans Aquarium

4.4 ★★★★★ 69 reviews

Aquarium

*Modern indoor aquarium & conservation center offering close encounters with sharks & penguins.* - Google

Dock Rd, V & A Waterfront, Cape Town, 8002, South Africa

aquarium.co.za

+27 21 418 3823
Lunches

Your registration includes three lunches, one for each of the main days of the conference, namely 8, 9, and 10 December. You will find your lunch tickets in your delegation pack.

For each day you will have $5 \times \text{R20}$ lunch vouchers, which you can use to purchase lunch items at the different stalls in the Strelitzia and Jasminum Conservatories (ground floor).

Banquet and Awards Function

The banquet and awards function is scheduled for Wednesday, 9 December, as from 19:00 in the Ballroom East. Admission will be allowed only if your admission ticket is shown at the entrance to the ballroom.

In your delegate pack, you will also receive vouchers for drinks. There will also be a cash bar available.

Hotels Near the CTICC

Delegates staying at official congress hotels must please settle their accommodation account in full on their departure. Please consult the Concierge desk at your hotel regarding check out times. Most hotel check out times range between 10:00 and 12:00. Unfortunately we do not have any space at the CTICC to store luggage on the day of departure. Please store luggage at your hotel.

The official IEEE SSCI 2015 hotels are

- Westin Hotel: +27 (0)21 412 9999
- Southern Sun Cullinan Hotel: +27 (0)21 415 4000
- Southern Sun Waterfront Hotel: +27 (0)21 409 4000
- Southern Sun Cape Sun Hotel: +27 (0)21 488 5100
- ParkInn Hotel by Radisson: +27 (0)21 427 4800

Airport Transfers

Departure airport transfers to Cape Town International Airport can be made by contacting Carlynne van der Merwe from Grosvenor Tours on +27 (0)82 318 1716. Alternatively you can visit the airport transfer desk located in Strelitzia Conservatory. Kindly note that airport transfers are for delegates own account and pre-bookings are essential.
Local Information

**Cape Town Tourism Information Centre:**
Located at The Pinnacle Building, Corner of Burg & Castle Street Tel: +27 (0) 21 487 6800. Opening hours: Mon – Fri 08:00 – 18:00, Sat 08:00 – 14:00, Sun 09:00 – 13:00.

**After Hours Shopping and Entertainment:**
All stores within the V&A Waterfront, with the exception of the Red Shed Craft Workshop (on Sundays and Public Holidays) and the V&A Craft Market & Wellness Centre, are open from 09:00 to 21:00 every day, including Sundays and public holidays.

**Medical Emergencies:**
The Netcare Christian Barnard Hospital offers a service for medical emergencies. The emergency centre is staffed 24 hrs a day Monday to Sunday. Tel: +27 (0) 21 480 6262. Physical address: 181 Longmarket Street, City Centre. For medical emergencies on-site at the CTICC, please visit the medical centre located at the entrance to P3 (press -1 in lift) or call Tel: +27 (0) 21 410 5000. Please note that all medical services are for delegates’ own account.

**Netcare Travel Clinic:**
The Netcare Travel Clinic is part of a national network of private clinics providing travel related products and services such as vaccines, malaria pills, bed nets, insect repellents and travel kits. Tel: +27 (0) 419 3172. Physical address: Room 1107, 11th Floor, Picbel Arcade, 58 Strand Street, City Centre.

**Late-night Pharmacies:**
Lite Clinic is located at Cnr. Longmarket and Plein Streets, City Centre. Tel: +27 (0) 461 0305. Open Monday – Friday 08:00 – 23:00 and Sat – Sun 09:00 – 23:00.

**Language:**
The official language of the conference is English.

**Business Hours in South Africa:**
Bank Hours: Monday to Friday 08:00 – 15:30 / Saturdays 09:00 – 12:00.
Office Hours: Monday to Friday 08:00 – 17:00.
Shopping Hours: Monday to Saturday 09:00 – 17:00, except V&A Waterfront open 09:00 – 21:00.

**Currency:**
The South African currency is RAND (ZAR).

To exchange currency:
Bidvest Bank / Rennies Foreign Exchange at the Victoria & Alfred Waterfront, Shop No. 102, Ground Floor, Victoria Wharf, Tel: +27 (0) 21 418 3744. Opening hours: Mondays to Sundays 09:00 – 21:00.

**Whats On: Cultural and Sports Events:**
Please consult our staff at the General Information Desk. Events are also listed in daily newspapers. Or visit these local websites for more information:
www.whatsonincapetown.com www.computicket.com

**Eating Out:**
Thanks to its myriad influences, history and diverse cultures, South African cuisine is a fantastic and surprising fusion of culinary arts from Europe, Asia, Africa and Arab States. Cape Town restaurants can satisfy all tastes and budgets, no matter what your palate desires: enjoy succulent sea food on the waters edge or experience country cooking on a wine estate; why not try some spicy blends from a Cape Malay kitchen… or if you are feeling more like a mouth-watering steak, a grill house will be just round the corner. No visit to Cape Town will be completed without tasting some of the sublime wines produced in the nearby surrounding vast and verdant Winelands. Our staff at the Information Desk will gladly assist with Restaurant bookings.

We can highly recommend the following restaurants located in and around the city centre:

- The Westin Executive Club Address: Convention Square, Lower Long Street, Cape Town (opposite CTICC) Tel: +27 (0)21 412 8082
- Beluga (Gourmet) Address: Prestwich Street, Green Point Tel: +27 (0)21 418 2948
- Reubens at the One&Only Cape Town (Gourmet) Address: V&A Waterfront Tel: +27 (0)21 431 5888
- Bizerca Bistro (Gourmet) Address: Jetty Street, Foreshore, Cape Town City Centre Tel: +27 (0)21 418 0001
- Savoy Cabbage (Gourmet) Address: 101 Hout Street Cape Town City Centre Tel: +27 (0)21 424 2626
- City Grill (Traditional) Shop 155, Lower Level, Victoria Wharf Shopping Centre, V&A Waterfront Tel: +27 (0)21 421 9820
• Meloncino (Italian) Shop 259, Upper Level, Victoria Wharf Shopping Centre, V&A Waterfront Tel: +27 (0)21 419 5558
• 95 Keerom (Italian) Address: 95 Keerom Street Cape Town City Centre Tel: +27 (0)21 422 0765
• CoLacchio (Italian) Address: 42 Hans Strijdom Avenue, Cape Town City Centre Tel: +27 (0)21 419 4848
• Bo-Kaap Kombuis (Malay) Address: 7 August Street on Upper Wale Street, Bo-Kaap, Tel: +27 (0)21 422 5446
• Marcos (African) Address: 15 Rose Lane, Bo-Kaap, Cape Town City Centre Tel: +27 (0)21 423 5412
• Africa Caf (African) Address: 108 Shortmarket Street, Cape Town City Centre Tel: +27 (0)21 422 0221
• Haiku (Asian) Address: 58 Burg Street, Cape Town City Centre Tel: +27 (0)21 424 7000
• Bombay Brasserie at the Taj Hotel (Indian) Address: Wale Street, Cape Town City Centre Tel: +27 (0)21 819 2000.
• Bukhara (Indian) Address: 33 Church Street, Cape Town City Centre Tel: +27 (0)21 424 0000

Cellphones (Mobile Phones):

South Africa has a comprehensive cellular telephone network and visitors can hire cellphones while in the country. Alternatively, visitors can use their own cellphone (mobile) in South Africa if it is able to receive/dial international calls, or can purchase a SIM card locally (a passport or ID card is required for registration of the SIM). Cellucity Store in the V&A Waterfront will be able to assist with cellphone rentals or SIM card purchases. Tel: +27 (0)21 401 1300. Open from Mondays to Sundays 09:00 – 21:00.

Driving:

A valid driver’s licence is accepted, provided that the photograph is an integral part of the document, and that it is printed in English. South African traffic drives on the left. The speed limit is usually 60 kilometres per hour in urban areas, on rural roads 100 km/h, and on freeways 120 km/h unless otherwise indicated. Wearing a seat belt is compulsory. Driving under the influence of alcohol is a serious offence and traffic laws are strictly enforced. Be aware that South African motorists are often not as aware of pedestrians as they should be, and may ignore pedestrian crossings.

Electricity:

Main power throughout South Africa is 230 - 220 volts AC 50Hz but many hotels and other tourist centres also provide 110-volt sockets. The most common type of power sockets are the 15-amp three-pin (round pins), though sockets are sometimes provided for the two-pin Europlug. Adaptors are available from your hotel or the CTICC Business Centre. They can also be purchased at the Pick n Pay Store in the V&A Waterfront.

Safety:

Your enjoyment and wellbeing during your stay in Cape Town are of the utmost importance. The Tourism and Safety authorities strive to make your visit special, to ensure that you leave with great memories and return to the future with your friends and families. Tourists can safely visit most parts of the country and city provided that they take basic common-sense precautions to ensure their stay is as pleasant and safe as possible. Basic safety tip guidelines will be available at hotels, tourism information offices and at the congress welcome desk.

Emergency numbers:

South African Police 10111
Ambulance 10177
All Emergency Number 107
All Emergency Landline Number +27 (0)21 480 7700
Poison Information 0800 333 444

Taxes:

Value Added Tax (VAT) of 14% is levied on nearly all goods and services.

Telephone:

For international calls from South Africa, dial 00 followed by the international code of the country, then dial the area code (without the 0) and finally your correspondents number.

Tipping:

It is expected in South Africa. A guideline for visitors is the following: Porters R5 per item, taxis 10%, waiters & waitresses in restaurants 10%.

Time:

Time in Cape Town is GMT+2
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Video recording by participants and other attendees during any portion of the conference is not allowed without special prior written permission of IEEE.

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IEEE Non-Discrimination Policy

IEEE is committed to the principle that all persons shall have equal access to programs, facilities, services, and employment without regard to personal characteristics not related to ability, performance, or qualifications as determined by IEEE policy and/or applicable laws.
## Program Summary

### Monday, December 7th, 2015

<table>
<thead>
<tr>
<th>Start Time</th>
<th>Event Description</th>
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<tbody>
<tr>
<td>13:00–18:00</td>
<td>Registration (Strelitzia Conservatory, Ground Level)</td>
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<tr>
<td>18:45–19:00</td>
<td>Busses depart from CTICC (Walter Sisulu Avenue) to Aquarium</td>
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<tr>
<td>19:00–19:00</td>
<td>Welcoming Reception (Two Oceans Aquarium)</td>
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<tr>
<td>21:00–21:15</td>
<td>Busses depart from Aquarium to CTICC and official hotels</td>
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</table>

**Color Key Code**
- Registration and Social Events
- Opening and Plenary Talks
- Keynote Talks
- Breaks and Lunches
- Regular Sessions
- Special Sessions
- Tutorial Sessions
- Meetings
<table>
<thead>
<tr>
<th>Time</th>
<th>Room 1.41</th>
<th>Room 1.42</th>
<th>Room 1.43</th>
<th>Room 1.44</th>
<th>Room 1.61</th>
<th>Room 1.62</th>
<th>Room 1.63</th>
<th>Audi 2</th>
<th>Boardroom</th>
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<tr>
<td>08:00</td>
<td>Registration (Strelitzia Conservatorium, Ground Level)</td>
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<td>08:30</td>
<td>Opening Remarks (Audi 2)</td>
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<td>08:40</td>
<td>Frank Rosenblatt Award Function (Audi 2)</td>
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<td>09:00</td>
<td>Plenary Talk by Marco Dorigo (Audi 2)</td>
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<td>10:00</td>
<td>CICA'15 Session 1 Fuzzy System Identification and Control</td>
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<td>10:20</td>
<td>CIVA'15 Session 1 Intelligent Transportation Systems</td>
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<td>10:40</td>
<td>CICS'15 Session 1 Informationally Structured Space Classification I</td>
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<td>11:00</td>
<td>CiMB'15 Session 1 Face and Skin Biometrics</td>
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<td>11:20</td>
<td>CIBM'15 Session 1 Olivier Scaillet</td>
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<td>Lunch (Strelitzia and Jasminum Conservatories)</td>
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<td>13:00</td>
<td>MCDM'15 Tutorial 1 Introduction to Dynamic Multi-Objective Optimization and Its Challenges</td>
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<td>13:20</td>
<td>FOCT'15 Tutorial 2 A Gentle Introduction to The Time Complexity Analysis of Evolutionary Algorithms</td>
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<td>13:40</td>
<td>SSCI'15 Tutorial 3 Computational Intelligence in Bioinformatics (has been cancelled)</td>
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<td>14:00</td>
<td>SIS'15 Session 1 Particle Swarm Optimization Algorithms I</td>
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<td>14:20</td>
<td>RiSS'15 Session 1 Intelligent Robotics</td>
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<td>CIDM'15 Tutorial 2a Special Session Mining of Human Centered Multimodal Data</td>
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<td>CIDM'15 Session 2a Special Session Machine Learning Techniques for Fingerprint Biometrics</td>
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<td>16:20</td>
<td>CIDM'15 Tutorial 3 Human Meta-cognition and Other Algorithms in Neural Networks and Particle Swarm Optimization</td>
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<td>16:40</td>
<td>CICARE'15 Tutorial 4 Multimodal Recognition of Mental States (Emotions, Dispositions, Pain)</td>
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<td>17:00</td>
<td>SSC15 Tutorial 5 Hyper-heuristics and Computational Intelligence</td>
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<td>17:20</td>
<td>SSC15 Tutorial 6 Learning in Nonstationary Environments: Perspectives and Applications</td>
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<td>17:40</td>
<td>SSC15 Tutorial 7 Towards Intelligent Energy Efficient Hyper-dense Wireless Networks with Trillions of Devices</td>
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<td>18:00</td>
<td>IEEE C1S WCI &amp; YP Meeting</td>
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*Tuesday, December 8th, 2015*
## Wednesday, December 9th, 2015

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<td>CIBD'15</td>
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<td>Joshua Knowles</td>
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<td>12:20</td>
<td>Lunch</td>
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## Thursday, December 10th, 2015

**Plenary Talk by Paolo Lisboa (Audi 2)**

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<th>Start Time</th>
<th>Room 1.41</th>
<th>Room 1.42</th>
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<th>Room 1.63</th>
<th>Audi 2</th>
<th>Boardroom</th>
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<tbody>
<tr>
<td><strong>08:00–16:00</strong></td>
<td>Registration (Strelitzia Conservatory, Ground Level)</td>
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<td><strong>08:30</strong></td>
<td><strong>Plenary Talk by Paolo Lisboa (Audi 2)</strong></td>
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<td><strong>Break (Strelitzia and Jasminum Conservatories)</strong></td>
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<td><strong>12:20</strong></td>
<td>Lunch (Strelitzia and Jasminum Conservatory)</td>
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<td><strong>17:00</strong></td>
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**Detailed Program**

**Tuesday, December 8, 08:00–10:00**

**Registration:** 08:00–16:00  
**Room:** Strelitzia Conservatorium, Ground Level

**Opening Remarks:** 08:30–08:40  
**Room:** Audi 2

**Frank Rosenblatt Award:** 08:40–09:00  
**Room:** Audi 2

**SSCI’15 Plenary Talk**  
**Speaker:** Marco Dorigo *Controlling Swarms of Cooperating Robots*  
Tuesday, December 8, 09:00–10:00, Room: Audi 2  
Chair: Xin Yao

**Tuesday, December 8, 10:00–12:20**

**SSCI’15 Keynote Talk**  
**Speaker:** Simon Lucas *Statistical Simulation Algorithms for General Video Game AI*  
10:20, Room: Audi 2  
Chair: Garrison Greenwood

**CIFEr’15 Keynote Talk**  
**Speaker:** Olivier Scaillet *Valuing American Options using Fast Recursive Projections*  
11:00, Room: Audi 2  
Chair: Antoaneta Serguieva

**CICA’15 Session: 1: Fuzzy System Identification and Control**  
Tuesday, December 8, 10:20–12:20, Room: 1.41  
Chair: Ginalber Serra, Co-chair: Alok Deb

10:20 [#1570188045] Self-Tuning Robust Stability Fuzzy Digital Controller  
Ginalber Serra, Edson Costa

10:40 [#1570191285] Fuzzy Logic Control and Fault Detection in Centralized Chilled Water System  
Noor Sulaiman, Mohd Othman, Hayati Abdullah

11:00 [#1570196363] A Novel Data Knowledge Representation with Collaborative Fuzzy Transfer Rule for Takagi Sugeno Kang Type Model  
Mukesh Prasad, Meng Joo Er, Chin Teng Lin, Om Kumar Prasad, Manoranjan Mohanty, Jagendra Singh

11:20 [#1570197773] Interval Type-2 Recursive Fuzzy C-Means Clustering Algorithm in the TS Fuzzy Model Identification  
Tamnoy Dam, Alok Deb

**CIVTS’15 Session: 1: Intelligent Transportation Systems**  
Tuesday, December 8, 10:20–12:20, Room: 1.42  
Chair: Marthinus Booysen, Co-chair: Yi Lu Murphey
10:20 [1570192697] Efficacy of Interventions and Incentives to Achieve Speed Compliance in the Informal Public Transport Sector  
Nelson Ebot Eny Akpa, Marthinus J Booysen, Marion Sinclair

Ayalew Habtie, Ajith Abraham, Dida Midikso

11:00 [1570192387] Multi-UAV Task Allocation: A Team-Based Approach  
Venugopalan Krishnaswamy, Kartick Subramanian, Suresh Sundaram

Supatcha Chainatamanan

CICS'15 Session: 1:  
Tuesday, December 8, 10:20–12:20, Room: 1.43  
Chair: Shubhalaxmi Kher

10:20 [1570191847] P2V: Effective Website Fingerprinting Using Vector Space Representations  
Khaled Alnaami, Gbadebo Ayoade, Asim Siddiqui, Nicholas Ruozzi, Latifur Khan

10:40 [1570192577] Quantum Based Neural Network Classifier and Its Application for Firewall to Detect Malicious Web Request  
Om Patel, Aruna Tiwari, Vikram Patel, Ojas Gupta

11:00 [1570193107] Conversion of Decision Tree Into Deterministic Finite Automation for High Accuracy Online SYN Flood Detection  
Marcin Luckner

11:20 [1570197379] Potentials of Using One-class SVM for Detecting Protocol-specific Anomalies in Industrial Networks  
Franka Schuster, Andreas Paul, Ren Rietz, Hartmut Koenig

CCMB'15 Session: 1:  
Tuesday, December 8, 10:20–12:20, Room: 1.44  
Chair: Angelo Cangelosi, Co-chair: Alessandro Di Nuovo

10:20 [1570195861] Empathic Interaction Using the Computational Emotion Model  
Zeeshan Rasool, Naoki Masuyama, Chu Kiong Loo, Md. Islam

10:40 [1570190189] Artificial Mental Imagery in Cognitive Robots Interaction  
Alessandro Di Nuovo, Angelo Cangelosi

11:00 [1570192161] Robustness and Real-Time Performance of an Insect Inspired Target Tracking Algorithm Under Natural Conditions  
Zahra Bagheri, Steven D Wiederman, Ben Cazzolato, Steven Grainger, David C O'Carroll

11:20 [1570192523] Combining CCA and CFP for Enhancing the Performance in the Hybrid BCI System  
Li-Wei Ko, Sai Kalyan Ranga Singanamalla

RiiSS'15 Session: 1: Informationally Structured Space  
Tuesday, December 8, 10:20–12:20, Room: 1.61  
Chair: Chu Kiong Loo, Co-chair: Takenori Obo

10:20 [1570192403] Development of Food Texture Sensor Using Two Magnetic Sensing Elements  
Hiroyuki Nakamoto, Daisuke Nishikubo, Futoshi Kobayashi, Fumio Kojima

10:40 [1570192441] Invariant Perception for Grasping an Unknown Object Using 3D Depth Sensor  
Hiroyuki Masuta, Hun-ok Lim, Tatsuo Motoyoshi, Ken’ichi Koyanagi, Toru Oshima

11:00 [1570196233] Fuzzy Spiking Neural Network for Abnormality Detection in Cognitive Robot Life Supporting System  
Dalai Tang, János Botzheim, Naoyuki Kubota, Tiong Yew Tang

11:20 [1570197453] Behavior Pattern Extraction Based on Growing Neural Networks for Informationally Structured Space  
Takenori Obo, Habeebah Kakudi, Chu Kiong Loo, Naoyuki Kubota
CIDM’15 Session: 1: Classification I
Tuesday, December 8, 10:20–12:20, Room: 1.62
Chair: Friedhelm Schwenker

10:20 [1570169637] Study on Index Model of Tropical Cyclone Intensity Change Based on Projection Pursuit and Evolution Strategy
Huantong Geng

10:40 [1570185043] Classification Uncertainty of Multiple Imputed Data
Tuomo Alasalmi, Heli Koskimki, Jaakko Sutala, Juha Rning

11:00 [1570188525] Calibrating Probability with Undersampling for Unbalanced Classification
Andrea Dal Pozzolo, Olivier Caelen, Reid Johnson, Gianluca Bontempi

Vladimir Stanovov, Evgenii Sopov, Eugene Semenkin

11:40 [1570192479] Classification Using Probabilistic Random Forest
Rajhans Gondane, V. Susheela Devi

CIBIM’15 Session: 1: Face And Skin Biometrics
Tuesday, December 8, 10:20–12:20, Room: 1.63
Chair: Eric Granger, Co-chair: Gian Luca Marcialis

10:20 [1570175885] Ensemble Methods for Robust 3D Face Recognition Using Commodity Depth Sensors
Florin Schimbinschi, Lambert Schomaker, Marco Wiering

10:40 [1570189451] Deep Convolutional Neural Networks and Support Vector Machines for Gender Recognition
Jos van de Woldshaar, Marco Wiering, Mahir Karaaba

11:00 [1570190639] Video Face Recognition From A Single Still Image Using an Adaptive Appearance Model Tracker
M. Ali Akber Dewan, Eric Granger, Robert Sabourin, Gian Luca Marcialis, Fabio Roli

11:20 [1570191637] Robust Face Recognition by Computing Distances From Multiple Histograms of Oriented Gradients
Mahir Karaaba, Olarik Surinta, Lambert Schomaker, Marco Wiering

11:40 [1570191657] Identifying Critical Factors Influencing Quality of Blood Vessel Information in JPEG Compressed Skin Images
Xiaojie Li, Adams Kong

Tuesday, December 8, 13:00–15:00

CIDM Keynote Talk
Speaker: Barbara Hammer Structure Metric Learning in Prototype-based Models and Its Application for Intelligent Tutoring
13:00, Room: Audi 2
Chair: Friedhelm Schwenker

CICS Keynote Talk
Speaker: Robert Abercrombie Impact of Big Data on Computational Intelligence Aspects of Cyber Security and the Computing Environment to Support Repeatable Scientific Experimentation
13:40, Room: Audi 2
Chair: Shubhalaxmi Kher
CICA Keynote Talk
Speaker: Er Meng Joo Cognitive Robotics: Recent Developments and Futuristic Trends
14:20, Room: Audi 2
Chair: Ginalber Serra

13:00 [Tutorial 1] MCDM: Introduction to Dynamic Multi-Objective Optimization and Its Challenges
Mardé Helbig
Room: 1.41

13:00 [Tutorial 2] FOCI: A Gentle Introduction to The Time Complexity Analysis of Evolutionary Algorithms
Pietro Oliveto
Room: 1.42

13:00 [Tutorial 3] SSCI: Computational Intelligence in Bioinformatics (Tutorial has been cancelled)
Ed Keedwell, Jonathan Mwaura
Room: 1.43

SIS’15 Session: 1: Particle Swarm Optimization I
Tuesday, December 8, 13:00–15:00, Room: 1.44
Chair: Pavel Krömer

13:00 [#1570173149] An Improved Method for Comprehensive Learning Particle Swarm Optimization
Zi-Jia Wang, Zhi-hui Zhan, Jun Zhang
13:20 [#1570192243] A Subspace-Based Method for PSO Initialization
Elre van Zyl, Andries Engelbrecht
13:40 [#1570192855] Particle Swarm Optimization with Minimum Spanning Tree Topology for Multi-modal Optimization
Yu-Hui Zhang, Yue-jiao Gong, Jun Zhang
14:00 [#1570190207] The Effect of Probability Distributions on the Performance of Quantum Particle Swarm Optimization for Solving Dynamic Optimization Problems
Kyle Harrison, Beatrice Ombuki-Berman, Andries Engelbrecht
14:20 [#1570197619] A Swarm-Based Approach to Learning Phase-Type Distributions for Continuous Time Bayesian Networks
Logan J Perreault, Monica Thornton, Rollie Goodman, John W. Sheppard
14:40 [#1570159763] Transistor Sizing Using Particle Swarm Optimization
Lyndon White, Lyndon While, Ben Deeks, Farid Boussaid

RiiSS’15 Session: 2: Intelligent Robotics
Tuesday, December 8, 13:00–15:00, Room: 1.61
Chair: János Botzheim, Co-chair: Hiroyuki Masuta

13:00 [#1570191529] Evolving Snake Robot Controllers Using Artificial Neural Networks as an Alternative to a Physics-Based Simulator
Grant Woodford, Mathys du Plessis, Christiaan Pretorius
13:20 [#1570191823] Genetic Bayesian ARAM for Simultaneous Localization and Hybrid Map Building
Wei Hong Chin, Chu Kiong Loo, Naoyuki Kubota, Yuichiro Toda
13:40 [#1570193227] Pareto-dominance Based MOGP for Evolving Soccer Agents
Christopher Lazarus
14:00 [#1570193245] Inter-connection Structure Optimization for Neural Oscillator Based Biped Robot Locomotion
Azhar Aulia Saputra, Indra Adjij Sulistijono, János Botzheim, Naoyuki Kubota
14:20 [#1570193421] Autonomous Viewpoint Selection of Robots Based on Aesthetic Composition Evaluation of a Photo
Kai Lan, Kosuke Sekiyama
CIDM’15 Session: 2a: Special Session: Mining of Human Centered Multimodal Data
Tuesday, December 8, 13:00–14:00, Room: 1.62
Chair: Markus Kächele

13:00 [#1570190953] Avoiding Bias in Classification Accuracy - a Case Study for Activity Recognition
Heli Koskimäki

13:20 [#1570196031] Fusion Mappings for Multimodal Affect Recognition
Martin Schels, Markus Kächele, Patrick Thiam, Friedhelm Schwenker

13:40 [#1570192227] Data Mining in MEDLINE for Disease-Disease Associations Via Second Order Co-Occurrence
Modest von Korff, Bernard Deffarges, Thomas Sander

CIDM’15 Session: 2b: Ensemble Methods
Tuesday, December 8, 14:00–15:00, Room: 1.62
Chair: Markus Kächele

14:00 [#1570192723] Evaluation of Fusion Methods for Gamma-divergence-based Neural Network Ensembles
Uwe Knauer, Andreas Backhaus, Udo Seiffert

14:20 [#1570192891] Improving Classification Performance by Merging Distinct Feature Sets of Similar Quality Generated by Multiple Initializations of mRMR
Thomas Bottesch, Guenther Palm

14:40 [#1570193191] Naïve Bayes Classification Ensembles to Support Modeling Decisions in Data Stream Mining
Patricia Lutu

CIBIM’15 Session: 2: Special Session: Machine Learning Techniques for Fingerprint Biometrics
Tuesday, December 8, 13:00–15:00, Room: 1.63
Chair: Ajita Rattani, Co-chair: Ruggero Donida Labati

13:00 [#1570192059] Fusion of Palmprint and Finger-Knuckle-Print for Human Personal Recognition
Aditya Nigam, Parvez Khan, Phalguni Gupta

13:20 [#1570192355] Distortion Analysis on Binary Representation of Minutiae Based Fingerprint Matching for Match-on-Card
Cynthia Mlambo

13:40 [#1570193443] Automatic Classification of Acquisition Problems Affecting Fingerprint Images in Automated Border Controls
Ruggero Donida Labati, Angelo Genovese, Enrique Munoz Ballester, Vincenzo Piuri, Fabio Scotti, Gianluca Sforza

14:00 [#1570195225] A Preliminary Study on Identifying Fabrication Material From Fake Fingerprint Images
Ajita Rattani, Zahid Akhtar, GianLuca Foresti

Tuesday, December 8, 15:20–17:20

Suresh Sundaram
Room: 1.44

15:20 [Tutorial 5] CIDM, CICARE: Multimodal Recognition of Mental States (Emotions, Dispositions, Pain)
Holger Hoffmann, Harald Traue, Steffen Walter, Friedhelm Schwenker, Sascha Meudt
Room: 1.61
15:20 [Tutorial 6] SSCI: Hyper-heuristics and Computational Intelligence  
   Nelishia Pillay  
   Room: 1.62

   Giacomo Boracchi, Gregory Ditzler  
   Room: 1.63

   Madalina Drugan  
   Room: Audi 2

   Abolfazl Mehbodniya, Fumiyuki Adachi  
   Room: Boardroom

CICA’15 Session: 2: System Identification and Learning with Applications  
Tuesday, December 8, 15:20–17:20, Room: 1.41  
Chair: Er Meng Joo, Co-chair: Fouzi Harrou

15:20 [#1570173237] Interpretation and Analysis of Input Selection Approaches in Distance Space  
   Tim Heinz, Oliver Nelles

15:40 [#1570184331] Extended Deterministic Local Search Algorithm for Maximin Latin Hypercube Designs  
   Tobias Ebert, Torsten Fischer, Julian Belz, Tim Heinz, Geritt Kampmann, Oliver Nelles

16:00 [#1570192287] Enhanced Anomaly Detection Via PLS Regression Models and Information Entropy Theory  
   Harrou Fouzi, Ying Sun

   Ananda Maiti, Alexander A. Kist, Andrew Maxwell

16:40 [#1570194283] GLRT Based Anomaly Detection for Sensor Network Monitoring  
   Harrou Fouzi, Ying Sun

17:00 [#1570196053] Multi-document Extractive Summarization Using Window-based Sentence Representation  
   Yong Zhang, Er Meng Joo, Rui Zhao

CIVTS’15 Session: 2: Driver Behavior Detection and Vehicle Vision Systems  
Tuesday, December 8, 15:20–17:20, Room: 1.42  
Chair: Yi Lu Murphey, Co-chair: Marthinus Booysen

15:20 [#1570192905] Real Time Drowsiness Detection Based on Lateral Distance Using Wavelet Transform and Neural Network  
   Jiaqi Ma, Yi Lu Murphey, Hong Zhao

15:40 [#1570182527] A Comparison of Low-Cost Monocular Vision Techniques for Pothole Distance Estimation  
   Sonja Nienaber, Marthinus J Booysen, Steve Kroon

16:00 [#1570190023] Performance Comparison of Dynamic Time Warping (DTW) and a Maximum Likelihood (ML) Classifier in Measuring Driver Behavior with Smartphones  
   Jarrett Engelbrecht, Marthinus J Booyseen, Gert-Jan van Rooyen, Frederick Bruwer

16:20 [#1570191749] Comparison of GPS and MEMS Support for Smartphone-Based Driver Behavior Monitoring  
   Frederick Bruwer, Marthinus J Booyseen

   Ritesh Kanjee, Johnson Carroll, Asheer Bachoo
CICS’15 Session: 2:
Tuesday, December 8, 15:20–17:20, Room: 1.43
Chair: Robert Abercrombie

15:20 [#1570169699] Information Warfare: Fighting Back Through the Matrix
Ramzi A. Haraty, Sanaa Kaddoura, Ahmed Zekri

15:40 [#1570170935] Security Analysis of Smart Grid Cyber Physical Infrastructures Using Modeling and Game Theoretic Simulation
Robert Abercrombie

16:00 [#1570181673] An Adaptive Approach Towards the Selection of Multi-factor Authentication
Arunava Roy, Abhijit Kumar Nag, Dipankar Dasgupta

16:20 [#1570189199] Histogram-Based Fast Text Paragraph Image Detection
Devadeep Shyam, Yan Wang, Alex Kot

Meuh S Raval, Vaibhav Joshi, Dhruv Gupta, Shubhalaxmi J Kher

Wednesday, December 9, 08:00–09:30

Registration: 08:00–16:00
Room: Strelitzia Conservatorium, Ground Level

SSCT’15 Plenary Talk
Speaker: Xin Yao Large Scale Global Optimisation Through Co-operative Co-evolution
Wednesday, December 9, 08:30–09:30, Room: Audi 2
Chair: Bernadette Bouchon-Meunier

Wednesday, December 9, 09:50–12:20

CIPLS’15 Keynote Talk
Speaker: Erwin Pesch Planning and Scheduling Models in Intermodal Transport Optimization
09:50, Room: Audi 2
Chair: Bülent Çatay

IEEE ALIFE’15 Keynote Talk
Speaker: Terry Bossomaier Complex Behaviour in Artificial Life
10:30, Room: Audi 2
Chair: Heiko Hamann

MCDM’15 Keynote Talk
Speaker: Joshua Knowles Automation vs Intuition in MCDM
11:10, Room: Audi 2
Chair: Hisao Ishibuchi

CIBD’15 Session: 1:
Wednesday, December 9, 09:50–12:20, Room: 1.41
Chair: Paulo Lisboa

09:50 [#1570197557] Hierarchical Mahalanobis Distance Clustering Based Technique for Prognostics in Applications Generating Big Data
Krishnan Raghavan, Sarangapani Jagannathan

Sue Ellen Haupt, Branko Kosovic

10:30 [#1570193585] Distributed, MapReduce-based Nearest Neighbor and E-Ball Kernel k-Means
Nikolaos Tsapanos, Anastasios Tefas, Nikos Nikolaidis, Ioannis Pitas
10:50  [#1570181525] Attribute Selection Via Multi-Objective Evolutionary Computation Applied to Multi-Skill Contact Center Data Classification
Fernando Jimenez, Enrico Marzano, Gracia Sánchez, Guido Sciavicco, Nicola Vitacolonna

11:10  [#1570197687] Fixed-Size Least Squares Support Vector Machines: Scala Implementation for Large Scale Classification
Mandar Chandorkar, Raghvendra Mall, Oliver Lauwers, Johan Suykens, Bart De Moor

11:30  [#1570191803] Big Data Analytics of Financial Strategies
Kabaji Egara, Jr, Yonghong Peng

11:50  [#1570194581] Integrated Analysis of Gene Expression Data for Colon Cancer Biomarker Discovery
Aamir Hassan, Masood Zaka, Demetres Kouvatsos, Yonghong Peng

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ADPRL’15 Session: 1:
Wednesday, December 9, 09:50–12:20, Room: 1.42
Chair: Marco Wiering, Co-chair: Madalina Drugan

09:50  [#1570191291] Learning an Optimal Control Policy for a Markov Decision Process Under Linear Temporal Logic Specifications
Masaki Hiromoto, Toshimitsu Ushio

10:10  [#1570192167] A Policy Gradient with Parameter-based Exploration Approach for Zone-heating
Kevin Van Vaerenbergh, Yann-Michäel De Haemere, Bruno Depraetere, Ann Nowé

10:30  [#1570192495] Temporal Difference Learning for the Game Tic-Tac-Toe 3D: Applying Structure to Neural Networks
Michiel van de Steeg, Madalina Drugan, Marco Wiering

10:50  [#1570197583] Distributed Adaptive Optimal Regulation of Uncertain Large-Scale Linear Networked Control Systems Using Q-Learning
Vignesh Narayanan, Sarangapani Jagannathan

11:10  [#1570196479] Bayesian Reinforcement Learning in Markovian and non-Markovian Tasks
Adnane Ez-zizi, Simon Farrell, David Leslie

11:30  [#1570192579] Bayesian Credible Intervals for Online and Active Learning of Classification Trees
Timothé Collet, Olivier Pietquin

11:50  [#1570202843] Correlated Gaussian Multi-Objective Multi-Armed Bandit Across Arms Algorithm
Saba Yahyaa, Madalina Drugan

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IntECS’15 Session: 1:
Wednesday, December 9, 09:50–12:20, Room: 1.43
Chair: Giacomo Boracchi

09:50  [#1570189433] Detecting Contaminants in Smart Buildings by Exploiting Temporal and Spatial Correlation
Manuel Roveri, Giacomo Boracchi, Michalis P Michaelides

10:10  [#1570192591] Controlled-Accuracy Approximation of Nonlinear Functions for Soft Computing Applications
Ines del Campo, Javier Echanobe, Estibaliz Asua, Raul Finker

10:30  [#1570193129] Semantic Mediation in Smart Water Networks
George M. Milis, Demetris Eliades, Christos Panayiotou, Marios Polycarpou

10:50  [#1570193189] A Pdf-free Change Detection Test for Data Streams Monitoring
Li Bu, Dongbin Zhao, Cesare Alippi

11:10  [#1570195973] Using Cultural Algorithms to Improve Wearable Device Gesture Recognition Performance
Faisal Waris, Robert G Reynolds

Francesco Orciuoli, Mimmo Parente

11:50  [#1570197457] Optimal Defense and Control for Cyber-Physical Systems
Haifeng Niu, Sarangapani Jagannathan
09:50 [1570197659] Short-term Forecasting of Wind Power Generation Based on the Similar Day and Elman Neural Network
  Xiaoyu Zhang, Rui Wang, Tao Zhang, Yabin Zha

10:10 [1570189421] Prediction Interval Modeling Tuned by an Improved Teaching Learning Algorithm Applied to Load Forecasting in Microgrids
  Franka Veltman, Luis Marin, Doris Saez, Alfredo Nez, Leonel Guiterrez

10:30 [1570192947] Electrical Energy Consumption Forecast Using External Facility Data
  Eugénia Vinagre, Luis Gomes, Zita Vale

  Philip J C Nel, Marthinus J Booysen, Brink van der Merwe

11:10 [1570196357] Frequency Prediction of Synchronous Generators in a Multi-machine Power System with a Photovoltaic Plant Using a Cellular Computational Network
  Yawei Wei, Iroshani Jayawardene, G. Kumar Venayagamoorthy

11:30 [1570185185] Semantically-enhanced Configurability in State Estimation Structures of Power Systems
  George M. Milis, Markos Asprou, Elias Kyriakides, Christos Panayiotou, Marios Polycarpou

11:50 [1570206977] Detecting Wind Power Ramp with Random Vector Functional Link (RVFL) Network
  Ye Ren, Xueheng Qiu, Ponnuthurai Nagaratnam Suganthan, Gehan A. J. Amaratunga

09:50 [1570173365] Maximum Entropy Production Principle for Stock Returns
  Pawel Fiedor

10:10 [1570181259] Predicting Stock Price Movements Based on Different Categories of News Articles
  Yauheniya Shynkevich, Martin McGinnity, Sonya A Coleman, Ammar Belatreche

10:30 [1570191001] Predicting Rainfall in the Context of Rainfall Derivatives Using Genetic Programming
  Sam Cramer, Michael Kampouridis, Alex A Freitas, Antonis Alexandridis

10:50 [1570191515] Predicting Credit Risk in Peer-to-Peer Lending: A Neural Network Approach
  Ajay Byanjankar, Markku Heikkil, Jozsef Mezei

11:10 [1570191705] Forecasting Financial Volatility Using Nested Monte Carlo Expression Discovery
  Tristan Cazenave, Sana Ben Hamida

11:30 [1570191739] High-Frequency Equity Index Futures Trading Using Recurrent Reinforcement Learning with Candlesticks
  Patrick Gabrielson, Ulf Johansson

  Yue Li, Khaldoun M Khashanah

09:50 [1570185549] An Alternating Optimization Approach Based on Hierarchical Adaptations of DBSCAN
  Alexander Dockhorn, Christian Braunste, Rudolf Kruse

10:10 [1570188213] Scalable Hierarchical Clustering: Twister Tries with a Posteriori Trie Elimination
  Michael Cochez, Ferrante Neri
Wednesday, December 9, 09:50–12:20, Room: 1.63
Chair: Jonathan Mwaura

09:50 [#1570213002] Feature Reduction for Dimensional Emotion Recognition in Human-Robot Interaction
Ntombikayise Banda, Andries Engelbrecht, Peter Robinson

10:30 [#1570191481] A Decision Tree-Based Approach for Cardiovascular Dysautonomias Diagnosis: a Case Study
Ali Idri, Ilham Kadi

Amir Hussain, Kamran Farooq, Bin Luo, Warner Slack

11:10 [#1570212581] Solar Powered Wheel Chair for Physically Challenged People Using Surface EMG Signal
M. Shamim Kaiser, Zamsheed Iqbal Chowdhury, Shamim Al Mamun, Amir Hussain, Mufti Mahmud

11:30 [#1570197423] Smartphone-based Tele-Rehabilitation System for Frozen Shoulder Using a Machine Learning Approach
Kanmanus Ongvisatepaiboon, Jonathan H. Chan, Vajirasak Vanijja

Wednesday, December 9, 13:00–15:00

ADPRL’15 Keynote Talk
Speaker: Jan Peters Motor Skill Learning: From Simple Skills to Table Tennis and Manipulation
13:00, Room: Audi 2
Chair: Marco Wiering

CIASG’15 Keynote Talk
Speaker: Om Malik Computational Intelligence Based Controllers for Real-Time Control in Power Systems
13:40, Room: Audi 2
Chair: G. Kumar Venayagamoorthy

ICES’15 Keynote Talk
Speaker: Lukas Sekanina Evolutionary Design for Approximate Computing: Trading Accuracy for Energy Efficiency and Performance in Circuits and Programs
14:20, Room: Audi 2
Chair: Andy Tyrell

13:00 [Tutorial 10] CIES: Dealing with Uncertainty in Computing: From Probabilistic and Interval Uncertainty to Combination of Different Approaches, with Application to Geoinformatics, Bioinformatics, and Engineering
Vladik Kreinovich
Room: 1.42

57
Robert G. Reynolds
Room: 1.43

13:00 [Tutorial 12] CICARE: A Computational Intelligence Library
Gary Pamparà, Filipe Nepomuceno
Room: 1.44

MCDM’15 Session: 1:
Wednesday, December 9, 13:00–15:00, Room: 1.41
Chair: Hisao Ishibuchi, Co-chair: Sanaz Mostaghim

13:00 [#1570190115] Comparative Study of Recent Multimodal Evolutionary Algorithms
Romaric Pighetti, Denis Pallez, Frederic Precioso
13:20 [#1570192815] Using ε-Dominance for Hidden and Degenerated Pareto-Fronts
Heiner Zille, Sanaz Mostaghim
Alon Snir, Barak Samina, Amiram Moshaiov
14:00 [#1570194071] Relation Between Weight Vectors and Solutions in MOEA/D
Hisao Ishibuchi, Ken Doi, Hiroyuki Masuda, Yusuke Nojima
14:20 [#1570203017] Approximative Pareto Front Identification
Madalina M Drugan
14:40 [#1570192469] Enhancing State-of-the-art Multi-objective Optimization Algorithms by Applying Domain Specific Operators
Newsha Ghoreishi, Jan Sørensen, Bo Jørgensen

CIFEr’15 Session: 2: Systemic Risk & Sentiment Analysis & Macroeconomic Modeling
Wednesday, December 9, 13:00–15:00, Room: 1.61
Chair: Peter Sarlin

Kuan-Heng Chen, Khaldoun Khashanah
Samuel Rönnqvist, Peter Sarlin
13:40 [#1570193079] An Extreme Firm-Specific News Sentiment Asymmetry Based Trading Strategy
Qiang Song, Anqi Liu, Steve Yang, Anil Deane, Kaushik Datta
14:00 [#1570193153] Learning Ordinary Differential Equations for Macroeconomic Modelling
Zhirko Georgiev, Dimitar Kazakov
14:20 [#1570193177] Sentiment Classification in the Financial Domain Using ν-SVM and Multi-Objective Optimisation
Fan Sun, Ammar Belatreche, Sonya A Coleman, Thomas McGinnity, Yuhua Li
14:40 [#1570193221] CrisisModeler: A Tool for Exploring Crisis Predictions
Markus Holopainen, Peter Sarlin

CIDM’15 Session: 4: Data Mining Applications
Wednesday, December 9, 13:00–15:00, Room: 1.62
Chair: Sascha Meudt

Ali Idri, Aya Hassani, Alain Abran
Kazuhisa Chiba, Hideyuki Yoda, Shoma Ito, Masahiro Kanazaki
13:40 [1570191593] Using Twitter for Next-Place Prediction, with an Application to Crime Prediction
Mingjun Wang, Matthew Gerber

14:00 [1570191959] Genetic Clustering Algorithm for Extractive Text Summarization
Sebastian Suarez Benjumea, Elizabeth León

14:20 [1570192513] Optimizing Seed Set for New User Cold Start
He-Da Wang, Ji Wu

14:40 [1570192589] Collaborative Filtering of Call for Papers
He-Da Wang, Ji Wu

FOCI’15 Session: 1: Fuzzy Logic
Wednesday, December 9, 13:00–15:00, Room: 1.63
Chair: Pablo Cordero

13:00 [1570173287] An Open Source Matlab/Simulink Toolbox for Interval Type-2 Fuzzy Logic Systems
Ahmet Taskin, Tufan Kumbasar

13:20 [1570193009] Omega-algebras
Branimir Seselj, Andreja Tepavcevic

13:40 [1570193137] L-E Fuzzy Boolean Algebras
Branimir Seselj, Andreja Tepavcevic

14:00 [1570197805] A Normal Form for Fuzzy Functional Dependencies
Jose Manuel Rodríguez-Jiménez, Estrella Rodríguez-Lorenzo, Pablo Cordero, Manuel Enciso, Angel Mora

14:20 [1570197849] On Fuzzy Preordered Sets and Monotone Galois Connections
Francisca García-Pardo, Inma Cabrera, Pablo Cordero, Manuel Ojeda-Aciego

14:40 [1570199563] Designing Lattices of Truth Degrees for Fuzzy Logic Programming Environments
Juan Guerrero, María del Señor Martínez, Gines Moreno, Carlos Vázquez

Wednesday, December 9, 15:20–17:20

15:20 [Panel Discussion 1]: Problem Niches for CI
Panelists: Hisao Ishibuchi, Bernadette Bouchon-Meunier, Pablo Estevez, Ed Keedwell, Robert Reynolds, Xin Yao
Room: Audi 2
Chair: Hisao Ishibuchi
Summary: Computational Intelligence (CI) methods are increasingly being used in solving various problems from machine learning, optimization, modeling, artificial intelligence and other computational areas. In certain such tasks, CI has a clear niche due to their flexible structure, stochastic operators, and modular approach. In this panel, eminent CI researchers will address and highlight various such problem classes for which CI methods have been demonstrated to have a niche and indicate possible other problems where they can potentially have an edge over existing methods.

Dimitar Kazakov, Zhivko Georgiev
Room: 1.61

Claude Touzet
Room: 1.62

Paolo Rocca
Room: 1.63
15:20 A Collaborative Lot-Sizing Problem with Production Limitations
Mario Ziebuhr, Tobias Buer, Herbert Kopfer

15:40 Adaptive IDEA for Robust Multiobjective Optimization. Application to the r-TSALBP-m/A
Manuel Chica, Joaquin Bautista, Sergio Damas, Oscar Cordon

16:00 The Influence of the Picking Times of the Components in Time and Space Assembly Line Balancing Problems: An Approach with Evolutionary Algorithms
Emanuel Alsina, Nicola Capodieci, Giacomo Cabri, Alberto Regattieri, Mauro Gamberi, Francesco Pilati

16:20 Component Analysis Based Approach to Support the Design of Meta-heuristics for MLCLSP Providing Guidelines
Luis Pessoa, Carolin Wagner, Fernando Lima Neto, Bernd Hellingrath

15:20 Evolving Robust Robot Team Morphologies for Collective Construction
Geoff Nitschke

15:40 The Benefits of Adaptive Behavior and Morphology for Cooperation
Geoff Nitschke

16:00 Evolution, Individual Learning, and Social Learning in a Swarm of Real Robots
Jacqueline Heinerman, Massimiliano Rango, A.E. Eiben

16:20 Evolving Robotic Neuro-Controllers Using Gene Expression Programming
Jonathan Mwaura, Ed Keedwell

16:40 A Multi-Agent System for Autonomous Adaptive Control of a Flapping-Wing Micro Air Vehicle
Garrison Greenwood, Michal Podhradsky, John Gallagher, Eric Matson

15:20 Study of Normalization and Aggregation Approaches for Consensus Network Estimation
Pau Bellot, Philippe Salembier, Albert Oliveras, Patrick Meyer

15:40 An Ansatz for a Theory of Living Systems
Dominique Chu, David Barnes

16:00 Effects of Several Bioinspired Methods on the Stability of Coevolutionary Complexity
Benjamin Inden, Jürgen Jost

16:20 Flora Robotica - Mixed Societies of Symbiotic Robot-Plant Bio-Hybrids
Heiko Hamann, Mostafa Wahby, Thomas Schmickl, Payam Zahadat, Daniel Hofstadler, Kasper Stoy, Sebastian Risi, Andres Faina, Frank Veenstra, Serge Kernbach, Igor Kuksin, Olga Kernbach, Phil Ayres, Przemyslaw Wojtaszek

16:40 Using the Simulation of Ecological Systems to Explain the Wheel of Retailing
Roderick Ducan, Terry Bossoomaer, Steven D'Alessandro, Craig Johnson, Kathyrn French

17:00 The Impact of Obstruction on a Model of Competitive Exclusion in Plants
Jeffrey Tsang, Daniel A Ashlock
SIS’15 Session: 2: Ant Colony Optimization
Wednesday, December 9, 15:20–17:20, Room: 1.44
Chair: Ashraf Abdelbar, Co-chair: Shigeyoshi Tsutsui

15:20 [#1570189623] A Comparative Study for Efficient Synchronization of Parallel ACO on Multi-core Processors in Solving QAPs
Shigeyoshi Tsutsui, Noriyuki Fujimoto

15:40 [#1570192483] Towards a Network Interpretation of Agent Interaction in Ant Colony Optimization
Pavel Krömer, Petr Gajdos, Ivan Zelinka

16:00 [#1570192887] A Gradient-Guided ACO Algorithm for Neural Network Learning
Ashraf Abdelbar, Khalid Salama

16:20 [#1570192889] Ant Colony Optimization for First-order Rule Discovery
Rafael Ramírez

16:40 [#1570192901] Investigating Evaluation Measures in Ant Colony Algorithms for Learning Decision Tree Classifiers
Khalid Salama, Ashraf Abdelbar, Fernando Otero

Thursday, December 10, 08:00–09:30

Registration: 08:00–16:00
Room: Strelitzia Conservatorium, Ground Level

SSCI’15 Plenary Talk
Speaker: Paulo Lisboa
Thursday, December 10, 08:30–09:30, Room: Audi 2
Chair: Simon Lucas

Thursday, December 10, 09:30–12:20

CIHLI’15 Keynote Talk
Speaker: Tristan Cazenave Monte Carlo Tree Search
09:50, Room: Audi 2
Chair: Jacek Mańdziuk

CIES’15 Keynote Talk
Speaker: Ralf Mikut Computational Intelligence in Smart Grids
10:30, Room: Audi 2
Chair: Rudolf Kruse

CIEL’15 Keynote Talk
Speaker: Ke Tang Evolutionary Ensemble Learning in Uncertain Environments
11:10, Room: Audi 2
Chair: Janusz Kacprzyk

CIComms’15 Session: 1a: Special Session: Nature-inspired Antenna Systems
Thursday, December 10, 09:50–11:10, Room: 1.41
Chair: Randy Haupt, Co-chair: Paolo Rocca

09:50 [#1570196203] Surrogate-Assisted Optimization of Metamaterial Devices for Advanced Antenna Systems
Lorenza Tenuti, Marco Salucci, Giacomo Oliveri, Paolo Rocca, Andrea Massa

10:10 [#1570192027] Role of Boundary Dynamics in Improving Efficiency of Particle Swarm Optimization on Antenna Problems
Pragnan Chakravorty, Durbadal Mandal
10:30 [1570192687] **Optimization of Antenna Arrays for SLL Reduction Towards Pareto Objectivity Using GA Variants**  
Sudipta Das, Gopi Ram Hardel, Pragnan Chakravorty, Durbadal Mandal, Rajib Kar, Sakti Prasad Ghoshal

10:50 [1570177745] **Optimizing an Antenna Array for Satellite Communications**  
Randy Haupt

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**CIComms’15 Session: 1b:**
Thursday, December 10, 11:10–12:20, Room: 1.41  
Chair: Kandarpa Kumar Sarma, Co-chair: Paolo Rocca

11:10 [1570189837] **An Adaptive Congestion Control and Fairness Scheduling Strategy for Wireless Mesh Networks**  
Sajid Sheikh, Riaan Wolluter, Herman A Engelbrecht

11:30 [1570190859] **A Dec-POMDP Model for Congestion Avoidance and Fair Allocation of Network Bandwidth in Rate-Adaptive Video Streaming**  
Mahdi Hemmati, Yassine Abdulzalam, Shervin Shirmohammadi

Alireza Baghai-Wadji

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**ICES’15 Session: 2: Applications of Evolvable Systems**
Thursday, December 10, 09:50–12:20, Room: 1.42  
Chair: Garry Greenwood

09:50 [1570193195] **Social-Insect-Inspired Networking for Autonomous Fault Tolerance**  
Matthew Rowlings, Martin Trefzer, Andy Tyrrell

10:10 [1570192363] **Neuromorphic Hardware Accelerated Adaptive Authentication System**  
Manan Suri, Vivek Parmar, Akshay Singla, Surag Nair, Rishabh Malviya

10:30 [1570192425] **Evolution of Non-Cryptographic Hash Function Pairs for FPGA-Based Network Applications**  
Roland Dobai, Jan Korenek

10:50 [1570192409] **An Investigation of Underlying Physical Properties Exploited by Evolution in Nanotubes Materials**  
Stefano Nichele, Odd Rune Lykkeb, Gunnar Tuft

11:10 [1570192401] **Modelling Epigenetic Mechanisms to Capture Dynamical Topological Morphology: Applications in Edge Detection**  
Alexander Turner, Martin Trefzer, Andy Tyrrell

11:30 [1570183955] **Simultaneous Improvement to Signal Integrity and Electromagnetic Interference in High-Speed Transmission Lines**  
Moritoshi Yasunaga, Ikuo Yoshihara

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**CIASG’15 Session: 2: Simulation, Operations and Control**
Thursday, December 10, 09:50–12:20, Room: 1.43  
Chair: Komla Folly

09:50 [1570193063] **Co-Simulation Platform for Characterizing Cyber Attacks in Cyber Physical Systems**  
Mohammad Sadi, Mohd Hasan Ali, Dipankar Dasgupta, Robert K Abercrombie, Shubhalaxmi J Kher

10:10 [1570191787] **Stochastic Optimization for Combined Economic and Emission Dispatch with Renewables**  
Mehdi Rahmani-andebili, G. Kumar Venayagamoorthy

10:30 [1570193043] **VPP Energy Resources Management Considering Emissions: The Case of Northern Portugal 2020 to 2050**  
João Soares, Nuno Borges, Cristina Lobo, Zita Vale

10:50 [1570197617] **Stochastic Model Predictive Control Based Economic Dispatch for Hybrid Energy System Including Wind and Energy Storage Devices**  
Yan Zhang, Rui Wang, Tao Zhang, Yajie Liu, Bo Guo, Tianjun Liao

62
11:10 [_deadline_1570197757] Development of Optimal PI Controllers for a Grid-Tied Photovoltaic Inverter
   Ali Arzani, Paranietharan Arunagirinathan, G. Kumar Venayagamoorthy

11:30 [_deadline_1570193105] Multi-machine Power System Stabilizer Design Based on Population Based Incremental Learning
   Dereck A Dombo, Komla Folly

SIS’15 Session: 3: Particle Swarm Optimization II
Thursday, December 10, 09:50–12:20, Room: 1.44
Chair: Sanaz Mostaghim

09:50 [_deadline_1570196169] Dynamic Vector-evaluated PSO with Guaranteed Convergence in the Sub-swarms
   M Helbig, Andries Engelbrecht

10:10 [_deadline_1570190193] Co-operative Vector-Evaluated Particle Swarm Optimization for Multi-objective Optimization
   Justin Maltese, Beatrice Ombuki-Berman, Andries Engelbrecht

10:30 [_deadline_1570190219] High-Dimensional Multi-objective Optimization Using Co-operative Vector-Evaluated Particle Swarm Optimization with Random Variable Grouping
   Justin Maltese, Andries Engelbrecht, Beatrice Ombuki-Berman

10:50 [_deadline_1570195045] A Parallel Implementation of Multiobjective Particle Swarm Optimization Algorithm Based on Decomposition
   Jin-Zhou Li, Wei-Neng Chen, Jun Zhang

11:10 [_deadline_1570182049] On the Performance of Particle Swarm Optimization Algorithms in Solving Cheap Problems
   Abdullah Al-Dujaili, Muhammad Rizwan Tanweer, Suresh Sundaram

11:30 [_deadline_1570188293] Frequency Distribution of Candidate Solutions in Angle Modulated Particle Swarms
   Bennie Leonard, Andries Engelbrecht

CICARE’15 Session: 2: Applications of Computational Intelligence in eHealth and Therapy
Thursday, December 10, 09:50–12:20, Room: 1.61
Chair: Marthinus Booysen

09:50 [_deadline_1570177143] Real Time Identification of Heart Sounds Using Selectional Regional Correlation of the Time Frequency Domain
   David Fourie, Marthinus J BooySEN

10:10 [_deadline_1570192339] Automatic Diagnosis of Voiding Dysfunction From Sound Signal
   Petr Hurtik, Michal Burda, Jan Krhut, Peter Zvara, Libor Luňáček

10:30 [_deadline_1570197173] Efficient Bone Detector and Geometric Descriptor for X-ray Imaging
   Jakub Romanowski, Marcin Korytkowski, Rafal Scherer

10:50 [_deadline_1570195913] Fuzzy Set-Based Detection of Hypotension Episodes for Predicting Leaks in Sleeve Gastrectomy
   Job Visser, Anna Wilbik, Uzay Kaymak, Simon Nienhuijs

11:10 [_deadline_1570191611] A Note on the Evaluation of Mutation Prioritization Algorithms
   Dusan Popovic, Jesse Davis, Alejandro Sifrim, Bart De Moor

CIDM’15 Session: 5a: Special Session: Process Mining
Thursday, December 10, 09:50–10:50, Room: 1.62
Chair: Andrea Buratti, Co-chair: Fabrizio Maggi, Chiara Di

09:50 [_deadline_1570178547] Constructing Probable Explanations of Nonconformity: A Data-aware and History-based Approach
   Mahdi Alizadeh, Massimiliano de Leoni, Nicola Zannone

10:10 [_deadline_1570193019] Efficient Process Discovery From Event Streams Using Sequential Pattern Mining
   Marwan Hassani, Sergio Siccha, Florian Richter, Thomas Seidl

10:30 [_deadline_1570193159] The Analysis of a Real Life Declarative Process
   Tijs Slaats, Soren Debois

63
CIDM'15 Session: 5b: Classification II
Thursday, December 10, 10:50–12:20, Room: 1.62
Chair: Andrea Burattin, Co-chair: Fabrizio Maggi, Chiara Di

10:50 [#1570192573] Improving SVM Training Sample Selection Using Multi-Objective Evolutionary Algorithm and LSH
Romaric Pighetti, Denis Pallez, Frédéric Precioso

11:10 [#1570192717] Subclass Marginal Fisher Analysis
Anastasios Maronidis, Anastasios Tefas, Ioannis Pitas

11:30 [#1570192883] Multivariate Time Series Classification Using Dynamic Time Warping Templates
Skyler Seto, Wenyu Zhang, Yichen Zhou

11:50 [#1570193235] Evolving Workflow Graphs Using Typed Genetic Programming
Tomáš Kron, Martin Pilat, Roman Neruda

FOCI'15 Session: 2: Evolutionary Computation and Machine Learning
Thursday, December 10, 09:50–12:20, Room: 1.63
Chair: Pietro Oliveto

09:50 [#1570169921] Improving Convergence in Cartesian Genetic Programming Using Adaptive Crossover, Mutation and Selection
Roman Kalkreuth, Guenter Rudolph, Jörg Krone

10:10 [#1570179501] Measuring Saturation in Neural Networks
Anna Rakitianskaia, Andries Engelbrecht

10:30 [#1570192193] Hybrid Approach for TSP Based on Neural Networks and Ant Colony Optimization
Carsten Mueller, Niklas Kiehne

10:50 [#1570192561] An Evolutionary Approach to the Discovery of Hybrid Branching Rules for Mixed Integer Solvers
Kjartan Petursson, Thomas Runarsson

11:10 [#1570192631] Population-Based Incremental Learning with Immigrants Schemes in Changing Environments
Michalis Mavrovouniotis, Shengxian Yang

11:30 [#1570192705] Graph Embedding Exploiting Subclasses
Anastasios Maronidis, Anastasios Tefas, Ioannis Pitas

11:50 [#1570196337] Towards A Generic Computational Intelligence Library: Preventing Insanity
Gary Pampará, Andries Engelbrecht

Thursday, December 10, 13:00–14:00

13:00 [Panel Discussion 2]: Ensuring Repeatable and Reliable CI
Panelists: Sanaz Mostaghim, Janusz Kacprzyk, Joshua Knowles, Paulo Lisboa, Paolo Rocca
Room: Audi 2
Chair: Sanaz Mostaghim
Summary: Computational Intelligence (CI) methods usually involve a random initialization, use stochastic operators, and involve algorithmic parameters that must often be tuned. Hence, an important question faced by CI researchers is on the issue of ensuring repeatable and reliable performance of CI methods in controlled as well as practical problem solving tasks. In this panel, eminent researchers will discuss various existing methodologies of ensuring repeatable and reliable performance of different CI methods, need for standardization, and other possible methods from statistics and contemporary fields.

13:00 CIS RSA Chapter Meeting
Room: 1.63

13:00 CFETC Meeting
Room: Boardroom
Thursday, December 10, 14:00–15:00

CIComms’15 Keynote Talk
Speaker: Andrea Massa Frontiers in Complex Engineering Optimization - The System-by-design Paradigm
14:00, Room: Audi 2
Chair: Paolo Rocca

CIHLI’15 Session: 1:
Thursday, December 10, 14:00–15:00, Room: 1.41
Chair: Jacek Mandziuk, Co-chair: Slawomir Zadrozny

14:00 [#1570192977] RoboCHAIR: Creative Assistant for Question Generation and Ranking
Senja Pollak, Borut Lesjak, Janez Kranjec, Vid Podpečan, Martin Znidaršič, Nada Lavrač

14:20 [#1570193215] Enhancing Environmental Surveillance Against Organised Crime with Radial Basis Neural Networks
Christian Napoli, Emiliano Tramontana, Marcin Woźniak

14:40 [#1570202855] A New Two-Stage Approach to the Multiaspect Text Categorization
Slawomir Zadrozny, Janusz Kacprzyk, Marek Gajewski

ICES’15 Session: 3: Evolvable Digital Systems
Thursday, December 10, 14:00–15:00, Room: 1.42
Chair: Andy Tyrrell

14:00 [#1570192267] An Evolutionary Strategy Based State Assignment for Area-Minimization Finite State Machines
Yanyun Tao, Lijun Zhang, Yuzhen Zhang

14:20 [#1570192079] Designing Polymorphic Circuits with Periodical Weight Adjustment
Houjun Liang, Rui Xie, Liang Chen

14:40 [#1570191729] Investigation of Replicating Tiles in Cellular Automata Designed by Evolution Using Conditionally Matching Rules
Michal Bidlo

SDE’15 Session: 1: Algorithmic Aspects of Differential Evolution
Thursday, December 10, 14:00–15:00, Room: 1.43
Chair: Ferrante Neri, Co-chair: Suresh Sundaram

14:00 [#1570191777] A Population Adaptation Mechanism for Differential Evolution Algorithm
Johanna Aalto, Jouni Lampinen

Petr Gajdos, Pavel Krömer, Ivan Zelinka

14:40 [#1570187733] Continuous Parameter Pools in Ensemble Differential Evolution
Giovanni Iacca, Fabio Caraffini, Ferrante Neri

CIASG’15 Session: 3: Demand Response
Thursday, December 10, 14:00–15:00, Room: 1.44
Chair: Zita Vale

14:00 [#1570193059] Demand Response Shifting Management Applied to Distributed Generation and Pumping
Diogo Sousa, Pedro Faria, Zita Vale

14:20 [#1570193199] Economic Impact of Demand Response in the Scheduling of Distributed Energy Resources
João Spinola, Pedro Faria, Zita Vale

14:40 [#1570192893] Quantum Particle Swarm Optimization Applied to Distinct Remuneration Approaches in Demand Response Programs
Fabio Pereira, João Soares, Pedro Faria, Zita Vale
CIDM’15 Session: 6: Advanced Data Mining Techniques
Thursday, December 10, 14:00–15:00, Room: 1.61
Chair: Friedhelm Schwenker

14:00 [#1570174967] On Accelerated Gradient Approximation for Least Square Regression with L1-regularization
Yongquan Zhang, Jianyong Sun

14:20 [#1570193289] Multi-Objective Genetic Programming for Dataset Similarity Induction
Jakub Smid, Klara Peskova, Martin Pilat, Roman Neruda

14:40 [#1570197693] On Perturbations of Multisets
Maciej Krawczak, Grażyna Szkatua

CIDM’15 Session: 7: Special Session: Analysis and Visualization of High-dimensional and Complex Data
Thursday, December 10, 14:00–15:00, Room: 1.62
Chair: Barbara Hammer, Co-chair: Frank-Michael Schleif, Alessio Micheli

14:00 [#1570171003] Model-Based Outlier Detection for Object-Relational Data
Fatemeh Riahi, Oliver Schulte

14:20 [#1570192941] Inferring Feature Relevances From Metric Learning
Alexander Schulz, Bassam Mokbel, Michael Biehl, Barbara Hammer

14:40 [#1570193131] Multiple Graph-Kernel Learning
Fabio Aiolli, Michele Donini, Nicolo Navarin, Alessandro Sperduti

CIES’15 Session: 1:
Thursday, December 10, 14:00–15:00, Room: 1.63
Chair: Rudolf Kruse, Co-chair: Vladik Kreinovich

14:00 [#1570166847] What is the Right Context for an Engineering Problem: Finding Such a Context is NP-Hard
Martine Ceberio, Vladik Kreinovich, Hung T. Nguyen, Songsak Sriboonchitta, Rujira Oncharoen

14:20 [#1570167961] In Engineering Classes, How to Assign Partial Credit: From Current Subjective Practice to Exact Formulas (Based on Computational Intelligence Ideas)
Joe Lorkowski, Vladik Kreinovich, Olga Kosheleva

Thursday, December 10, 15:20–17:00

CIHLI’15 Session: 2:
Thursday, December 10, 15:20–17:00, Room: 1.41
Chair: Sławomir Zadrożny, Co-chair: Jacek Maćdziuk

Emmanuelle-Anna Dietz, Steffen Hölldobler, Raphael Höps

15:40 [#1570189065] A Novel Approach Toward X-RAY Images Classifier
Marcin Woźniak, Dawid Polap, Leon Kośmider, Christian Napoli, Emiliano Tramontana

16:00 [#1570192459] Risk-Aware Project Scheduling for Projects with Varied Risk Levels
Karol Wałędzik, Jacek Maćdziuk, Sławomir Zadrożny

16:20 [#1570197747] Design Methodology for Rough Neuro-fuzzy Classification with Missing Data
Robert Nowicki, Bartosz Nowak, Rafał Scherer, Marcin Korytkowski

66
CIEL’15 Session: 1:
Thursday, December 10, 15:20–17:00, Room: 1.42
Chair: Jacomine Grobler, Co-chair: Achyut Tripathi

15:20  [#1570190559] Upper Limb Motor Skills Evaluation in Patients with Early Multiple Sclerosis Using the IDEA System
Alexandros Pino, Georgios Kouroupetroglou, Nikolaos Papatheodorou, Elisabeth Andreadou, Charalambos Papageorgiou

15:40  [#1570191633] Metric-Based Heuristic Space Diversity Management in a Meta-Hyper-Heuristic Framework
Jacomine Grobler, Andries Engelbrecht

16:00  [#1570194635] Evolving Non-linear Stacking Ensembles for Prediction of Go Player Attributes
Josef Moudřík, Roman Neruda

16:20  [#1570196317] Acoustic Event Classification Using Ensemble of One-Class Classifiers for Monitoring Application
Achyut Tripathi

16:40  [#1570197809] Block Sparse Representations in Modified Fuzzy C-Regression Model Clustering Algorithm for TS Fuzzy Model Identification
Tanmoy Dam, Alok Deb

SDE’15 Session: 2: Problem Oriented Design and Applications of Differential Evolution
Thursday, December 10, 15:20–17:00, Room: 1.43
Chair: Ferrante Neri, Co-chair: Jiri Jaros

Aboubakar Hameed, Anna Kononova, David Corne

15:40  [#1570189303] Improved Constructive Coevolutionary Differential Evolution for Large-Scale Optimisation
Emile Glorieux, Bo Svensson, Fredrik Danielsson, Bengt Lennartson

16:00  [#1570182065] DE vs. PSO: A Performance Assessment for Expensive Problems
Abdullah Al-Dujaili, Muhammad Rizwan Tanweer, Suresh Sundaram

16:20  [#1570191503] Adaptive Differential Evolution Applied to Point Matching 2D GIS Data
Noel Khan, Ferrante Neri, Samad Ahmadi

Jiri Jaros, Pavel Mensik

CIPLS’15 Session: 2:
Thursday, December 10, 15:20–17:00, Room: 1.44
Chair: Erwin Pesch

Wei Shi, Thomas Weise, Raymond Chiong, Bulent Catan

15:40  [#1570191475] Comparing a Weiszfeld’s-based Procedure and (1 + 1)-es for Solving the Planar Single-Facility Location-Routing Problem
Pepijn van Heiningen, Edgar Reehuis, Thomas Bück

16:00  [#1570196173] Crew Constrained Home Care Routing Problem with Time Windows
Basak Tozlu, Rebi Daldal, Bulent Catan, Tonguc Unbuyurt

16:20  [#1570181509] An Integrated Matching and Partitioning Problem with Applications in Intermodal Transport
Erwin Pesch, Dominik Kress, Sebastian Meiswinkel
### CIFEr’15 Session: 3: Portfolio Optimization & Hedging Strategies & The Bitcoin Market & Market Games
Thursday, December 10, 15:20–17:00, Room: 1.61
Chair: Katherine Malan

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Presenters</th>
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<tbody>
<tr>
<td>15:20</td>
<td>Constraint Handling Methods for Portfolio Optimization Using Particle Swarm Optimization</td>
<td>Stuart Reid, Katherine Malan</td>
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<td>15:40</td>
<td>Order Routing and Arbitrage Opportunities in a Multi-Market Trading Simulation</td>
<td>Andrew Todd, Peter Beling, William Scherer</td>
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<td>16:00</td>
<td>Bitcoin Market Return and Volatility Forecasting Using Transaction Network Flow Properties</td>
<td>Steve Yang, Jinhyoung Kim</td>
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<td>16:20</td>
<td>Discrete-time Quadratic-Optimal Hedging Strategies for European Contingent Claims</td>
<td>Easwar Subramanian, Sanjay Bhat</td>
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<tr>
<td>16:40</td>
<td>Winning in Retail Market Games: Relative Profit and Logit Demand</td>
<td>Jasper Hoogland, Mathijs De Weerdt, Han La Poutre</td>
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### CIDM’15 Session: 8: Special Session: Partially Supervised Learning
Thursday, December 10, 15:20–17:00, Room: 1.62
Chair: Sascha Meudt

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<tr>
<th>Time</th>
<th>Title</th>
<th>Presenters</th>
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<tr>
<td>15:20</td>
<td>Self-Configuring Ensemble of Neural Network Classifiers for Emotion Recognition in the Intelligent Human-Machine Interaction</td>
<td>Evgenii Sopov, Ilia Ivanov</td>
</tr>
<tr>
<td>15:40</td>
<td>Ensembles of Support Vector Data Description for Active Learning Based Annotation of Affective Corpora</td>
<td>Patrick Thiam, Markus Kächele, Friedhelm Schwenker, Guenther Palm</td>
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<tr>
<td>16:00</td>
<td>Applying Interval Type-2 Fuzzy Rule Based Classifiers Through a Cluster-Based Class Representation</td>
<td>Javier Navarro, Christian Wagner, Uwe Aickelin</td>
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### CIES’15 Session: 2:
Thursday, December 10, 15:20–17:00, Room: 1.63
Chair: Vladik Kreinovich, Co-chair: Rudolf Kruse

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<tr>
<th>Time</th>
<th>Title</th>
<th>Presenters</th>
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<tbody>
<tr>
<td>15:20</td>
<td>Computational Intelligence for Efficient Numerical Design of Structures with Uncertain Parameters</td>
<td>Wolfgang Graf, Marco Götz, Ferenc Leichsenring, Michael Kaliske</td>
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<tr>
<td>15:40</td>
<td>Acceptance-based Software Architecture Deployment for Improvement of Existing Applications</td>
<td>Hannes Klee, Michael Buchholz, Torben Materna, Klaus Dietmayer</td>
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<td>16:00</td>
<td>A Clustering Approach to a Major-Accident Data Set: Analysis of Key Interactions to Minimise Human Errors</td>
<td>Raphael Moura, Christoph Doell, Michael Beer, Rudolf Kruse</td>
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<tr>
<td>16:20</td>
<td>Computational Intelligence for Structural Identifications</td>
<td>Abdullah Al-Hussein, Achintya Haldar</td>
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<tr>
<td>16:40</td>
<td>Fault Diagnosis and Evaluation of the Performance of the Overcurrent Protection in Radial Distribution Networks Based on Wavelet Transform and Rule-based Expert System</td>
<td>Helton do Nascimento Alves</td>
</tr>
</tbody>
</table>
15:20  [#1570192867] Differential Evolution with Random Walk Mutation and an External Archive for Multimodal Optimization
   Yu-Hui Zhang, Yue-jiao Gong, Jun Zhang

15:40  [#1570191961] The Impact of Subcultures in Cultural Algorithm Problem Solving
   Robert G Reynolds, Yousof Gawasmeh, Areej Salaymeh

16:00  [#1570171835] A Modified Chaotic Firefly Algorithm for Solving Discrete Logarithm Problem and Analysis
   Mohit Mishra, Utkarsh Chaturvedi, K K Shukla, Roman Yampolskiy
Plenary Talks

Tuesday, December 8, 09:00

Controlling Swarms of Cooperating Robots

Marco Dorigo
Université Libre de Bruxelles, Belgium

Abstract

Swarm robotics is about constructing and controlling swarms of autonomous robots that cooperate to perform tasks that go beyond the capabilities of the single robots in the swarm. In this talk, I will give an overview of recent and ongoing research in swarm robotics in my research lab, IRIDIA, at the Université Libre de Bruxelles. In particular, I will present results obtained with homogeneous and heterogeneous swarms of robots that cooperate both physically and logically in search and retrieval tasks.

Biography

Marco Dorigo received his PhD in electronic engineering in 1992 from Politecnico di Milano, Italy, and the title of Agrégé de l’Enseignement Supérieur, from Université Libre de Bruxelles (ULB), in 1995. Since 1996, he has been a tenured Researcher of the fund for scientific research F.R.S.-FNRS of Belgium’s French Community, and a Research Director of IRIDIA, ULB. He is the inventor of the ant colony optimization metaheuristic. His current research interests include swarm intelligence and swarm robotics. He is the Editor-in-Chief of Swarm Intelligence. Dr. Dorigo is a IEEE, AAAI, and ECCAI Fellow. He was awarded the Italian Prize for Artificial Intelligence in 1996, the Marie Curie Excellence Award in 2003, the Dr. A. De LeeuwDamry-Bourlart award in applied sciences in 2005, the Cajastur International Prize for Soft Computing in 2007, and an ERC Advanced Grant in 2010. In 2015 he will receive the IEEE Frank Rosenblatt Award.
Wednesday, December 9, 08:30
Large Scale Global Optimisation Through Co-operative Co-evolution

Xin Yao
University of Birmingham, United Kingdom

Abstract

Evolutionary optimisation has moved on in recent years from optimising just a few dozens of real-valued variables, although they are still challenging problems. This talk will give a brief overview of some recent efforts towards large scale global optimisation (LSGO) using co-operative co-evolution. Starting the journey from one of the first efforts in optimising problems with up to 1000 real-valued variables, we illustrate new challenges posed by such problems to evolutionary computation approaches and how co-operative co-evolution could be harnessed to address some of those challenges. Then we focus on one of the key issues in LSGO by co-operative co-evolution — automatic grouping of variables into different co-evolving sub-populations. This is actually a generic and important issue of learning and understanding problem characteristics, especially the interactions among variables. In practice, there is a trade-off to be made between the time we spend on learning problem characteristics and the time we spend on optimisation. Learning makes sense only if the learned information helps to speed up the optimisation more than the time spent on learning. Unfortunately, little is known about the best trade-off. Much work has been based on computational studies, from simple random grouping, which is very fast, to more sophisticated differential grouping, which takes more time in learning. Such grouping methods are not restricted to any particular optimisers used. They can be used in conventional evolutionary algorithms, as well as differential evolution and particle swarm optimisation. Similar ideas are applicable to combinatorial optimisation too. This talk will end with a brief discussion of future research directions and how nature inspiration should be considered in problem-solving, e.g., optimisation.

Biography

Xin Yao is a Professor of Computer Science at the University of Birmingham, UK. His main research interests include evolutionary computation and ensemble learning. He has had a long-term interest in co-evolution since early 1990s, both for optimisation and learning. He has always been keen on framing co-evolution as an automatic approach to divide-and-conquer in problem solving. His recent work on large scale global optimisation (LSGO) started in 2008, covering more “conventional” evolutionary algorithms as well as estimation of distribution algorithms for either numerical or combinatorial optimisation. Closely related to his practical interest in scaling up evolutionary algorithms, he is also interested in time complexity of evolutionary algorithms, i.e., a more theoretical aspect of scalability.
Computational intelligence (CI) models are often evaluated on the basis of predictive performance, lacking appropriate consideration of other aspects than association which might make a claim to the intelligence of the model. Yet appearances can be deceiving, especially with summary performance measures e.g. AUROC. This is especially the case for non-linear models given their ability to exploit any weaknesses in the data, for instance structural artefacts which add a confounding effect over and above the presence of noise. In addition, many applied CI models work well for well classified cases but cannot explain predictions for borderline cases. In other words, they confirm to expert users what they already know but do not add insights to the data in the difficult cases for which CI is most needed. The talk will illustrate some of the pitfalls in the design and validation of databased models. It will then explore principled approaches to interpreting neural networks using theoretical methodologies applied to the often opaque maximal separation models driven by computational learning theory and also probabilistic non-linear models from which the geometry of data spaces can be derived. Some important general questions will be explored including the derivation of nomograms for non-linear models, efficiency and interpretability of rule induction, but also a radically different approach to user interfaces for probabilistic classifiers by deriving statistically principled intelligent query systems for case-based reasoning. These models find particular application in clinical medicine where examples will illustrate tumour delineation and detection of response treatment from brain spectroscopy.

Biography

Paulo Lisboa is Professor in Industrial Mathematics at Liverpool John Moores University and Research Professor at St Helens & Knowsley Teaching Hospitals. He is Fellow of the IMA (Institute of Mathematics & its Applications, UK), Fellow of the IET (Institute of Engineering and Technology, UK) and chair of the Medical Data Analysis Task Force in the Data Mining Technical Committee of the IEEE-CIS. He is on the Advisory Group for Societal Challenge 1: Health, Demographics and Wellbeing in Horizon 2020, the largest coordinated funding programme of health-related research in Europe, which combines medicine and ICT. His research interests are computer-based decision support and data analytics in clinical medicine, public health and sports science, as well as computational marketing. The current focus of interest is on principled approaches to interpret non-linear models. He has over 250 refereed publications with awards for citations and is Associate Editor for IET Science Measurement and Technology, Neural Computing Applications, Applied Soft Computing and Source Code for Biology and Medicine.
Keynote Talks

Tuesday, December 8, 10:20

Statistical Simulation Algorithms for General Video Game AI

Simon Lucas
University of Essex, United Kingdom

Abstract

Monte Carlo Tree Search (MCTS) has revolutionised AI for classic board games such as Go, and more recently has been applied with some promising results to controlling agents in real-time video games. Where a forward model that can be run much faster than real-time is available, this can be applied to build game agent controllers that can operate across a variety of games with out being specifically programmed for any particular game.

Recently it has been shown that evolutionary algorithms applied in a rolling horizon way, much like MCTS, can achieve similar performance while perhaps being simpler to implement and easier to adapt. Some of the problems involved with real-time agents (including massive branching factors, limited horizon depth, limited roll-out budget and flat reward landscape) will be covered together with possible outline solutions.

The talk will also report on the General Video Game AI Competition series which offers a way to objectively compare these algorithms across a variety of games and implemented by a diverse set of researchers (see http://gvgai.net), and offers a great challenge for computational intelligence research.

Biography

Simon Lucas is a professor of Computer Science in the School of Computer Science and Electronic Engineering at the University of Essex (UK) where he is the Head of School and leads the Game Intelligence Group. He holds a PhD degree (1991) in Electronics and Computer Science from the University of Southampton. His main research interests are games, evolutionary computation, and machine learning, and he has published widely in these fields with over 180 peer-reviewed papers. He is the inventor of the scanning ntuple classifier, is the founding Editor-in-Chief of the IEEE Transactions on Computational Intelligence and AI in Games and co-founded the IEEE Conference on Computational Intelligence and Games. His main research area now is developing and applying computational intelligence techniques to build better game AI, better games, and provide deep insights into the nature of intelligence.
Tuesday, December 8, 11:00
Valuing American Options using Fast Recursive Projections

Olivier Scaillet
Université de Genève and Swiss Finance Institute, Switzerland

Abstract

This keynote introduces a new numerical option pricing method by fast recursive projections. The projection step consists in representing the payoff and the state price density with a fast discrete transform based on a simple grid sampling. The recursive step consists in transmitting coefficients of the representation from one date to the previous one by an explicit recursion formula. We characterize the convergence rate of the computed option price. Numerical illustrations with different American and Bermudan payoffs with discrete dividend paying stocks in the Black-Scholes and Heston models show that the method is fast, accurate, and general. We apply our recursive projection method with the models of Black-Scholes, Merton and Heston on a sample of call options on stocks with quarterly dividends during the period January 1996 through December 2012. We illustrate that the choice of the model is important for both the early exercise decision and for the quantification of the dollar amount that the buyer of the option forgoes when he fails to optimally exercise to the advantage of the seller.

Biography

Olivier Scaillet, Belgian, is professor of finance and statistics at the Geneva Finance Research Institute of the University of Geneva and has a senior chair at the Swiss Finance Institute. He holds both a master and Ph.D. from University Paris IX Dauphine in applied mathematics. Professor Scaillet’s research expertise is in the area of derivatives pricing, econometric theory and econometrics applied to finance and insurance. He has published several papers in top journals in econometrics and finance, and co-authored a book on financial econometrics. He has been one of the winners of the bi-annual award for the best paper published in the Journal of Empirical Finance on the topic of quantitative risk management and of the Banque Prive Espirito Santo award prize on the topic of mutual fund performance. He is associate editor of several leading academic journals in econometrics, statistics, banking and finance. He is an advisor for research teams in the finance and banking industry.
Abstract

Prototype-based learning techniques enjoy a wide popularity due to their intuitive training and model interpretability. Applications include biomedical data analysis, image classification, or fault detection in technical systems. Recently, first promising attempts incorporate such models into the domain of intelligent tutoring systems (ITS): in a nutshell, ITSs provide automated, personalised feedback to learners when performing some learning task such as learning how to program. Here a challenge is to avoid time-consuming expert generation of how to provide such feedback; machine learning technology offers promising ways to automate this process, specifically, prototype-based methods enable an automatic feedback generation by highlighting prototype solutions given a learner solution. This strategy relies on the core property of such models that they represent data in terms of typical representatives. Within the talk, we will mainly focus on modern variants of so-called learning vector quantization (LVQ) due to their strong learning theoretical background and exact mathematical derivative from explicit cost functions.

The use of LVQ in ITSs faces two challenges: 1) Data are typically non-vectorial, e.g. structured data such as sequences are present; since classical LVQ models have been designed for euclidean vectors only, the question is how to extend LVQ technology towards non-vectorial data. We will present relational extensions of LVQ technology which enable its use for proximity data as provided by structure metrics such as alignment in a very generic way. 2) Structure metrics crucially depend on model parameters such as the scoring function, and their optimum choice is not clear. Still, the accuracy of such models crucially depends on a correct choice of these metric parameters. We will present recent results which allow to adjust structure metric parameters autonomously based on the given data and learning task only.

Biography

Barbara Hammer received her Ph.D. in Computer Science in 1995 and her venia legendi in Computer Science in 2003, both from the University of Osnabrueck, Germany. From 2000-2004, she was chair of the junior research group 'Learning with Neural Methods on Structured Data' at University of Osnabrueck before accepting an offer as professor for Theoretical Computer Science at Clausthal University of Technology, Germany, in 2004. Since 2010, she is holding a professorship for Theoretical Computer Science for Cognitive Systems at the CITEC cluster of excellence at Bielefeld University, Germany. Several research stays have taken her to Italy, U.K., India, France, the Netherlands, and the U.S.A. Her areas of expertise include hybrid systems, self-organizing maps, clustering, and recurrent networks as well as applications in bioinformatics, industrial process monitoring, or cognitive science. She has been chairing the IEEE CIS Technical Committee on Data Mining in 2013 and 2014, and she is chair of the Fachgruppe Neural Networks of the GI and vice-chair of the GNNS. She has published more than 200 contributions to international conferences / journals, and she is coauthor/editor of four books.
Impact of Big Data on Computational Intelligence Aspects of Cyber Security and the Computing Environment to Support Repeatable Scientific Experimentation

Robert Abercrombie
Oak Ridge National Laboratory (ORNL), Oak Ridge, USA

Abstract

Big Data is being generated by everything around us at all times. Every digital process and social media exchange produces it. Systems, sensors and mobile devices transmit it. Big data is arriving from multiple sources at an alarming velocity, volume and variety. To extract meaningful value from big data, today’s scientists need optimal processing power, analytics capabilities and skills. Advances in information and communications technologies (ICT) have transformed the way citizens, business, and governments interact, collaborate, and conduct business. ICT form the backbone of many aspects of the critical infrastructure sectors, particularly in technologically advanced countries. The interdependencies between critical infrastructure sectors in one or more countries can potentially lead to large-scale (or global) systemic failures, resulting in loss of human life and social unrest. Securing our cyberspace and critical infrastructure (a nation’s strategic national assets) is important in order to ensure economic growth, prosperity, and safety; and is recognized as one of the great Grand Challenges and will continue to be of importance in the foreseeable future. This process must have scientific rigor applied to it to ensure a repeatable proven successful solution. ICT security has become a business priority. The US government recognized this as evidenced by recent significant budget increases in cyber security. Business organizations are investing enormous resources (money, time and human capital) in security activities. A principal tenant of the scientific method is that experiments must be repeatable and relies on ceteris paribus (i.e., all other things being equal). As a scientific community, involved in data sciences and cyber security, researchers must investigate ways to establish an environment where experiments can be repeated. We can no longer allude to where the data comes from, we must add rigor to the data collection and management process from which our analysis is conducted. This keynote describes a computing environment to support repeatable scientific big data experimentation, in order to provide value to investigators from government agencies, academic institutions, and industry entities. The described computing environment also adheres to the recently instituted digital data management plan mandated by multiple US government agencies, which involves all stages of the digital data life cycle including capture, analysis, sharing, and preservation. It particularly focuses on the sharing and preservation of digital research data. This keynote supports the theme of 2015 IEEE CICS in that Computational Intelligent (CI) techniques have demonstrated to enhance cyber security measures, and have been increasingly applied in the area of information security and information assurance. Moreover, the multi-faceted CI approaches are beginning to provide a new security paradigm to deal with influx of new threats in a large network of computers. These approaches can also be used to augment defense-in-depth architectures and to add necessary security enhancements to the design, implementation and operation of legacy and future cyber-enabled systems.

Biography

Robert (Bob) K. Abercrombie is Co-Director, Computational Intelligence Behavior Modeling Laboratory, S&T Manager in the Computational Sciences and Engineering Division, Oak Ridge National Laboratory (ORNL), Oak Ridge, TN USA. Additionally he has a joint faculty appointment with the Graduate School and Department of Computer Science, The University of Memphis, collaborating with the Center for Information Assurance, the Center for Earthquake Research and Information and the Systems Testing Excellence Program. He is also Program Manager/Principal Investigator at ORNL with extensive experience in all phases of program and project life cycle management from requirements definition through retirement and closeout of system. Additional interests include technical management of R&D multi-disciplinary complex endeavors, their supply chain management and associated cyber security related endeavors. He has previously conducted research and managed military, government and civilian projects dealing the characterization of vehicles and associated cargo. In recent years, his research interests and endeavors include cyber security and information...
assurance technologies in secure environments and transitioning this research to the private sector via ORNL technology transfer process. Current research efforts deal with developing break-through approaches for analytic capabilities that work across heterogeneous data sets and addressing the necessary computational intelligence techniques to address cyber security, big data analytics, and applications of theories of emergence.

Dr. Abercrombie is a Senior Member of IEEE, Senior Member of IEEE Computational Intelligence Society, Senior Member, IEEE Computer Society, Member of ACM, and Founding Member of International Society for Weigh-In-Motion (ISWIM).
Cognitive Robotics: Recent Developments and Futuristic Trends

Er Meng Joo
Nanyang Technological University, Singapore

Abstract

The quest for building human-like intelligence has gained enormous momentum in recent decades. Since the seminal works on Artificial Intelligence (AI), the desire of realizing the quest has become stronger. With the rapid developments in Science, Engineering and Technology, machines that mimic human intelligence have become a reality and sometimes indispensable parts in our daily life, such as Apple Siri and Google Voice. Cognition is a group of mental processes that include attention, memory, producing and understanding language, solving problems and making decisions and making decisions. Cognitive robotics is concerned with endowing robots with intelligent behavior by providing a processing architecture that will allow it to learn and reason about how to behave in response to complex goals in a complex world. In this talk, recent developments of cognitive robotics with applications in the healthcare industry, domestic services, etc will be reviewed. The futuristic trends and challenges will also be discussed.

Biography

Professor Er Meng Joo is currently a Full Professor in Electrical and Electronic Engineering, Nanyang Technological University, Singapore. He has authored 5 books, 16 book chapters and more than 500 refereed journal and conference papers in his research areas of interest. His areas of research interests are Intelligent control theory and applications, computational intelligence, robotics and automation, sensor networks, biomedical engineering and cognitive science. In recognition of the significant and impactful contributions to Singapore's development by his research project entitled Development of Intelligent Techniques for Modelling, Controlling and Optimizing Complex Manufacturing Systems, Professor Er won the Institution of Engineers, Singapore (IES) Prestigious Engineering Achievement Award 2011. He is also the only dual winner in Singapore IES Prestigious Publication Award in Application (1996) and IES Prestigious Publication Award in Theory (2001). He received the Teacher of the Year Award for the School of EEE in 1999, School of EEE Year 2 Teaching Excellence Award in 2008, the Most Zealous Professor of the Year Award 2009 and Outstanding Mentor Award 2014. He also received the Best Session Presentation Award at the World Congress on Computational Intelligence in 2006 and the Best Presentation Award at the International Symposium on Extreme Learning Machine 2012. Under his leadership as Chairman of the IEEE CIS Singapore Chapter from 2009 to 2011, the Singapore Chapter won the CIS Outstanding Chapter Award 2012. In recognition of his outstanding contributions to professional bodies, he was bestowed the IEEE Outstanding Volunteer Award (Singapore Section) and the IES Silver Medal in 2011. On top of this, he has more than 50 awards at international and local competitions. Currently, Professor Er serves as the Editor-in-Chief of 2 international journals, namely the Transactions on Machine Learning and Artificial Intelligence and International Journal of Electrical and Electronic Engineering and Telecommunications, an Area Editor of International Journal of Intelligent Systems Science, an Associate Editor of thirteen refereed international journals including the IEEE Transaction on Fuzzy Systems and IEEE Transactions on Cybernetics as well as an editorial board member of the EE Times. Professor Er is a highly sought-after speaker and he has been invited to deliver more than 60 keynote speeches and invited talks overseas. Due to outstanding achievements in research and education, he is listed in Whos Who in Engineering Singapore, Second Edition, 2013.
Wednesday, December 9, 09:50
Planning and Scheduling Models in Intermodal Transport Optimization

Erwin Pesch
University of Siegen, Germany

Abstract

Attracting a higher share of freight traffic on rail requires freight handling in railway yards that is more efficient, and which includes technical innovations as well as the development of suitable optimization approaches and decision-support systems. In this talk we will review some planning and scheduling problems of container processing in railway yards, and analyze basic decision problems and solution approaches for the two most important yard types: conventional rail road and modern rail -rail transshipmetnt yards. We introduce new matching problems that generalize container assignment in railway yards and sea ports. Furthermore, we review some of the relevant literature and identify open research challenges. Additionally we address a scheduling problem that arises in intermodal container transportation, where containers need to be transported between shipper or receiver customers and container terminals (rail or maritime) and vice versa. The solution method can be applied to other problems as well.

Biography

Erwin Pesch holds a Chair in Management Information Sciences at the University of Siegen. He was employed as a Software Engineer at the Commerzbank AG and worked from 1989 to 2001 as an Assistant Professor at the Faculty of Economics and Business Administration of the University in Maastricht and as a Professor at the Institute of Economics of the University in Bonn. He holds a Ph.D. in Mathematics and a Habilitation in Business Administration both from the Technical University Darmstadt. His research areas are in Logistics, Management Information and Decision Support Systems, Project Management and Scheduling many of which are closely related to various industrial projects. He is author or co-author of 5 books and has published more than 150 papers in many international journals, among others in Mathematical Programming, Artificial Intelligence, Management Science, Journal of Combinatorarial Theory, Journal of Graph Theory, IEEE Transactions on Robotics and Automation, Discrete Mathematics, Discrete Applied Mathematics, and serves on the editorial boards of 12 international journals including INFORMS Journal on Computing, Journal of Scheduling, European Journal of Operational Research, Operations Research Letters. He received many Federal Grants from the German National Science Foundation (DFG) and for more than 10 years always achieved leading positions in citation analysis and publication based rankings in German speaking countries. In 2008 he got the Award of the Polish Minister for Research and Education and obtained the prestigious Copernicus Award (with J. Blazewicz) in 2012.
Wednesday, December 9, 10:30
Complex Behaviour in Artificial Life

Terry Bossomaier
Charles Sturt University, Australia

Abstract

Artificial Life systems frequently display, interesting dynamic behaviour. An early example was Conways Game of Life. Reynolds flocking of boids introduced coherent flock dynamics from simple rules. However, finding metrics for such complex dynamical behaviour has proved illusive. Information theory has shown a lot of promise since Langton’s original work on cellular automata. This talk will review its application across a range of ALife systems, from networks to flocking behaviour.

Biography

Terry Bossomaier is the Strategic Research Professor in the Faculty of Business at Charles Sturt University. His research interests are very diverse, ranging from vision to high performance computing. He co-founded the Asia-Pacific Complex Systems conferences, which have run biennially since the early 90s. At Charles Sturt University he set up the Centre for Research in Complex Systems (CRiCS) and has run a series of complex systems research summer schools since 1998. His current research interests focus on the agent based modelling of socio economics systems and information-theoretic approaches to studying tipping points. He has published numerous articles range of fields from biological vision to high performance and parallel computing and is a co-author/editor of five books and is just completing a book on information flow in complex systems.
Wednesday, December 9, 11:10

Automation vs Intuition in MCDM

Joshua Knowles

University of Birmingham, United Kingdom

Abstract

Advances in the automatic design and configuration of algorithms over the past 5-10 years show considerable promise in delivering high-performance optimization methods, including for non-expert users. Automation brings further benefits in setting and raising standards of algorithm evaluation (replicability), and is a crucible for true design understanding.

When we consider MCDM and MOO methods, automation seems more challenging and fraught because human preferences, learning, and even intuition play a role. What do we stand to gain and lose from automating MCDMO design, is it even possible, and what is the way forward?

Biography

Joshua Knowles is Professor of Natural Computation at the School of Computer Science, University of Birmingham, UK. He graduated with a PhD from University of Reading, UK, in 2002, following degrees in Physics, and Information Systems Engineering.

Professor Knowles main research interests are computational intelligence, multi-objective optimization, and expensive black-box problems. He is known for early EMO work especially developing the PAES algorithm (with David Corne) and the technique 'multiobjectivization' (with Richard Watson and David Corne), and more recently the ParEGO algorithm for expensive multiobjective problems, and MOCK (with Julia Handl) a powerful multiobjective clustering and model selection method. Joshua’s applied work, mostly in computational biochemistry, has included the optimization of analytical instruments, evolution of combinatorial drug therapies, and the directed evolution of DNA 'aptamers' (all done with physical experiments in the optimization loop). To date, he has published approx.120 articles in conferences, journals and books, attracting over 12,500 citations (h-index=51).

Professor Knowles has twice won the annual Outstanding Paper Award of the Transactions on Evolutionary Computation from IEEE Computational Intelligence Society, as well as fellowships from BBSRC and the European Commission. He is an editorial board member of Evolutionary Computation journal, co-chair of the 2015 Dagstuhl Seminar on Understanding Complexity in Multiobjective Optimisation, and a member of the Steering committee of the EMO series of international conferences.
Abstract

Autonomous robots that can assist humans in situations of daily life have been a long standing vision of robotics, artificial intelligence, and cognitive sciences. A first step towards this goal is to create robots that can learn tasks triggered by environmental context or higher level instruction. However, learning techniques have yet to live up to this promise as only few methods manage to scale to high-dimensional manipulator or humanoid robots. In this talk, we investigate a general framework suitable for learning motor skills in robotics which is based on the principles behind many analytical robotics approaches. It involves generating a representation of motor skills by parameterized motor primitive policies acting as building blocks of movement generation, and a learned task execution module that transforms these movements into motor commands. We discuss learning on three different levels of abstraction, i.e., learning for accurate control is needed to execute, learning of motor primitives is needed to acquire simple movements, and learning of the task-dependent hyperparameters of these motor primitives allows learning complex tasks. We discuss task-appropriate learning approaches for imitation learning, model learning and reinforcement learning for robots with many degrees of freedom. Empirical evaluations on a several robot systems illustrate the effectiveness and applicability to learning control on an anthropomorphic robot arm. These robot motor skills range from toy examples (e.g., paddling a ball, ball-in-a-cup) to playing robot table tennis against a human being and manipulation of various objects.

Biography

Jan Peters is a full professor (W3) for Intelligent Autonomous Systems at the Computer Science Department of the Technische Universitaet Darmstadt and at the same time a senior research scientist and group leader at the Max-Planck Institute for Intelligent Systems, where he heads the interdepartmental Robot Learning Group. Jan Peters has received the Dick Volz Best 2007 US PhD Thesis Runner-Up Award, the Robotics: Science & Systems - Early Career Spotlight, the INNS Young Investigator Award, and the IEEE Robotics & Automation Societys Early Career Award. In 2015, he was awarded an ERC Starting Grant. Jan Peters has studied Computer Science, Electrical, Mechanical and Control Engineering at TU Munich and FernUni Hagen in Germany, at the National University of Singapore (NUS) and the University of Southern California (USC). He has received four Masters degrees in these disciplines as well as a Computer Science PhD from USC.
Computational Intelligence Based Controllers for Real-Time Control in Power Systems

Om Malik
University of Calgary, Canada

Abstract

Conventional and linear optimal controllers are based on the deterministic control theory. They are designed using a linear system model obtained for a particular operating condition. The non-linear nature, wide range of operating conditions and the non-deterministic properties of most large systems, such as power systems, present problems to the conventional controllers. Adaptive control theory offers an approach to design a controller that can mitigate these problems. Developments in digital technology have made it feasible to develop and implement improved controllers based on modern more sophisticated techniques. The strength of this approach will be illustrated using power system stabilizer as an application example. Design of controllers based on computational intelligence techniques, such as neural networks and fuzzy logic, will be described. The performance of such controllers by both simulation studies on single machine and multi-machine power systems, and real-time tests on physical models of single machine-infinite bus systems will also be illustrated.

Biography

Professor Om P. Malik has done pioneering work in the development of controllers for application in electric power systems and wind power generation over the past 45 years. After extensive testing, these controllers are now employed on large generating units. He has published over 700 papers including over 360 papers in international Journals and is the coauthor of two books. Professor Malik graduated in 1952 from Delhi Polytechnic. After working for nine years in electric utilities in India, he obtained a Masters Degree from Roorkee University in 1962, a Ph.D. from London University and a DIC from the Imperial College, London in 1965. He was teaching and doing research in Canada from 1966 to 1997 and continues to do research as Professor Emeritus at the University of Calgary. Over 100, including 45 Ph.D., students have graduated under his supervision. Professor Malik is a Life Fellow of IEEE, and a Fellow of IET, the Engineering Institute of Canada, Canadian Academy of Engineering, Engineers Canada and World Innovation Foundation. He is a registered Professional Engineer in Alberta and Ontario, Canada, and has received many awards. He was Director, IEEE Region 7 and President, IEEE Canada during 2010-11. Currently, he is President, Engineering Institute of Canada.
Wednesday, December 9, 14:20

Evolutionary Design for Approximate Computing: Trading Accuracy for Energy Efficiency and Performance in Circuits and Programs

Lukas Sekanina
Brno University of Technology, Czech Republic

Abstract

Approximate computing is a new design paradigm emerging as a response to the growing need for performance and energy efficiency of computing systems. It exploits the fact that the requirement of perfect functional behavior can be relaxed in some applications because they are inherently error resilient (consider, for example, multimedia and data mining applications). The error can be used as a design metric and traded for area, delay, throughput or power consumption. An open question is how to systematically approximate hardware (electronic circuits) and software. Evolutionary computing (EC) seems to be a promising method in this area because it is capable of delivering efficient circuit designs in terms of a multi-objective design scenario, where circuits displaying the best tradeoff among key parameters are automatically sought. This talk will present some EC-based methods developed to digital circuit approximation. We will also deal with the scalability problems of evolutionary circuit design and present methods (based on formal verification and various acceleration techniques) enabling us to evolve/approximate complex digital circuits. Finally, we will discuss the relation between genetic improvement and approximation of software.

Biography

Lukas Sekanina received the Ing. and Ph.D. degrees from Brno University of Technology, Brno, Czech Republic, in 1999 and 2002, respectively. He is a Full Professor with the Faculty of Information Technology, Brno University of Technology. His research interests include evolutionary design, evolvable hardware and approximate computing. In these areas, he co-authored over 150 papers. He received a Fulbright Scholarship to work with NASA Jet Propulsion Laboratory, Caltech, USA, in 2004. He was a visiting professor with Pennsylvania State University, USA in 2001, Universidad Politecnica de Madrid, CEI, Spain in 2012 and a visiting researcher with the University of Oslo, Norway, in 2001. He was an Associate Editor of IEEE Transactions on Evolutionary Computation and an Editorial Board Member of Genetic Programming and Evolvable Machines and International Journal of Innovative Computing and Applications. He is a senior member of IEEE.
Monte Carlo Tree Search

Tristan Cazenave
Dauphine Universite Paris, France

Abstract

Monte Carlo Tree Search is a family of algorithms that improved greatly the state of the art in multiple games and optimization problems. This talk will address its application to games such as Go and General Game Playing. Nested Monte Carlo Search is a related algorithm for optimization problems. We will describe how it broke world records for puzzles, mathematical problems and expression discovery.

Biography

Tristan Cazenave is professor of computer science at LAMSADE, University Paris-Dauphine. He does research in Artificial Intelligence for games and optimization using Monte Carlo Tree Search and heuristic search.
Thursday, December 10, 10:30
Computational Intelligence in Smart Grids

Ralf Mikut
Karlsruhe Institute of Technology, Germany

Abstract

Future energy systems will be characterized by an increasing proportion of fluctuating renewable energy sources, including solar and wind energy. As an example, the German energy master plan called “Energiewende” assumes a share of more than 80% of renewable power generation until 2050. This requires a complete redesign of the energy system with steps to a closer integration of different types of energy (power, gas, heat, steam etc.), the use of storage and conversion strategies, new policies and market designs, demand-side and demand-response strategies to influence the consumption behavior, and an increasing decentralization of generation and storage. To guarantee a stable and reliable behavior of such systems, the stepwise launching of so-called smart grids was proposed to collect and exploit information of decentralized generation, consumption, transmission and storage units. To establish smart grids, some existing grids have been equipped with smart meter technology and/or experimental market policies and further projects addressing different aspects and scales are in the planning and implementation phase. Such smart grids have started collecting large datasets, mainly in form of time series with different sampling periods. Modeling approaches include first principle methods based on physical knowledge (e.g., for wind farms) as well as data-driven approaches based on meteorological forecasts and smart grid time series. The models are needed for understanding the underlying systems and for short- and midterm predictions as part of optimization and control algorithms to balance energy generation, consumption, and storage in decentralized systems. Computational Intelligence (CI) approaches including fuzzy clustering, Artificial Neural Networks, and Evolutionary Algorithms are strong candidates to support data-driven modeling and forecasts as well as many decentralized optimization tasks. The aim of this plenary talk is to give a survey of future trend scenarios of smart grids with a special focus on data-driven modeling with CI approaches. In addition, personal experiences will be highlighted in the analysis of terabyte-scale smart meter datasets with high time resolution in the kHz range, in the modeling of demand response strategies using fuzzy clustering and regressions methods, and in the prediction of price-influenced load changes. Finally, publicly available datasets such as smart meter data from Olympic Peninsula Project1, phasor measurement units from the EPFL Lausanne in Switzerland2 and solar power data from the Ausgrid Solar Home Electricity Data3 will be discussed to encourage the CI community to apply and to improve algorithms in the scope of this emerging field of research.

Biography

Ralf Mikut is head of the group for Automated Image and Data Analysis at the Institute for Applied Computer Science and Professor at the Faculty for Mechanical Engineering at the Karlsruhe Institute of Technology (KIT), Germany. In addition, he is responsible for the Topic “Big Data” in the “Energy Lab 2.0” project sponsored by the Helmholtz Association, the German Federal Ministry of Education and Research (BMBF) and the Ministry of Science, Research and Art (MWK) of the State of Baden-Württemberg in Germany. He holds a masters degree in Automatic Control of TU Dresden and a Ph.D. degree and Habilitation degree in Mechanical Engineering from the University of Karlsruhe.

Prof. Mikut co-authored 69 peer-reviewed journal papers as well as numerous book chapters and conference papers. His research interests include general and customized Computational Intelligence, data mining and image processing algorithms for a wide range of applications from life sciences to engineering. He is Associate Editor of IEEE Transactions on Fuzzy Systems, editorial board member of the German journal at-Automatisierungstechnik. In addition, he was program committee member of FUZZ-IEEE, IEEE SSCI, SMPS and PPSN conferences and Chair of the Expert Committees “Fuzzy Control” and “Computational Intelligence” of the German Society for Measurement and Automatic Control.
Evolutionary algorithms (EAs) have been long believed to have great potential for ensemble learning, as a base learner of an ensemble can be naturally viewed/regarded as an individual of the population of an EA. Previous applications of EAs to ensemble learning are largely focused on relatively traditional learning tasks, e.g., classification problems for which the prior distribution of classes are fixed and balanced. This talk will introduce our recent progress on utilizing EAs to construct classifier ensembles for problems with uncertain (likely to be imbalanced) class prior distributions and even uncertain misclassification costs. Specifically, with the Receiver Operating Characteristic (ROC) analysis as a bridge, we will show that a number of Multi-Objective evolutionary approaches outperform the state-of-the-art methods from the machine learning area on this family of problems.

Abstract

Biography

Ke Tang is currently a Full Professor at the School of Computer Science and Technology, University of Science and Technology of China. He has authored/co-authored more than 100 refereed publications. His major research interests include evolutionary computation and machine learning. He has been conducting research on ensemble learning for more than 10 years. He is an Associate Editor or Editorial Board Member of the IEEE Computational Intelligence Magazine, Computational Optimization and Applications (Springer), Natural Computing (Springer) and Memetic Computing (Springer). He has also served for seven international conferences as program/technical chair/co-chair, including the IEEE CEC2010 and IEEE CEC2013. He is a member of the IEEE Computational Intelligence Society (CIS) Evolutionary Computation Technical Committee and the IEEE CIS Emergent Technologies Technical Committee.
The design of real-world complex engineering systems has recently shifted from ad-hoc strategies based on the designers’ experience to optimization based search methods. The introduction of such techniques has been enabled by the availability of huge computational resources as well as the existence of efficient simulation tools that reliably evaluate the quality of the guess solutions. Nevertheless, several synthesis problems still remain computationally intractable (i.e., their optimization through iterative procedures requires months/years). Moreover, this class of problems is becoming more and more important because of increasing demand for advanced systems operating across different scales (e.g., combining nano- to macro-scale) and involving multiple disciplines (e.g., physics, engineering, cognitive sciences). In this framework, the aim of this Talk is to discuss the fundamental engineering challenge of the curse of dimensionality in complex systems design and to present a new general-purpose and flexible engineering optimization paradigm, namely the System-by-Design (SbD). The foundations of this paradigm are the description of a complex system in terms of a set of hierarchical layers (e.g., architecture, geometry, material, etc.), the identification of the degrees-of-freedom (DoFs) of each layer, and the customization and development of suitable synthesis tools able to exploit these DoFs in an effective and computationally efficient way.
Abstracts

Tuesday, December 8, 10:00–12:20

CICA’15 Session: 1: Fuzzy System Identification and Control
Tuesday, December 8, 10:20–12:20, Room: 1.41
Chair: Ginalber Serra, Co-chair: Alok Deb

10:20 [#1570188045] Self-Tuning Robust Stability Fuzzy Digital Controller
Serra, Ginalber; Costa, Edison;
A self-tuning fuzzy control methodology via particle swarm optimization based on robust stability criterion, is proposed. The plant to be controlled is modeled considering a Takagi-Sugeno (TS) fuzzy structure from input-output experimental data, by using the fuzzy C-Means clustering algorithm (antecedent parameters estimation) and weighted recursive least squares (WRLS) algorithm (consequent parameters estimation), respectively. An adaptation mechanism based on particle swarm optimization is used to tune recursively the parameters of a model based fuzzy PID controller, from the gain and phase margins specifications. Computational results for adaptive fuzzy control of a thermal plant with time varying delay is presented to illustrate the efficiency and applicability of the proposed methodology.

10:40 [#1570191285] Scalable Hierarchical Clustering: Twister Tries with a Posteriori Trie Elimination
Sulaiman, Noor; Othman, Mohd; Abdullah, Hayati;
The objective of this work is to develop and implement a fuzzy controller and fuzzy fault detection for centralized chilled water system. Both controller and fault detector are implemented in supply air dampers of air handling unit (AHU). A few cases are tested in this paper to investigate the effectiveness of the developed systems. All simulation is carried out using MATLAB/SIMULINK. Results illustrate that the fuzzy controller is able to maintain rooms’ temperature according to desired temperature whereas the fault detection can detect unusual behavior in supply air flowrate.

11:00 [#1570196363] A Novel Data Knowledge Representation with Collaborative Fuzzy Transfer Rule for Takagi Sugeno Kang Type Model
Prasad, Mukesh; Er, Meng Joo; Lin, Chin Teng; Prasad, Om Kumar; Mohanty, Manoranjan; Singh, Jagendra;
A novel data knowledge representation with the combination of structure learning ability of preprocessed collaborative fuzzy clustering and fuzzy expert knowledge of Takagi-Sugeno-Kang type model is presented in this paper. The proposed method divides a huge dataset into two or more subsets of dataset. The subsets of dataset interact with each other through a collaborative mechanism in order to find some similar properties within each-other. The proposed method is useful in dealing with big data issues since it divides a huge dataset into subsets of dataset and finds common features among the subsets. The salient feature of the proposed method is that it uses a small subset of dataset and some common features instead of using the entire dataset and all the features. Before interactions among subsets of the dataset, the proposed method applies a mapping technique for granules of data and centroid of clusters. The proposed method uses information of only half or less/more than the half of the data patterns for the training process, and it provides an accurate and robust model, whereas the other existing methods use the entire information of the data patterns. Simulation results show that proposed method performs better than existing methods on some benchmark problems.

11:20 [#1570197773] Interval Type-2 Recursive Fuzzy C-Means Clustering Algorithm in the TS Fuzzy Model Identification
Dam, Tannoy; Deb, Alok;
This paper presents iterative Takagi Sugeno Fuzzy Model (TSFM) identification. Interval Type-2 Recursive Fuzzy C-Means (IT2RFCM) clustering algorithm has been used to classify the data space to obtain premise variable parameters and Weighted Recursive Least Square (WRLS) technique has been used to determine consequence parameters of each linear model. IT2RFCM clustering algorithm has been obtained from type-1 fuzzy c-means clustering algorithm by introducing fuzziness parameters for handling more uncertainty in the model. The effectiveness of proposed IT2RFCM algorithm was tested on Mackey-Glass time series prediction.
10:20 Efficacy of Interventions and Incentives to Achieve Speed Compliance in the Informal Public Transport Sector
Akpa, Nelson Ebot Eno; Booysen, Marthinus J; Sinclair, Marion;

The informal public transport industry in South Africa, primarily dominated by minibus taxis is noted for poor compliance and disregard towards posted speed limits. They go so far as driving over the differentiated speed limit of the lighter passenger vehicles used for private transport. This paper compares and evaluates improvements in their speed compliance using two renowned interventions: automated Average Speed Enforcement (ASE), and auditory Intelligent Speed Adaptation (ISA). It also investigates the impact of each intervention on fuel consumption to provide an additional incentive to the most efficient intervention. The main finding was that for minibus taxis, ASE needs ISA as a supplementary intervention. It was discovered that the drivers showed little or no behavioural change while driving on the ASE route, while the introduction of the ISA system resulted in significant changes bringing violation frequencies down to 47.4% from 81.2% on the enforcement route. These behavioural changes also resulted in lower fuel consumption rates especially while the ISA system was active. However fuel economy did not seem to work as a self-regulatory incentive for speed compliance.

10:40 Cellular Network Based Real-Time Urban Road Traffic State Estimation Framework Using Neural Network Model Estimation
Habtie, Ayalew; Abraham, Ajith; Midekso, Dida;

This paper presents real time road traffic state estimation framework together with its evaluation. To evaluate the framework, a three-layer Artificial Neural Network model is proposed and used to estimate complete link traffic state. The inputs to the ANN model include probe vehicle’s position, time stamps and speeds. To model the arterial road network the microscopic simulation SUMO is used to generate aggregated speed and FCD export files which are used in the training and evaluation of the ANN model. Besides, real A-GPS data gathered using A-GPS mobile phone on a moving vehicle on the sample roads is used to evaluate the ANN model. The performance of the ANN model is evaluated using the performance indicators RMSE and MPAE and on average the MPAE is less than 1.2%. The trained ANN model is also used to estimate the sample road link speeds and compared with ground truth speed (aggregate edge states) on a 10-minute interval for 1hr. The estimation accuracy using MAE and estimation availability indicated that reliable link speed estimation can be generated and used to indicate real-time urban road traffic condition.

11:00 Multi-UAV Task Allocation: A Team-Based Approach
Krishnaswamy, Venugopalan; Subramanian, Kartick; Sundaram, Suresh;

This paper presents a team-search based decentralized task allocation scheme for multiple homogeneous unmanned aerial vehicles (UAVs) to provide protection to static convoys of ground vehicles. The UAVs, during operation, protect the ground convoy by searching their vicinity for imminent threat, analyzing/confirming threat level, attacking it and finally assessing the damage to confirm if the threat has been nullified. The proposed approach utilizes search maps to form a common information base for intelligent decision making. A decentralized scheme is developed based on team theory, wherein the best course of action for each UAV is selected to minimize resource use of the team. This scheme is generic enough to handle different types of UAVs and control technique and caters to a dynamic environment. The proposed convoy protection scheme is evaluated by software simulation with multi-UAV-multi-targets. Different experiments were performed to analyze the efficacy of this approach. The performance comparison with greedy task allocation highlights the advantage of the proposed scheme.

11:20 Aircraft 4D Trajectories Planning Under Uncertainties
Chaimatanan, Supatcha;

In the new air traffic management paradigm called trajectory-based operation concept, this paper presents a strategic 4D aircraft trajectory planning approach aiming at minimizing interaction between aircraft trajectories for a given day. The proposed methodology allocates an alternative departure time, a horizontal flight path, and a flight level to each flight at a country and a continent scale. Uncertainties of aircraft position and arrival time on its curvilinear abscissa are taken into account in the trajectory planning process. The proposed approach optimizes the 4D trajectory of each aircraft so as to minimize the interaction between trajectories. A hybrid-metaheuristic optimization algorithm has been developed to solve this large-scale mixed-variable optimization problem. The algorithm is implemented and tested with real air traffic data taking into account uncertainty over the French and the European airspace for which a conflict-free and robust 4D trajectory plan is produced.
10:20 | P2V: Effective Website Fingerprinting Using Vector Space Representations
Alnaami, Khaled; Ayoade, Gbadebo; Siddiqui, Asim; Ruozzi, Nicholas; Khan, Latifur;

Language vector space models (VSMs) have recently proven to be effective across a variety of tasks. In VSMs, each word in a corpus is represented as a real-valued vector. These vectors can be used as features in many applications in machine learning and natural language processing. In this paper, we study the effect of vector space representations in cyber security. In particular, we consider a passive traffic analysis attack (Website Fingerprinting) that threatens users’ navigation privacy on the web. By using anonymous communication, Internet users (such as online activists) may wish to hide the destination of web pages they access for different reasons such as avoiding tyrant governments. Traditional website fingerprinting studies collect packets from the users’ network and extract features that are used by machine learning techniques to reveal the destination of certain web pages. In this work, we propose the packet to vector (P2V) approach where we model website fingerprinting attack using word vector representations. We show how the suggested model outperforms previous website fingerprinting works.

10:40 | Quantum Based Neural Network Classifier and Its Application for Firewall to Detect Malicious Web Request
Patel, Om; Tiwari, Aruna; Patel, Vikram; Gupta, Ojas;

In this paper, a quantum based neural network classifier is designed as Firewall (QNN-F) to detect malicious Web request on the Web. The proposed algorithm forms neural network architecture constructively by adding the hidden layer neuron one by one. The connection weight and threshold of the neuron are decided using the quantum computing concept. Forming a network constructively eliminates the problem of unnecessarily learning of neural network thus save time. The quantum computing concept gives large subspace for selection of appropriate connection weight in evolutionary ways. Also, the threshold value is decided using the quantum computing concept. To increase the performance of system, a Web crawler is also proposed which find objection URLs on the Web according to the objectionable keywords. The proposed algorithm is tested on Web data, to develop a firewall which detects malicious Web request. Extensive testing on 2000 objectionable and non objectionable URLs are done which shows that proposed system works efficiently for detection of objectionable content.

11:00 | Conversion of Decision Tree Into Deterministic Finite Automation for High Accuracy Online SYN Flood Detection
Luckner, Marcin;

While collecting data from network traffic, one can create classifiers that recognize threats, anomalies, or other events. The set of labelled NetFlow records collecting traffic statistics is a very useful source of decision rules that classify the records. These rules can be created automatically using machine learning techniques. However, the classifiers learned on such records may recognise only past events and cannot recognise current events, because not all data were collected.

11:20 | Potentials of Using One-class SVM for Detecting Protocol-specific Anomalies in Industrial Networks
Schuster, Frank; Paul, Andreas; Rietz, Ren; Koenig, Hartmut;

Support Vector Machines (SVM) have been considered for real-life machine learning applications in various fields. Security concerns in modern industrial networks, also used in critical infrastructures, require novel monitoring techniques applicable for these constrained, real-time environments. Characteristics of these networks’ traffic indicate that SVM can be a powerful tool for realizing a self-configuring monitoring for industrial infrastructures regarding attacks as kind of anomalies. This paper presents the experimental results of applying one-class SVM (OCSVM) on a number of real-world industrial traffic traces from very different industrial control systems (ICS). Initially focusing on a few network packet attributes, the results are discussed in terms of f-score, precision, and recall for different mappings of the features. The results demonstrate the high potential of using one-class SVM for monitoring packets and packet sequences in these networks.
This paper describes robot perception to grasp an unknown object intuitively. Generally, a robot should recognize object's

second, the structure of the sensor is illustrated, and the principle is explained. Finally, a fabricated prototype is
described. In addition, the effectiveness of the sensor is confirmed through experiments using the prototype and foods.

Another evaluation method is a use of food texture instruments. The instruments quantify food texture. However, its sensor
test-based evaluation. Although the sensory test directly evaluates food texture, it requires many subjects and high cost.

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Another evaluation method is a use of food texture instruments. The instruments quantify food texture. However, its sensor
has the simple function which measures load. Its evaluation performance is not enough for food texture evaluation. In this

paper, we propose a food texture sensor. The sensor is based on a human tooth, and has the structure which is composed of

lightweight and low-power flying insects, such as dragonflies, can readily chase prey and mates within cluttered natural
environments, deftly selecting their target amidst distractors (swarms). In our laboratory, we record from 'target-detecting'
neurons in the dragonfly brain that underlie this pursuit behavior. We recently developed a closed-loop target detection and
tracking algorithm based on key properties of these neurons. Here we test our insect-inspired tracking model in open-loop
against a set of naturalistic sequences and compare its efficacy and efficiency with other state-of-the-art engineering models.

In terms of tracking robustness, our model performs similarly to many of these trackers, yet is at least 3 times more efficient
in terms of processing speed.

We used LDC and PARZEN for estimating the classification accuracy for the proposed method and individual method.
Highest accuracy of 96.1% is obtained for combined feature method (CCA+CFP). Whereas, the accuracy is 89.6% with CCA
and 91.6% with CFP method. A significance test has shown that the performance of the proposed method is significantly
different from both the individual methods ($p < 0.05$).

11:00 [1570192161] Robustness and Real-Time Performance of an Insect Inspired Target Tracking Algorithm Under Natural Conditions
Bagheri, Zahr; Wiederman, Steven D; Cazzolato, Ben; Grainger, Steven; O’Carroll, David C;

Many computer vision tasks require the implementation of robust and efficient target tracking algorithms. Furthermore,
in robotic applications these algorithms must perform whilst on a moving platform (egomotion). Despite the increase in
computational processing power, many engineering algorithms are still challenged by real-time applications. In contrast,
lightweight and low-power flying insects, such as dragonflies, can readily chase prey and mates within cluttered natural
environments, deftly selecting their target amidst distractors (swarms). In our laboratory, we record from 'target-detecting'
neurons in the dragonfly brain that underlie this pursuit behavior. We recently developed a closed-loop target detection and
tracking algorithm based on key properties of these neurons. Here we test our insect-inspired tracking model in open-loop
against a set of naturalistic sequences and compare its efficacy and efficiency with other state-of-the-art engineering models.

In terms of tracking robustness, our model performs similarly to many of these trackers, yet is at least 3 times more efficient
in terms of processing speed.

11:20 [1570192523] Combining CCA and CFP for Enhancing the Performance in the Hybrid BCI System
Ko, Li-Wei; Singanamalla, Sai Kalyan Ranga;

Hybrid Brain Computer Interface (BCI) is gaining attention as it can provide better performance or increase the number
of user commands to control an external device. Hybrid BCI system using Motor imagery (MI) and Steady-state visually
evoked potential (SSVEP) is one such system. Maintaining the performance during channel reduction is important in practical
applications. In this paper we propose a combined feature extraction method using Canonical Correlation Analysis (CCA) and
Common Frequency Pattern (CFP) method, where the features obtained from these methods were combined for classification.
We used LDC and PARZEN for estimating the classification accuracy for the proposed method and individual method.
Highest accuracy of 96.1% is obtained for combined feature method (CCA+CFP). Whereas, the accuracy is 89.6% with CCA
and 91.6% with CFP method. A significance test has shown that the performance of the proposed method is significantly
different from both the individual methods ($p < 0.05$).

RiiSS’15 Session: 1: Informationally Structured Space
Tuesday, December 8, 10:20–12:20, Room: 1.61
Chair: Chu Kiong Loo, Co-chair: Takenori Obo

10:20 [1570192403] Development of Food Texture Sensor Using Two Magnetic Sensing Elements
Nakamoto, Hiroyuki; Nishikubo, Daisuke; Kobayashi, Futoshi; Kojima, Fumio;

An effective evaluation method of food texture is required for food development. A conventional evaluation method is sensory
test-based evaluation. Although the sensory test directly evaluates food texture, it requires many subjects and high cost.
Another evaluation method is a use of food texture instruments. The instruments quantify food texture. However, its sensor
has the simple function which measures load. Its evaluation performance is not enough for food texture evaluation. In this
paper, we propose a food texture sensor. The sensor is based on a human tooth, and has the structure which is composed of
a contactor, an elastomer membrane and a base. Two kinds of sensing elements detect displacement of the contactor. The
sensing elements work as fast and slow adaptive receptors. In this paper, first the structure and function of human tooth are
described. Second, the structure of the sensor is illustrated, and the principle is explained. Finally, a fabricated prototype is
demonstrated. In addition, the effectiveness of the sensor is confirmed through experiments using the prototype and foods.

10:40 [1570192441] Invariant Perception for Grasping an Unknown Object Using 3D Depth Sensor
Masuta, Hiroyuki; Lim, Hun-ok; Motoyoshi, Tatsu; Koyanagi, Ken’ichi; Oshima, Toru;

This paper describes robot perception to grasp an unknown object intuitively. Generally, a robot should recognize object’s
The feature extraction of human behavior, and SNN is used to associate the features with event information labels. We show and contextual relation modeling using Growing Neural Gas (GNG) and Spiking Neural Network (SNN). GNG is applied to extraction method based on growing neural networks. The learning system is composed of two modules for feature extraction is one of the most important tasks, which provides suitable information service to users. This paper proposes a pattern analysis method that supports classification with missing values. It also supports the use of any classifier, even if it does not support classification from multiple imputed data. We show that the algorithm performs as well as the benchmark algorithm with a classifier that does not generalize to this case. Thus in this paper we propose a novel algorithm to estimate classification uncertainty with multiple imputed data set contains missing values, not all classifiers can be used directly. Imputing missing values solves this problem but it suppresses variation in the data leading to underestimation of uncertainty and can also bias the results. Multiple imputation, where several copies of the data set are created, solves these problems but the classical approach for uncertainty estimation can suppress variation in the data leading to underestimation of uncertainty and can also bias the results. Therefore, it is important to integrate informationally structured space with cognitive robot to confirm the elderly’s abnormal situation with human-robot interactions before sending out warning signals to healthcare workers. In this work, we proposed an evolutionary computation based approach to optimize fuzzy spiking neural network for detecting abnormal activities in the elderly people’s daily activities.

11:00 [#1570196233] Fuzzy Spiking Neural Network for Abnormality Detection in Cognitive Robot Life Supporting System
Tang, Dalai; Botzheim, Janos; Kubota, Naoyuki; Tang, Tiong Yew;

In aging nation such as Japan, elderly people belong to the vulnerable group that constantly need health care and monitoring for their well-being. Therefore, an early warning system for detecting abnormality in their daily activities could save their life (e.g. heart attack, stroke and etc.). However, such early warning system must not trigger any false warning signals in order to robustly operate in real world applications. Robot interactions with human are useful to prevent false warning signals from sending out to healthcare worker. Next, the system should be able to detect short-term abnormal and also long-term abnormal behaviors of the elderly people within their normal daily life routine. Therefore, it is important to integrate informationally structured space with cognitive robot to confirm the elderly’s abnormal situation with human-robot interactions before sending out warning signals to healthcare workers. In this work, we proposed an evolutionary computation based approach to optimize fuzzy spiking neural network for detecting abnormal activities in the elderly people’s daily activities.

11:20 [#1570197453] Behavior Pattern Extraction Based on Growing Neural Networks for Informationally Structured Space
Obo, Takesori; Kakudi, Habeebah; Loo, Chu Kiong; Kubota, Naoyuki;

In this paper, we focus on behavior pattern extraction using sensor networks and portable sensing system. Behavior analysis is one of the most important tasks, which provides suitable information service to users. This paper proposes a pattern extraction method based on growing neural networks. The learning system is composed of two modules for feature extraction and contextual relation modeling using Growing Neural Gas (GNG) and Spiking Neural Network (SNN). GNG is applied to the feature extraction of human behavior, and SNN is used to associate the features with event information labels. We show several experimental results, and discuss the effectiveness of our proposed method.

CIDM’15 Session: 1: Classification I
Tuesday, December 8, 10:20–12:20, Room: 1.62
Chair: Friedhelm Schwenker

10:20 [#1570169637] Study on Index Model of Tropical Cyclone Intensity Change Based on Projection Pursuit and Evolution Strategy
Geng, Huantong;

This paper deals with the forecasting of tropical cyclone (TC) landed intensity change problem in which multi-level and multi-attribute decision are considered. A novel index model of tropical cyclone intensity change based on projection pursuit (PP) and evolution strategy (ES) is proposed to forecast the TC intensity change. We propose to use projection pursuit to project the high-dimensional TC intensity observation samples with 18 different attributes into one-dimensional projection index value. According to the projection index value distribution of learning samples, including TC intensifying and weakening, we can determine the cut off index value which distinguishes two different index value of intensifying and weakening samples. The final best projection unit vector can reflect degree of each attribute influence on TC intensity change. In order to solve the high-dimensional globally optimal problem in PP, evolution strategy with stochastic ranking is used to optimize the projection vector. The role of stochastic ranking is to balance the dominance of objective and penalty functions. Based on the index model, experimental results indicate that the accuracy of 693 TC intensity change samples reaches 89.2% when we take the index value 1.40 as the cutoff value between TC intensifying and TC weakening, and the seven core attributes can also reflect the main meteorological characters of TC intensity change accurately.

10:40 [#1570185043] Classification Uncertainty of Multiple Imputed Data
Alasalmi, Tuomo; Koskimki, Heli; Suutala, Jaakko; Rinning, Juha;

Every classification model contains uncertainty. This uncertainty can be distributed evenly or into certain areas of feature space. In regular classification tasks, the uncertainty can be estimated from posterior probabilities. On the other hand, if the data set contains missing values, not all classifiers can be used directly. Imputing missing values solves this problem but it suppresses variation in the data leading to underestimation of uncertainty and can also bias the results. Multiple imputation, where several copies of the data set are created, solves these problems but the classical approach for uncertainty estimation does not generalize to this case. Thus in this paper we propose a novel algorithm to estimate classification uncertainty with multiple imputed data. We show that the algorithm performs as well as the benchmark algorithm with a classifier that supports classification with missing values. It also supports the use of any classifier, even if it does not support classification
11:00 [#1570188525] Calibrating Probability with Undersampling for Unbalanced Classification
Pozzolo, Andrea Dal; Caelen, Olivier; Johnson, Reid; Bontempi, Gianluca;

Undersampling is a popular technique for unbalanced datasets to reduce the skew in class distributions. However, it is well-known that undersampling one class modifies the priors of the training set and consequently biases the posterior probabilities of a classifier. In this paper, we study analytically and experimentally how undersampling affects the posterior probability of a machine learning model. We formalize the problem of undersampling and explore the relationship between conditional probability in the presence and absence of undersampling. Although the bias due to undersampling does not affect the ranking order returned by the posterior probability, it significantly impacts the classification accuracy and probability calibration. We use Bayes Minimum Risk theory to find the correct classification threshold and show how to adjust it after undersampling. Experiments on several real-world unbalanced datasets validate our results.

Stanovov, Vladimir; Sopov, Evgenii; Semenkin, Eugene;

A hybridization of genetic algorithms and machine learning techniques have proved its effectiveness for many complex benchmark and real-world problems. In this study we present a novel approach that combines self-configuring genetic algorithm for multimodal optimization and fuzzy rule based classifier. The proposed search metaheuristic controls the interactions of many techniques for multimodal optimization (different genetic algorithms) and leads to the self-configuring solving of problems with a priori unknown structure. Applying this approach to designing the fuzzy rule based classifiers, we can obtain many optimal solutions with different representation. The results of numerical experiments with popular optimization benchmark problems (for multimodal genetic algorithm) and with well-studied real-world classification problems (for self-configuring fuzzy rule based classifier design) are presented and discussed. The main feature of the proposed approach is that it does not require the participation of the human expert, because it operates in an automated, self-configuring way.

11:40 [#1570192479] Classification Using Probabilistic Random Forest
Goudane, Rajhans; Devi, V. Susheela;

The Probabilistic random forest is a classification model which chooses a subset of features for each random forest depending on the F-score of the features. In other words, the probability of a feature being chosen in the feature subset increases as the F-score of the feature in the dataset. A larger F-score of feature indicates that feature is more discriminative. The features are drawn in a stochastic manner and the expectation is that features with higher F-score will be in the feature subset chosen. The class label of patterns is obtained by combining the decisions of all the decision trees by majority voting. Experimental results reported on a number of benchmark datasets demonstrate that the proposed probabilistic random forest is able to achieve better performance, compared to the random forest.

10:20 [#1570175885] Ensemble Methods for Robust 3D Face Recognition Using Commodity Depth Sensors
Schimbinschi, Florin; Schomaker, Lambert; Wiering, Marco;

In this paper we introduce a new dataset and pose invariant sampling method and describe the ensemble methods used for recognizing faces in 3D scenes, captured using commodity depth sensors. We use the 3D SIFT keypoint detector to take advantage of the similarities between faces, which leads to a set of points of interest based on the curvature of the face. For each keypoint, features are extracted using a 3D feature descriptor. Then, a variable-sized amount of features are generated per each 3D face image. The first ensemble method we constructed uses a K-nearest neighbors classifier to classify each keypoint-sampled feature vector as belonging to one of the subjects recorded in our dataset. All votes over all keypoints are combined. In the second ensemble technique, the keypoints are clustered with K-means, using the feature vectors and approximated sampling positions relative to the face. This leads to a set of experts that specialize for a specific region. Then a K-nearest neighbors classifier is trained on the examples falling in each expert’s specialized region. Finally, for a new 3D face image, votes from all experts are combined in a sum ensemble technique to categorize the 3D face. We also introduce 6 new “real world” datasets with different variances: 3 types of 3D rotations, distance to sensor, expressions, and an all-in-one dataset. The results show very high cross validation accuracies for the same type of variance. In addition, 36 variance specific pair-tests in which the system is trained on one dataset and tested on a completely different dataset also show encouraging results.

10:40 [#1570189451] Deep Convolutional Neural Networks and Support Vector Machines for Gender Recognition
van de Wolfshaar, Jos; Wiering, Marco; Karaaba, Mahir;

Social behavior and many cultural etiquettes are influenced by gender. There are numerous potential applications of automatic
11:00 [#1570190639] Video Face Recognition From A Single Still Image Using an Adaptive Appearance Model Tracker

Dewan, M. Ali Akber; Grainger, Eric; Sabourin, Robert; Marcialis, Gian Luca; Roli, Fabio;

Systems for still-to-video face recognition (FR) are typically used to detect target individuals in watch-list screening applications. These surveillance applications are challenging because the appearance of faces changes according to capture conditions, and very few reference stills are available a priori for enrollment. To improve performance, an adaptive appearance model tracker (AAMT) is proposed for on-line learning of a track-face-model linked to each individual appearing in the scene. Meanwhile, these models are matched over successive frames against stored reference stills images of each target individual (enrolled to the system) for robust spatiotemporal FR. Compared to the gallery-face-models produced by self-updating FR systems, the track-face-models (produced by the AAMT-FR system) are updated from facial captures that are more reliably selected, and can incorporate greater intra-class variations from the operational environment. Track-face-models allow selecting facial captures for modeling more reliably than self-updating FR systems, and can incorporate a greater diversity of intra-class variation from the operational environment. Performance of the proposed approach is compared with several state-of-the-art FR systems on videos from the Chokepoint dataset when a single reference template per target individual is stored in the gallery. Experimental results show that the proposed system can achieve a significantly higher level of FR performance, especially when the diverse facial appearances captured through AAMT correspond to that of reference stills.

11:20 [#1570191637] Robust Face Recognition by Computing Distances From Multiple Histograms of Oriented Gradients

Karaaba, Mahir; Surinta, Olarik; Schomaker, Lambert; Wiering, Marco;

The Single Sample per Person Problem is a challenging problem for face recognition algorithms. Patch-based methods have obtained some promising results for this problem. In this paper, we propose a new face recognition algorithm that is based on a combination of different histograms of oriented gradients (HOG) which we call Multi-HOG. Each member of Multi-HOG is a HOG patch which belongs to a grid structure. To recognize faces, we create a vector of distances computed by comparing train and test face images. After this, a distance calculation method is employed to calculate the final distance value between a test and a reference image. We describe here two distance calculation methods: mean of minimum distances (MMD) and a multi-layer perceptron based distance (MLPD) method. To cope with aligning difficulties, we also propose another technique which finds the most similar regions for two images compared. We call it the most similar region selection algorithm (MSRS). The regions found by MSRS are given to the algorithms we proposed. Our results show that, while MMD and MLPD contribute to obtaining much higher accuracies than the use of a single histogram of oriented gradients, combining them with the most similar region selection algorithm results in state-of-the-art performances.

11:40 [#1570191657] Identifying Critical Factors Influencing Quality of Blood Vessel Information in JPEG Compressed Skin Images

Li, Xiaojie; Kong, Adams;

Recent research results demonstrate the potential of using blood vessel patterns for criminal and victim identification. With newly developed methods, blood vessel patterns under human skin are possible to be visualized from evidence images (e.g., child sexual abuse images). However, these images are always taken by consumer cameras and compressed by the JPEG method, which can degrade the blood vessel information seriously. In this paper, an analysis is conducted to find out the critical factors influencing the quality of the blood vessel information. Simulations using different compression ratios are performed on skin images with different resolutions. The results indicate that the quality of blood vessel information is controlled by several low frequency discrete cosine transform (DCT) coefficients in the Y, U and V channels. The findings will be useful for designing algorithms to restore the blood vessel information lost in the JPEG compression process in future research.
13:00 [1570173149] An Improved Method for Comprehensive Learning Particle Swarm Optimization
Wang, Zi-Jia; Zhan, Zhi-hui; Zhang, Jun;

Particle Swarm Optimization (PSO) is a population-based stochastic search technique for solving optimization problems, which has been proven to be effective in wide applications in scientific and engineering domains. However, it is inefficient when searching in complex problems spaces. Lots of improved PSO variants with different features have been proposed, such as Comprehensive Learning PSO (CLPSO). CLPSO is an enhanced PSO variant by adopting a better learning strategy that has some chance to choose other particles’ historical best information to update velocity. Comparing with the standard PSO, CLPSO has successfully improved the diversity of population and hence avoids the deficiency of premature convergence and local optima. However, this algorithm causes slow convergence speed, especially during the late state of searching process. In this paper, an improved CLPSO algorithm is proposed, termed as ICLPSO, to accelerate convergence speed and keep diversity of population at the same time. We set the learning probability based on particles’ own fitness and adaptively construct different learning exemplars for different particles according to particles’ own features and properties, which is a more appropriate learning strategy for particles’ optimization. Experimental results show that the performance of ICLPSO is better than standard CLPSO and some other peer algorithms, using the functions both on unimodal and multimodal.

13:20 [1570192243] A Subspace-Based Method for PSO Initialization
van Zyl, Elre; Engelbrecht, Andries;

Particle swarm optimization (PSO) is known to suffer under the curse of dimensionality. This paper proposes a novel strategy of particle swarm initialization particularly for high dimensional problems. The initialization strategy encourages the swarm to focus on exploitation rather than exploration, thereby allowing it to find fairly good solutions, even in the face of high dimensionality and very large search spaces. The proposed initialization strategy is compared to a number of other initialization strategies on high dimensional problems. The proposed strategy performed considerably better than all the other initialization strategies for the higher dimensional problems. Reasons for the observed behaviour are also discussed.

13:40 [1570192855] Particle Swarm Optimization with Minimum Spanning Tree Topology for Multimodal Optimization
Zhang, Yu-Hui; Gong, Yue-jiao; Zhang, Jun;

Multimodal optimization amounts to finding multiple optima of a problem. In recent years, particle swarm optimization (PSO) algorithms have been widely used by the evolutionary computation community to tackle multimodal problems. However, the capability of using a suitable PSO communication topology to induce stable niching behavior has not been well explored. In this paper, we propose a minimum spanning tree (MST) topology for PSO to solve multimodal problems. In each iteration, a minimum spanning tree is built based on the configuration of particles. The neighbors of each particle are determined according to the MST. The MST topology is able to capture the distribution of particles using a small number of edges. Moreover, a number of max weighted edges in the MST are cut to avoid the genetic drift phenomenon and to enhance the niching performance. The proposed topology is integrated with a canonical PSO and a locally informed particle optimizer (LIPS) to tackle multimodal problems. Experiments have been conducted on the CEC2013 benchmark functions to test the performance the integrated algorithms. Experimental results show that PSOs with MST topology are very effective in solving multimodal problems.

14:00 [1570190207] The Effect of Probability Distributions on the Performance of Quantum Particle Swarm Optimization for Solving Dynamic Optimization Problems
Harrison, Kyle; Ombuki-Berman, Beatrice; Engelbrecht, Andries;

The quantum particle swarm optimization (QPSO) algorithm was developed to address the limitations of the traditional particle swarm optimization (PSO) algorithm in dynamic environments. Some particles in the QPSO algorithm are chosen as “quantum” particles, and the positions of these are sampled uniformly within a radius (i.e., a hypersphere) centred around the global best particle. The remainder of particles follow standard PSO behaviour. This paper proposes sampling various alternative probability distributions to update the positions of quantum particles. Ten probability distributions are examined on dynamic environments with varying dimensionalities, temporal change severities, and spatial change severities, with both single-peak and five-peak environments considered. Results indicated that the most effective distribution to use is dependent upon the type of dynamism present. In general, it was observed that a small quantum radius was preferable to a large radius, indicating that exploitation is more beneficial than exploration with regards to QPSO performance. Finally, despite having been commonly used in various QPSO applications, the performance of the uniform distribution was found to be sub-par.
14:20 [#1570197619] A Swarm-Based Approach to Learning Phase-Type Distributions for Continuous Time Bayesian Networks
Perreault, Logan J; Thornton, Monica; Goodman, Rollie; Sheppard, John W;

The use of phase-type distributions is an established method for extending the representational power of continuous time Bayesian networks beyond exponentially-distributed state transitions. In this paper, we propose a method for learning phase-type distributions from known parametric distributions. We find that by using particle swarm optimization to minimize a modified KL-divergence value, we are able to efficiently obtain good phase-type approximations for a variety of parametric distributions. Our experiments show that particle swarm optimization outperforms genetic algorithms and hill climbing with simulated annealing. In addition, we investigate the trade-off between accuracy and complexity with respect to the number of phases in the phase-type distribution. Finally, we propose and evaluate an extension that uses informed starting locations during optimization, which we found to improve convergence rates when compared to random initialization.

14:40 [#1570159763] Transistor Sizing Using Particle Swarm Optimisation
White, Lyndon; While, Lyndon; Deeks, Ben; Boussaid, Farid;

We describe an application of particle swarm optimisation to the problem of determining the optimal sizing of transistors in an integrated circuit. The algorithm minimises the total area of silicon utilised by a given circuit, whilst maintaining the propagation delay of the circuit within a hard limit. It assesses designs using the well-known circuit simulation engine SPICE, making allowance for the inability of SPICE to assess poorly-designed circuits within a reasonable timeframe. Experiments on three different types of circuits demonstrate that the algorithm is able to derive excellent designs for a range of problem instances, including several problems where the Monte Carlo method is unable to find any feasible solutions at all.

13:00 [#1570191529] Evolving Snake Robot Controllers Using Artificial Neural Networks as an Alternative to a Physics-Based Simulator
Woodford, Grant; du Plessis, Mathys; Pretorius, Christiaan;

Traditional simulators can be complex, time-consuming and require specialized knowledge to develop while still being unable to adequately model reality. Artificial Neural Networks (ANNs) can be trained to simulate real-world robots and therefore serve as an alternative to traditional approaches of robot simulation during the Evolutionary Robotics (ER) process. ANN-based simulators require little specialized knowledge and can automatically incorporate many real-world peculiarities. This paper reports a simulator that consisted of ANNs which were trained to predict changes in the position of a real-world snake-like robot. Navigational behaviours were evolved in simulation and subsequently verified on the real-world robot. This paper demonstrated that ANNs are a viable alternative to traditional simulators for evolving controllers for snake-like robots.

13:20 [#1570193245] Inter-connection Structure Optimization for Neural Oscillator Based Biped Robot Locomotion
Saputra, Azhar Aulia; Sulistijono, Indra Adjii; Botzheim, Janos; Kubota, Naoyuki;

One of the problems in neural oscillator based humanoid locomotion is the interconnection structure and its weights. They influence the locomotion performance. This paper proposes an evolutionary algorithm for determining the interconnection structure in humanoid robot locomotion based on neural oscillator. The aim of this paper is to form the interconnection structure of motor neurons in order to produce the locomotion pattern in humanoid biped robot. The evolutionary system forms the connection and determines the synapse weight values of the 12 motor neurons distributed to 6 joint angles (two
that mining for disease-disease associations by second order co-occurrence is a powerful tool for medical science. All five examples showed only disease-disease associations that could be validated by medical literature. These results show a field in the vector represented a gene or a protein. The value in the field was derived from the number of publications in which this gene occurred together with the disease term. Disease-disease associations were calculated by vector similarity calculations.

A new method -DDMiner- for mining disease-disease associations in MEDLINE is presented together with its first results. DDMiner searches for co-occurrences of gene names and disease terms and finds relationships between diseases by word vector similarity calculations. All records in PubMed were labeled with around 40,000 gene and protein names, and around 4,000 disease terms. Each disease term was described by a word vector from which the length is the number of gene names. Each field in the vector represented a gene or a protein. The value in the field was derived from the number of publications in which this gene occurred together with the disease term. Disease-disease associations were calculated by vector similarity calculation. Five diseases were examined together with their closest neighbor diseases to show the validity of our approach. All five examples showed only disease-disease associations that could be validated by medical literature. These results show that mining for disease-disease associations by second order co-occurrence is a powerful tool for medical science.
14:00 [1570192723] Evaluation of Fusion Methods for Gamma-divergence-based Neural Network Ensembles
Knauer, Uwe; Backhaus, Andreas; Seiffert, Udo;
A significant increase in the accuracy of hyperspectral image classification has been achieved by using ensembles of radial basis function networks trained with different number of neurons and different distance metrics. Best results have been obtained with Gamma-divergence distance metrics. In this paper, previous work is extended by evaluation of different approaches for the fusion of the multiple real-valued classifier outputs into a crisp ensemble classification result. Evaluation is done by 10-fold cross-validation. Results show that an additional gain in classification accuracy can be achieved by selecting the appropriate fusion algorithm. Second, the SCANN algorithm and Fuzzy Templates are identified as the best performing fusion methods with respect to the complete ensemble of base classifiers. For several subsets of classifiers majority voting yields similar results while other simple combiners perform worse. Trained combiners based on adaptive boosting and Random Forest are ranked among the top methods.

14:20 [1570192891] Improving Classification Performance by Merging Distinct Feature Sets of Similar Quality Generated by Multiple Initializations of mRMR
Bottesch, Thomas; Palm, Guenther;
The success of machine learning algorithms often depends on the combination of model size, computational cost and interpretability. One way to optimize these properties is feature selection. Computational cost and model size can be reduced by discarding features with low relevance. Furthermore, feature selection can provide a deeper understanding of the feature’s importance. This work focuses on the minimal-redundancy-maximal-relevance algorithm (mRMR) which is a filter-method for feature selection that uses pairwise mutual information as a measure to decide which feature is relevant. The algorithm is initialized with the feature with the highest relevance according to the measure and an iterative algorithm selects the next feature which optimizes for a high relevance while maintaining a low redundancy to the previously selected features. This work extensively studies distinct feature sets which can be generated when running the mRMR algorithm multiple times using features of descending relevance as initialization. By exploiting information about the order in which the iterative algorithm chooses the features in the various runs, a strategy is proposed to generate a new combined feature set from all initializations. Applying the proposed strategy to four datasets of different sizes and two classification algorithms shows that the resulting feature sets are significantly better compared to the original mRMR algorithm for the given classification task. The proposed method is well-suited for cases where it is not feasible to use wrapper-methods to increase classification accuracy.

14:40 [1570193191] Naïve Bayes Classification Ensembles to Support Modeling Decisions in Data Stream Mining
Lutu, Patricia;
Data stream mining is the process of applying data mining methods to a data stream in real-time in order to create descriptive or predictive models. Due to the dynamic nature of data streams, new classes may emerge as a data stream evolves, and the concept being modelled may change with time. This gives rise to the need to continuously make revisions to the predictive model. Revising the predictive model requires that labelled training data should be available. Manual labelling of training data may not be able to cope with the speed at which data needs to be labelled. This paper proposes a predictive modeling framework which supports two of the common decisions that need to be made in stream mining. The framework consists of two components: an online component and an offline component. The online component uses Naïve Bayes ensemble base models to make predictions for newly arrived data stream instances. The offline component consists of algorithms to combine base model predictions, determine the reliability of the ensemble predictions, select training data for new base models, create new base models, and determine whether the current online base models need to be replaced.
are tracked using LK-tracking constrained by Gaussian response pattern and some geometrical constrains. This system has been tested on some publicly available databases such as CASIA-PALM, PolyU-PALM and PolyU-KNUCKLE. The system has been found to perform well over these databases and fusion has shown significant improvements.

13:20 [#1570192355] Distortion Analysis on Binary Representation of Minutiae Based Fingerprint Matching for Match-on-Card
Mlambo, Cynthia;

The fingerprint matching on the smart card has long been developed and recognized faster method than fingerprint matching on a computer or large capacity systems. There has been much research and activities concerned with improving the accuracy, time efficient implementations, security and efficient space of the match on card. In this paper presented is the survey on the methods used to improve the accuracy in matching and memory usage by representing minutiae points in binary. In addition, distortion is a major challenge in binary representation of minutiae points that affect the accuracy in fingerprint matching. Therefore this paper includes the methods used to deal with fingerprint distortion while representing minutiae points as binary vectors. This survey will assist on the new developments of match on card applications, in improving the accuracy and memory efficient while dealing with the problem of fingerprint distortion.

13:40 [#1570193443] Automatic Classification of Acquisition Problems Affecting Fingerprint Images in Automated Border Controls
Labati, Ruggero Donida; Genovese, Angelo; Ballester, Enrique Munoz; Piuri, Vincenzo; Scotti, Fabio; Sforza, Gianluca;

Automated Border Control (ABC) systems are technologies designed to increase the speed and accuracy of the identity verifications performed at international borders. A great number of ABCs deployed in different countries use fingerprint recognition techniques because of their high accuracy and user acceptability. However, the accuracy of fingerprint recognition methods can drastically decrease in this application context due to user-sensor interaction factors. This paper presents two main contributions. The first of them consists in an experimental evaluation performed to search the main negative aspects that could affect the usability and accuracy in ABCs based on fingerprint biometrics. The mainly considered aspects consists in the presence of luggage and cleanliness of the finger skin. The second contribution consists in a novel approach for automatically identifying the type of user-sensor interaction that caused quality degradations in fingerprint samples. This method uses a specific feature set and computational intelligence techniques to detect non-idealities in the acquisition process and to suggest corrective actions to travelers and border guards. To the best of our knowledge, this is the first method in the literature designed to detect problems in user-sensor interaction different from improper pressures on the acquisition surface. We validated the proposed approach using a dataset of 2880 images simulating different scenarios typical of ABCs. Results shown that the proposed approach is feasible and can obtain satisfactory performance, with a classification error of 0.098.

14:00 [#1570195225] A Preliminary Study on Identifying Fabrication Material From Fake Fingerprint Images
Rattani, Ajita; Akhtar, Zahid; Foresti, GianLuca;

Existing studies suggest the vulnerability of fingerprint verification system against spoof attacks. A spoofing attack occurs when an adversary mimics the biometric trait of another individual for illegitimate access and advantages. Liveness detection algorithms aim to detect live fingerprint samples from the fake artifact. However, the performance of these liveness detection algorithms severely degrade when new spoof materials are encountered during the operational stage. The aim of this work is to design a scheme for automatic detection of the fabrication material from the fake fingerprint images. Such a classifier will facilitate the detection and automatic adaptation of the liveness detector to new spoof materials.

Tuesday, December 8, 15:20–17:20

CICA’15 Session: 2: System Identification and Learning with Applications
Tuesday, December 8, 15:20–17:20, Room: 1.41
Chair: Er Meng Joo, Co-chair: Fouzi Harrou

15:20 [#1570173237] Interpretation and Analysis of Input Selection Approaches in Distance Space
Heinz, Tim; Nelles, Oliver;

In this paper five different model free input selection approaches are summarized. While all the criteria are based on geometrical properties of the data, it is possible to visualize most of the approaches in the here called 'Distance Space'. The five discussed approaches for input selection are interpreted and analyzed in the Distance Space scatter plot. The influence of noise and wrong chosen inputs to the Distance Space is outlined. With the chosen search strategy, the input space is changed. Afterward the best input combination is selected. Several dynamic systems are used to generate data sets, in order to compare the different approaches.
15:40 [157014331] Extended Deterministic Local Search Algorithm for Maximin Latin Hypercube Designs
Ebert, Tobias; Fischer, Torsten; Belz, Julian; Heinz, Tim; Kämpmann, Geritt; Nelles, Oliver;

This paper introduces the Extended Deterministic Local Search (EDLS) algorithm for Latin Hypercube (LH) designs. The main goal of the algorithm is to improve an existing algorithm towards a better uniformity of the data distribution, while maintaining a good computational performance. After presenting background information about LH designs and how to assess their quality (choice of loss function), the EDLS algorithm is explained and compared to two other algorithms for LH designs.

16:00 [1570192287] Enhanced Anomaly Detection Via PLS Regression Models and Information Entropy Theory
Fouzi, Harrou; Sun, Ying;

Accurate and effective fault detection and diagnosis of modern engineering systems is crucial for ensuring reliability, safety and maintaining the expected product quality. In this work, we propose an innovative method for detecting small faults in the highly correlated multivariate data. The developed method utilizes partial least square (PLS) method as a modeling framework, and the symmetrized Kullback-Leibler divergence (KLD) as a monitoring index, where it is used to quantify the dissimilarity between probability distributions of current PLS-based residual and reference one obtained using fault-free data. The performance of the PLS-based KLD fault detection algorithm is illustrated and compared to the conventional PLS-based fault detection methods. Using synthetic data, we have demonstrated the greater sensitivity and effectiveness of the developed method over the conventional methods, especially when data are highly correlated and small faults are of interest.

Maiti, Ananda; Kist, Alexander A.; Maxwell, Andrew;

Remote Access Laboratories (RAL) are online environments that allow users to interact with instruments through the Internet. RALs are governed by a Remote Laboratory management system (RLMS) that usually provides the specific control technology and control policies with regards to an experiment and the corresponding hardware. Normally, in a centralized RAL these control strategies and policies are created by the experiment providers in the RLMS. In a distributed Peer-to-Peer RAL scenario, individual users designing their own rigs are incapable of producing and enforcing the control policies to ensure safe and stable use of the experimental rigs. Thus the experiment controllers in such a scenario have to be smart enough to learn and enforce those policies. This paper discusses a method to create Markov’s Decision Process from the user’s interactions with the experimental rig and use it to ensure stability as well as support other users by evaluating the current state of the rig in their experimental session.

16:40 [1570194283] GLRT Based Anomaly Detection for Sensor Network Monitoring
Fouzi, Harrou; Sun, Ying;

Proper operation of antenna arrays requires continuously monitoring their performances. When a fault occurs in an antenna array, the radiation pattern changes and can significantly deviate from the desired design performance specifications. In this paper, the problem of fault detection in linear antenna arrays is addressed within a statistical framework. Specifically, a statistical fault detection method based on the generalized likelihood ratio (GLR) principle is utilized for detecting potential faults in linear antenna arrays. The proposed method relies on detecting deviations in the radiation pattern of the monitored array with respect to a reference (fault-free) one. To assess the abilities of the GLR based fault detection method, three case studies involving different types of faults have been performed. The simulation results clearly illustrate the effectiveness of the GLR-based fault detection method in monitoring the performance of linear antenna arrays.

17:00 [1570196053] Multi-document Extractive Summarization Using Window-based Sentence Representation
Zhang, Yong; Joo, Er Meng; Zhao, Rui;

Multi-document summarization has gained popularity in many real-world applications because significant information can be obtained within a short time. Extractive summarization aims to generate a summary of a document or a set of documents by ranking sentences, whose performance relies heavily on the quality of sentence features. However, almost all previous algorithms require hand-crafted features for sentence representation. In this paper, we leverage on word embedding to represent sentences so as to avoid the intensive labor of feature engineering. We propose a new technique, namely window-based sentence representation (WSR), to obtain the features of sentences using pre-trained word vectors. The method is developed based on the Extreme Learning Machine (ELM). Our proposed framework does not require any prior knowledge and therefore can be applied to various document summarization tasks with different languages, written styles and so on. We evaluate our proposed method on the DUC 2006 and 2007 datasets. This proposed method achieves superior performance compared with state-of-the-art document summarization algorithms with a much faster learning speed.
Kanjee, Ritesh; Carroll, Johnson; Bachoo, Asher;

This paper proposes and validates a real-time on-road vehicle detection system, which uses a single camera for the purpose of intelligent driver assistance. A three-step vehicle detection framework is presented to detect and track the target vehicle within an image. In the first step, probable vehicle locations are hypothesized using pattern recognition. The vehicle candidates are then verified in the hypothesis verification step. In this step, lane detection is used to filter vehicle candidates that are not within the lane region of interest. In the final step tracking and online learning are implemented to optimize the detection algorithm during misdetection and temporary occlusion. Good detection performance and accuracy was observed in highway driving environments with minimal shadows.

15:40 [#1570182527] A Comparison of Low-Cost Monocular Vision Techniques for Pothole Distance Estimation
Nienaber, Sonja; Booysen, Marthinus J; Kroon, Steve;

Consider a single camera mounted on the inside of a vehicle's windsheen used for detecting potholes and other obstacles on the road surface. This paper outlines three approaches to the depth estimation problem of determining the distance to these obstacles in the range of 5 m to 30 m. We provide an empirical evaluation of the accuracy of these approaches under various conditions, and make recommendations for when each approach is most suitable. The approaches are based on the pinhole camera model: the simplest approach is based on the geometry of similar triangles, another employs the cross-ratio of a set of collinear points, and the final approach relies on calibration of the camera matrix. We recommend the use of the cross ratio approach for a fixed camera setup and depth estimation almost directly ahead, and an approach using similar triangles when predicting distances at wide angles or adjusting the camera height may be necessary.

16:00 [#1570190023] Performance Comparison of Dynamic Time Warping (DTW) and a Maximum Likelihood (ML) Classifier in Measuring Driver Behavior with Smartphones
Engelbrecht, Jarrett; Booysen, Marthinus J; van Rooyen, Gert-Jan; Bruwer, Frederick;

The ubiquitous presence of smartphones provides a new platform on which to implement sensor networks for Intelligent Transport Systems (ITS) applications. Smartphone-based driving behavior monitoring has applications in the insurance industry, fleet management, driver training, and for law enforcement. In this paper we propose a Maximum Likelihood (ML) classifier to identify and classify the recklessness of driving maneuvers using the embedded sensors and GPS receiver of a smartphone. We compare the developed approach to the commonly used Dynamic Time Warping (DTW) based method. The solutions are both suitable for real-time applications, such as driver assistance and safety systems. An endpoint detection algorithm is used on filtered accelerometer and gyroscope data to find the start- and endpoints of driving events. The events are isolated with the endpoint detection algorithm are then classified using the DTW algorithm and an ML classifier. Results show that the ML classifier outperforms the DTW approach.

16:20 [#1570191749] Comparison of GPS and MEMS Support for Smartphone-Based Driver Behavior Monitoring
Bruwer, Frederick; Booysen, Marthinus J;

Smartphone-based driver monitoring and other forms of smartphone-based telematics are fast becoming a prevalent trend, especially in the vehicle insurance industry. Choosing the most appropriate sensor system is a pivotal aspect of any driver behavior monitoring system. This paper evaluates the performance of the two sensor systems for smartphone-based driver behavior monitoring and telematics—GPS and MEMS— in terms of the usefulness of data that can be collected for detecting and classifying driving maneuvers as well as the convenience of use and the effect on battery life. Comparisons are done in terms of selected Figures of Merit (FoM) that are commonly employed as metrics for classifying driving style. The results of comprehensive testing show that the MEMS inertial sensors outperform a GPS platform in terms of sampling rate, battery life and the accuracy with which acceleration, braking, swerving and cornering can be detected.

16:40 [#1570192177] Real Time Drowsiness Detection Based on Lateral Distance Using Wavelet Transform and Neural Network
Ma, Jiaqi; Murphey, Yi Lu; Zhao, Hong;

The paper proposed a model using real time driving front video recording to detect driver drowsiness. The video recordings were fed into the TRW's simulator to obtain the lane-related signals. Time domain features and frequency domain features were extracted from the lane-related signals to characterize the difference of alert state and drowsiness state. Both support vector machine and neural network were used to detect the drowsiness. Experimental results on real word driving recordings illustrated that the proposed method can detect the drowsiness with good accuracy. It also show that TRW simulator can generate reliable lane related signals if high quality video sequences are provided.

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which achieves 99.5% in accuracy and 15 millisecond per image in speed implemented in C++. More than 2000 images of with and without paragraphs. The results show the effectiveness of the proposed detection system, to differentiate images with paragraphs and those without. To imitate the scenario, we construct a new dataset covering a step curve is designed to apply on the autocorrelation of those histograms. The area under the curve is further utilized.

In this paper, we propose a histogram-based fast detection method to determine whether an image contains paragraphs of text or embedded with sufficient text, such that the text filters (e.g. OCR) only need to focus on those suspected images. In this way, Rumormongers always use long paragraphs to spread slanderous stories so that they can convince readers. Those illegal or sensitive rumors uploaded into the internet can be written on images to bypass text filters. These images can be detected by existing filters such as OCR, but the detection is very time-consuming. To prohibit the dissemination of those commentaries, detecting whether an image contains a sufficient amount of words provides convenience to the government or internet service providers. Because of this, we focus on developing a fast pre-processor algorithm for detecting images embedded with sufficient text, such that the text filters (e.g. OCR) only need to focus on those suspected images. In this paper, we propose a histogram-based fast detection method to determine whether an image contains paragraphs of text or not. Binary histograms are extracted from the converted binary images. Then, due to the periodic pattern of the histograms, a step curve is designed to apply on the autocorrelation of those histograms. The area under the curve is further utilized to differentiate images with paragraphs and those without. To imitate the scenario, we construct a new dataset covering more than 2000 images of with and without paragraphs. The results show the effectiveness of the proposed detection system, which achieves 99.5% in accuracy and 15 millisecond per image in speed implemented in C++.
Authenticating Super-resolved Image and Enhancing Its PSNR Using Watermark

Raval, Mehul S; Joshi, Vaibhav; Gupta, Dhruv; Kher, Shubhalaxmi J;

In this paper, a novel watermarking scheme is proposed for super-resolved images. All watermarking methods reduce PSNR of a host signal, while the proposed algorithm increases it. The singular values (SV) derived from edges of the low resolution (LR) image forms the image dependent watermark. Next we obtain linear measurements of the watermark using a compressive sensing (CS). These measurements are embedded in the super-resolved image using a lossless compression framework. Watermark is extracted at the receiver and super-resolved image is authenticated. After positive authentication, watermark (SV’s) is used to regenerate edge information which is added to the super-resolved image. This addition increases the PSNR. To best of our knowledge, it is the first algorithm that achieves simultaneous PSNR improvement and provide authentication to the super-resolved image.

Wednesday, December 9, 09:50–12:20

CIBD’15 Session: 1: 
Wednesday, December 9, 09:50–12:20, Room: 1.41
Chair: Paulo Lisboa

Attribute Selection Via Multi-Objective Evolutionary Computation Applied to Multi-Skill Contact Center Data Classification
Jimenez, Fernando; Marzano, Enrico; Sanchez, Gracia; Sciavicco, Guido; Vitacolonna, Nicola;

Attribute or feature selection is one of the basic strategies to improve the performances of data classification tasks, and, at the same time to reduce the complexity of classifiers, and it is a particularly fundamental one when the number of attributes is relatively high. Evolutionary computation has already proven itself to be a very effective choice to consistently reduce the number of attributes towards a better classification rate and a simpler semantic interpretation of the inferred classifiers. We propose the application of the multi-objective evolutionary algorithm ENORA to the task of feature selection for multi-class classification of data extracted from an integrated multi-channel multi-skill contact center, which include technical, service and central data for each session. Additionally, we propose a methodology to integrate feature selection for classification, model evaluation, and decision making to choose the most satisfactory model according to a “a posteriori” process in a multi-objective context. We check out our results by comparing the performance and the classification rate against the well-known multi-objective evolutionary algorithm NSGA-II. Finally, the best obtained solution is validated by a data expert’s semantic interpretation of the classifier.

Haupt, Sue Ellen; Kosovic, Branko;

To blend growing amounts of renewable energy into utility grids requires accurate estimate of the power from those resources for both day ahead planning and real-time operations. This requires predicting the wind and solar resource on those timescales. Accurate prediction of these meteorological variables is a big data problem that requires a multitude of disparate data, multiple models that are each applicable to a specific time frame, and application of computational intelligence techniques to successfully blend all of the model and observational information in real-time and deliver it to the decision-makers at utilities and grid operators.

Distributed, MapReduce-based Nearest Neighbor and E-Ball Kernel k-Means
Tsapanos, Nikolaos; Tefas, Anastasios; Nikolaidis, Nikos; Pitas, Ioannis;

Data clustering is an unsupervised learning task that has found many applications in various scientific fields. The goal is to find subgroups of closely related data samples (clusters) in a set of unlabeled data. A classic clustering algorithm is the so-called k-Means. It is very popular, however, it is also unable to handle cases in which the clusters are not linearly separable. Kernel k-Means is a state of the art clustering algorithm, which employs the kernel trick, in order to perform clustering on a higher dimensionality space, thus overcoming the limitations of classic k-Means regarding the non linear separability of the input data. Kernel k-Means typically computes the kernel matrix, which contains the results of the kernel function for every possible sample combination. This matrix can be viewed as the weight matrix of a full graph, where the samples are the vertices and the edges are weighed according to the similarity between the samples they connect, according to the kernel function. In this context, it is possible to work on the Nearest Neighbor graph, where each sample is only connected to some of its closest samples, or only using information from samples that are sufficiently close to each other, referred to as e-ball. Doing so reduces the size of the kernel matrix and can provide improved clustering results. In this paper, we present a MapReduce based distributed implementation of Nearest Neighbor and e-ball Kernel k-Means.
10:50 [1570197557] Hierarchical Mahalanobis Distance Clustering Based Technique for Prognostics in Applications Generating Big Data

Hassan, Aamir; Jagannathan, Sarangapani;

In this paper, a Mahalanobis Distance (MD) based hierarchical clustering technique is proposed for prognostics in applications generating Big Data. This technique is shown to have the ability to overcome certain challenges concerning Big Data analysis. In this technique, Mahalanobis Taguchi Strategy is utilized to organize the MD values into a tree and hierarchical clustering approach is then applied to obtain an overall MD value. This overall MD value is trended over time for prediction. Simulation results are presented to demonstrate the efficiency of the proposed technique.

11:10 [1570197687] Fixed-Size Least Squares Support Vector Machines: Scala Implementation for Large Scale Classification

Chandorkar, Mandar; Mall, Raghavendra; Lauwers, Olver; Suykens, Johan; De Moor, Bart;

We propose FS-Scala, a flexible and modular Scala based implementation of the Fixed Size Least Squares Support Vector Machine (FS-LSSVM) for large data sets. The framework consists of a set of modules for (gradient and gradient free) optimization, model representation, kernel functions and evaluation of FS-LSSVM models. A kernel based Fixed-Size Least Squares Support Vector Machine (FS-LSSVM) model is implemented in the proposed framework, while heavily leveraging the parallel computing capabilities of Apache Spark. Global optimization routines like Coupled Simulated Annealing (CSA) and Grid Search are implemented and used to tune the hyper-parameters of the FS-LSSVM model. Finally, we carry out experiments on benchmark data sets and evaluate the performance of various kernel based FS-LSSVM models.

11:30 [1570191803] Big Data Analytics of Financial Strategies

Egara, Kabaji Jr.; Peng, Yonghong;

This paper first presents an evaluation of profitability of three well-known trading indicators, i.e. the Simple Moving Average (SMA), the Relative Strength Index (RSI) and the Connors Relative Strength Index (CRSI). The evaluation of different trading strategies was based on a financial time-series big data spanning from 2003 to 2013. To overcome the respective weakness and enhance the strength, ensemble approaches combining multiple trading strategies were considered to be more effective. In the literature, the 2-period RSI strategy, commonly known as RSI2, is created by combining SMA and RSI. However, it is known that RSI quite often generates false signals and whipsaws that trigger the unnecessary selling and buying. A whipsaw is when a signal to trade is reversed over a short period of time. False signals increase the probability for losses while whipsaws generate commissions that eat away at profits and test trading stamina. In this paper, an enhanced ensemble trading strategy is proposed. Different from RSI2, the proposed approach uses SMA and CRSI as two base indicators in the ensemble strategy. CRSI helps us identify the trend while simple moving average confirms the trend and indicate the most explosive part, i.e. the highest jump in price. This combination helps minimize acting on sideways movement and instead trading only when the market is showing a profitable movement. Using this in conjunction with a large portfolio set, the experimental results showed that a combination of the Connors RSI and Simple Moving Average resulted in stronger and more appropriate signals and in turn led to generate greater returns. The respective underlying indicators are also tweaked further to create an optimized strategy to maximize profits.

11:50 [1570194581] Integrated Analysis of Gene Expression Data for Colon Cancer Biomarker Discovery

Hassan, Aamir; Zaka, Masood; Kouvatsos, Demetres; Peng, Yonghong;

The identification of molecular markers with prognostic value in colorectal cancer is a challenging task that is needed to define therapeutic guidelines. Despite recent advances in the screening, diagnosis, and treatment of colorectal cancer, an estimated 608,000 people die every year from this form of cancer, which is 8% of all cancer deaths. We performed two staged integrated bioinformatics analytics on gene expression data sets of three latest developed studies of colon cancer. We identified two groups of integrated signatures from the comparison of normal versus tumor and tumor versus metastatic samples.

105

Simulation results are presented to demonstrate the efficiency of the proposed technique.
costs. First, we construct a deterministic Rabin automaton (DRA) that accepts all and only infinite words satisfying the
LTL control specification. Second, we construct a product MDP of the MDP and the DRA to represent a dynamic control
policy that satisfies the control specification. Third, we modify the product MDP in order to apply RL to the design of an
optimal control policy. The control action of the modified product MDP is a pair of a pattern and an action, where the
pattern is a set of actions. Moreover, we introduce a reward that represents both the satisfaction of the control specification
and the minimally restrictiveness of the pattern. Finally, we proposed an algorithm for design of an optimal control policy
that consists of a sequential decision making of two steps. At the first decision making, we select a pattern that maximizes a
discounted sum of the reward. At the second one, we select an action from the pattern selected at the first one such that it
minimizes the expected discounted sum of the costs. Moreover, we consider an illustrative example to show that the proposed
algorithm can obtain an optimal control policy.

10:10 [1570192167] A Policy Gradient with Parameter-based Exploration Approach for Zone-heating
Vaerenbergh, Kevin Van; De Hauwere, Yann-Michael; Depraetere, Bruno; Nowé, Ann;

Heating a home is an energy consuming task. Most thermostats are programmed to turn on the heating at a particular
time in order to reach and maintain a predefined target temperature. A lot of energy is wasted if these thermostats are not
configured optimally since most of these thermostats do not take energy consumption into account but are only concerned
with reaching the target temperature. In this paper we present a learning approach based on policy gradient with parameter
estimations to balance user comfort with energy consumption. Our results show that our approach is capable of offering good
trade-off solutions between these objectives.

10:30 [1570192495] Temporal Difference Learning for the Game Tic-Tac-Toe 3D: Applying Structure to Neural Networks
van de Steeg, Michiel; Drugan, Madalina; Wiering, Marco;

When reinforcement learning is applied to large state spaces, such as those occurring in playing board games, the use of a
good function approximator to learn to approximate the value function is very important. In previous research, multi-layer
perceptrons have often been quite successfully used as function approximator for learning to play particular games with
temporal difference learning. With the recent developments in deep learning, it is important to study if using multiple
hidden layers or particular network structures can help to improve learning the value function. In this paper, we compare
five different structures of multilayer perceptrons for learning to play the game Tic-Tac-Toe 3D, both when training through
self-play and when training against the same fixed opponent they are tested against. We compare three fully connected
multilayer perceptrons with a different number of hidden layers and/or hidden units, as well as two structured ones. These
structured multilayer perceptrons have a first hidden layer that is only sparsely connected to the input layer, and has units
that correspond to the rows in Tic-Tac-Toe 3D. This allows them to more easily learn the contribution of specific patterns on
the corresponding rows. One of the two structured multilayer perceptrons has a second hidden layer that is fully connected
to the first one, which allows the neural network to learn to non-linearly integrate the information in these detected patterns.
The results on Tic-Tac-Toe 3D show that the deep structured neural network with integrated pattern detectors has the
strongest performance out of the compared multilayer perceptrons against a fixed opponent, both through self-training and
through training against this fixed opponent.

10:50 [1570192579] Bayesian Credible Intervals for Online and Active Learning of Classification Trees
Collet, Timothé; Pietquin, Olivier;

Classification trees have been extensively studied for decades. In the online learning scenario, a whole class of algorithms
decision trees has been introduced, called incremental decision trees. In the case where subtrees may not be discarded,
an incremental decision tree can be seen as a sequential decision process, consisting in deciding to extend the existing tree
or not. This problem involves an trade-off between exploration and exploitation, which is addressed in recent work with
the use of Hoeffding’s bounds. This paper proposes to use Bayesian Credible Intervals instead, in order to get the most out
of the knowledge of the output’s distribution’s shape. It also studies the case of Active Learning in such a tree following
the Optimism in the Face of Uncertainty paradigm. Two novel algorithms are introduced for the online and active learning
problems. Evaluations on real-world datasets show that these algorithms compare positively to state-of-the-art.

11:10 [1570196479] Bayesian Reinforcement Learning in Markovian and non-Markovian Tasks
Ez-zizi, Adnane; Farrell, Simon; Leslie, David;

We present a Bayesian reinforcement learning model with a working memory module which can solve some non-Markovian
decision processes. The model is tested, and compared against SARSA(lambda), on a standard working-memory task from
the psychology literature. Our method uses the Kalman temporal difference framework, and its extension to stochastic state
transitions, to give posterior distributions over state-action values. This framework provides a natural mechanism for using
reward information to update more than the current state-action pair, and thus negates the use of eligibility traces. Further-
more, the existence of full posterior distributions allows the use of Thompson sampling for action selection, which in turn
removes the need to choose an appropriately parameterised action-selection method.
11:30 [#1570197583] Distributed Adaptive Optimal Regulation of Uncertain Large-Scale Linear Networked Control Systems Using Q-Learning
Narayanan, Vignesh; Jagannathan, Sarangapani;

A novel Q-learning approach is introduced for the design of a linear adaptive regulator for a large-scale interconnected system. The subsystems communicate with each other through a network. The network induced random delays and data drop out are modeled along with the system dynamics. Stochastic Q-learning is used to estimate the Q-function parameters for the case of periodic and intermittent feedback. The estimated parameters are subsequently used for the regulator design without using value and policy iterations. The asymptotic convergence of the system state vector and boundedness of the parameter vector is demonstrated using Lyapunov analysis. Further, when the regression vector of the Q-function estimator satisfies the persistency of excitation (PE) condition, the Q-function parameters converge to the expected target values. The analytical design is evaluated using numerical examples via simulation.

11:50 [#1570202843] Correlated Gaussian Multi-Objective Multi-Armed Bandit Across Arms Algorithm
Yahyaa, Saba; Drugan, Madalina;

Stochastic multi-objective multi-armed bandit problem, (MOMAB), is a stochastic multi-armed problem where each arm generates a vector of rewards instead of a single scalar reward. The goal of (MOMAB) is to minimize the regret of playing suboptimal arms while playing fairly the Pareto optimal arms. In this paper, we consider Gaussian correlation across arms in (MOMAB), meaning that the generated reward vector of an arm gives us information not only about that arm itself but also on all the available arms. We call this framework the correlated-MOMAB problem. We extended Gittins index policy to correlated (MOMAB) because Gittins index has been used before to model the correlation between arms. We empirically compared Gittins index policy with multi-objective upper confidence bound policy on a test suite of correlated-MOMAB problems. We conclude that the performance of these policies depend on the number of arms and objectives.

09:50 [#1570189433] Detecting Contaminants in Smart Buildings by Exploiting Temporal and Spatial Correlation
Roveri, Manuel; Boracchi, Giacomo; Michaelides, Michalis P;

Monitoring the indoor air quality is one of the most critical activities within a smart building environment. The introduction of contaminant sources inside the building envelope can compromise the air quality and possibly endanger the lives of the inhabitants. In this paper, a new contaminant detection system is proposed for the prompt and effective detection (and isolation) of contaminant sources. Specifically, we address the challenging scenario where the contaminant of interest is also naturally present in the indoor building environment (e.g. CO2). A key feature of the proposed system is that it does not require a model of the contaminant propagation, but relies instead in its ability to exploit the temporal and spatial relationships present in the datastreams acquired by the sensors deployed within the smart building. The effectiveness of the proposed system has been evaluated on a reference testbed.

10:10 [#1570192591] Controlled-Accuracy Approximation of Nonlinear Functions for Soft Computing Applications
del Campo, Ines; Echanobe, Javier; Asua, Estibaliz; Finker, Raul;

Intelligent embedded systems can be found everywhere in a variety of innovative applications. The main challenge consists in developing small-size single-chip embedded systems with low power consumption, capable of processing data and intelligent algorithms with the required speed. These key issues are normally carefully analyzed during the design process of embedded systems with the aim of meeting the required specifications. However, the problem of accuracy is hardly ever explored at early stages of the design flow, even though too low accuracy could limit digital hardware performance in a crucial way. This piece of work proposes a controlled accuracy approximation scheme of nonlinear functions based on Taylor’s Theorem and the Lagrange form of the remainder. A hardware co-processor based on a Field programmable Gate Array (FPGA) is developed. The co-processor is suitable for efficient computation of nonlinear functions involved in typical soft computing techniques such as: activation functions (neural networks); membership functions (fuzzy systems); or kernel functions (support vector machines). The method is applied to the development of an intelligent embedded system for a smart scenario. Experimental results are provided for both online training and feed-forward computation of a single-layer feed-forward neural network.

10:30 [#1570193129] Semantic Mediation in Smart Water Networks
Mills, George M.; Eliades, Demetris; Fanayiotou, Christos; Polycarpou, Marios;

Water Distribution Networks (WDN) are the infrastructures responsible for delivering drinking water to consumers. The effective monitoring and control of these systems is of vital importance since malfunction may significantly affect the health, safety, security and/or economic well-being of people. The advancements in coupling WDN with the ICT infrastructure, combined with the more recent introduction of smart sensing and actuation technologies, have enabled the enhancement of “Supervisory Control And Data Acquisition (SCADA)”-based applications. These applications in current water systems assume pre-defined configuration and characteristics of the involved components (sensors, actuators, controllers, etc.). This
work explores how semantic mediation techniques may contribute to the online configuration of the monitoring and control architectures by exploiting and reasoning over the capabilities of deployed devices.

10:50 [#1570193189] A Pdf-free Change Detection Test for Data Streams Monitoring
Bu, Li; Zhao, Dongbin; Alippi, Cesare;
We experience changes in stationarity/time variance in many practical applications. Since changes modify the operational framework the application is working with, its accuracy performance is in turn affected. When changes can occur, we need to detect them as soon as possible, in general by inspecting features extracted from data, and afterwards intervene to mitigate their effects. In this paper, we propose a novel change detection test based on the least squares density difference estimation. Neither assumptions about the distribution of features are needed, nor the change types are made (the method is pdf-free and can handle arbitrary changes.). What here proposed requires limited data to become operational and thresholds needed to assess the change can be set met to predefined false positive rates. We show through comprehensive experiments the effectiveness of the detection method and point out how it outperforms other related methods.

11:10 [#1570195973] Using Cultural Algorithms to Improve Wearable Device Gesture Recognition Performance
Waris, Faisal; Reynolds, Robert G;
Wearable computing devices are now mainstream. Many such devices have capable MEMS sensors that can be exploited for recognizing dynamic, in-the-air gestures. Noting the somewhat limited compute and battery life of today’s devices, we present a computationally efficient approach to gesture recognition that can be effectively used inside an app running on standard, off-the-shelf hardware, such as an Android Smartwatch. Our approach has two phases. The first phase is to construct finite state machines (FSM) for gesture recognition. We present a novel approach - which leverages techniques from functional programming languages - to define rich yet compact FSM. Such FSM can be further tuned for higher accuracy with help of some training data and a suitable optimization method - this is the second phase. To demonstrate effectiveness, we created a gesture recognition system for an automotive scenario as an Android Smartwatch app and then tuned the gesture recognition engine using Cultural Algorithms optimization and training data. We achieved 77% gesture recognition accuracy which is on par which more computationally intensive techniques such as Hidden Markov Models.

11:30 [#1570197457] Optimal Defense and Control for Cyber-Physical Systems
Niu, Haifeng; Jagannathan, Sarangapani;
In this paper, we present a novel representation for cyber-physical systems wherein the states of the physical system are incorporated into the cyber system and vice versa. Next, by using this representation, optimal strategies are derived for the defender and the attacker by using zero-sum game formulation and iterative Q-learning is utilized to obtain the Nash equilibrium. In addition, a Q-learning-based optimal controller is revisited for the physical system in the presence of uncertain dynamics resulting from the cyber system under attacks. The benefit of the learning strategy is that the approach can handle a variety of attacks provided they affect packet losses and delays. Simulation results, on the yaw-channel control of the unmanned aerial vehicle (UAV), show that on the cyber side, both the defender and the attacker gain their largest payoff and on the physical system side, the optimal controller maintains the system stable.

Orciuoli, Francesco; Parente, Mimmo;
In this paper we propose an advanced computational intelligence solution for an an Agent-based framework for implementing blended shopping scenarios. The proposed solution meets needs recently arose in Ubiquitous Computing and Pervasive Computing as well. The work focuses on the definition of an Indoor Navigation System that guides shoppers in a shopping mall, towards the shops providing the most suitable offerings for them, in a given time window. Such system is based on a distributed algorithm that runs on a network of intelligent cells sensing both shoppers and offerings by means of the sensor devices deployed in the mall.
In recent years there has been growing interest in prediction models for non-conventional energy sources and demand in electrical systems because of the increasing use of renewable energy sources. The prediction interval models proposed in this paper are validated using local load data from a real-life microgrid in Huatacondo, Chile. The microgrid operates with an energy management system (EMS), which dispatches distributed generators based on unit commitment, minimizing generation costs. The relevant inputs for the EMS are predictions of the consumption and the available amount of renewable resources. In this paper a linear and a Takagi-Sugeno fuzzy model are proposed and they are used to construct a prediction interval that includes a representation of the uncertainties. The model parameters are identified such that they minimize a multi-objective cost function that not only includes the error but also the width of the prediction interval and its coverage probability. The resulting parameter identification is a complex non-convex problem. An Improved Teaching Learning Based Optimization (ITLBO) algorithm is proposed in order to solve the problem. This method is compared with a Particle Swarm Optimization procedure for a benchmark problem, showing that both algorithms find similar results. ITLBO is used to identify the load prediction models. These models are used to predict load up to two days ahead. Both models succeed in accomplish the design objectives.

Recent changes in the power systems gives place to the active consumers participation. The participation in demand response programs requires consumers to undertake strategic management of their consumption. Small and medium players should have the capability of performing day-ahead and hour-ahead load management which requires forecasting techniques applied to the consumption and generation. A good forecasting accuracy is very important for the quality of the management results but also very difficult to achieve. This paper proposes an artificial neural network based methodology to forecast the consumption in an office building. The considered building is equipped with a Supervisory Control and Data Acquisition (SCADA) system that stores data every 10 seconds. The stored data are used together with additional data, such as, the temperature and the solar radiation.

This paper presents the use of outlet temperature and water meter data as inputs to a physical model of a domestic electric water heater (EWH) for estimating the energy consumption for various control settings. Four sets of actual household data, consisting of at least 7 consecutive days each, is used to determine the accuracy of the energy consumption estimates in comparison to measured energy consumption. Both the outlet temperature and water meter data inputs used were able to estimate the total energy input with an error of less than 10 percent for 3 of the 4 datasets considered. Additionally, both methods are also implemented as a smartphone application that can be used to obtain input from users, as well as provide instantaneous feedback on the impact of control changes.

Power systems with synchronous generators and solar photovoltaic (PV) experience frequency and power fluctuations due to high variability of PV power. Automatic generation control is implemented to control power outputs of the generators and stabilize the system frequency. It is desirable with increasing levels of PV penetration to have foresight of frequency fluctuations to empower advanced control systems. A new methodology is presented in this paper for predicting frequency of synchronous generators in a power system with solar PV. A cellular computational network (CCN) is used to perform the frequency prediction over multi-time scale. CCNs are decentralized and distributed computing paradigms. Thus, CCNs are suitable for fast prediction of frequency of synchronous generators distributed spatially across a power system. The inputs to cells of the CCN are derived from phasor measurement unit (PMU) measurements of frequency and voltage phasor at the respective generator buses. Past, current and predicted measurements enable multi-timescale predictions of synchronous generator frequencies in a power system. Typical multi-time scale frequency predictions using the CCN are illustrated on a two-area four machine power system with solar PV integrated.

The estimation of the states of an electric power system, that is, the magnitude and angle of the voltage at all buses, is a very critical input to many monitoring and control functions of power systems. The recently witnessed rapid deployment of synchronized measurement technology (SMT) in power systems, has led to research advancements in the state estimation technology that introduce the notion of hybrid state estimation. These techniques incorporate the synchrophasors provided by the Phasor Measurement Units (PMUs) in the state estimation process, thus improving the state estimation accuracy. However, both the traditional as well as the hybrid techniques, assume a pre-defined configuration and characteristics of the measurement devices. This work explores how semantic modelling and reasoning techniques may contribute to the online
configuration of the state estimation architectures given the available measurement capabilities at each moment.

11:50 [#1570206977] Detecting Wind Power Ramp with Random Vector Functional Link (RVFL) Network
Ren, Ye; Qu, Xueheng; Suganthan, Ponnuthurai Nagaratnam; Amaratunga, Gehan A. J.;

Due to the intermittent nature of the wind, the wind speed is fluctuating. Fluctuating wind speed cause even more fluctuation in wind power generation. The sudden changes of the wind power injected into the power grid within a short time frame is known as power ramp, which can be harmful to the grid. This paper presents algorithms to detect the wind power ramps in a certain forecasting horizon. The importance and challenges of wind power ramp detection are addressed. Several different Wind power ramps are defined in this paper. A random vector functional link (RVFL) network is employed to predict the future occurrence of wind power ramp. The forecasting methods are evaluated with a real world wind power data set. The RVFL network has comparable performance as the benchmark methods: random forests (RF) and support vector machine (SVM) but it has better performance than the artificial neural network (ANN). The computation time of training and testing is also in favor of the RVFL network.

CIFEr’15 Session: 1: Forecasting & Predictive Modeling
Wednesday, December 9, 09:50–12:20, Room: 1.61
Chair: Peter Beling

09:50 [#1570173365] Maximum Entropy Production Principle for Stock Returns
Fiedor, Pawel;

In our previous studies we have investigated the structural complexity of time series describing stock returns on New York’s and Warsaw’s stock exchanges, by employing two estimators of Shannon’s entropy rate based on Lempel-Ziv and Context Tree Weighting algorithms, which were originally used for data compression. Such structural complexity of the time series describing logarithmic stock returns can be used as a measure of the inherent (model-free) predictability of the underlying price formation processes, testing the Efficient-Market Hypothesis in practice. We have also correlated the estimated predictability with the profitability of standard trading algorithms, and found that these do not use the structure inherent in the stock returns to any significant degree. To find a way to use the structural complexity of the stock returns for the purpose of predictions we propose the Maximum Entropy Production Principle as applied to stock returns, and test it on the two mentioned markets, inquiring into whether it is possible to enhance prediction of stock returns based on the structural complexity of these and the mentioned principle.

10:10 [#1570181259] Predicting Stock Price Movements Based on Different Categories of News Articles
Shynkevich, Yauheniya; McGinnity, Martin; Coleman, Sonya A; Belatreche, Ammar;

Publications of financial news articles impact the decisions made by investors and, therefore, change the market state. It makes them an important source of data for financial predictions. Forecasting models based on information derived from news have been recently developed and researched. However, the advantages of combining different categories of news articles have not been investigated. This research paper studies how the results of financial forecasting can be improved when news articles with different levels of relevance to the target stock are used simultaneously. Integration of information extracted from five categories of news articles partitioned by sectors and industries is performed using the multiple kernel learning technique for predicting price movements. News articles are divided into these five categories based on their relevance to a targeted stock, its sub industry, industry, group industry and sector while separate kernels are employed to analyze each one. The experimental results show that the simultaneous usage of five news categories improves the prediction performance in comparison with methods based on a lower number of news categories.

10:30 [#1570191001] Predicting Rainfall in the Context of Rainfall Derivatives Using Genetic Programming
Cramer, Sam; Kampouridis, Michael; Freitas, Alex A; Alexandridis, Antonis;

Rainfall is one of the most challenging variables to predict, as it exhibits very unique characteristics that do not exist in other time series data. Moreover, rainfall is a major component and is essential for applications that surround water resource planning. In particular, this paper is interested in the prediction of rainfall for rainfall derivatives. Currently in the rainfall derivatives literature, the process of predicting rainfall is dominated by statistical models, namely using a Markov-chain extended with rainfall prediction (MCRP). In this paper we outline a new methodology to be carried out by predicting rainfall with Genetic Programming (GP). This is the first time in the literature that GP is used within the context of rainfall derivatives. We have created a new tailored GP to this problem domain and we compare the performance of the GP and MCRP on 21 different data sets of cities across Europe and report the results. The goal is to see whether GP can outperform MCRP, which acts as a benchmark. Results indicate that in general GP significantly outperforms MCRP, which is the dominant approach in the literature.
Emergence of peer-to-peer lending has opened an appealing option for micro-financing and is growing rapidly as an option in the financial industry. However, peer-to-peer lending possesses a high risk of investment failure due to the lack of expertise on the borrowers’ creditworthiness. In addition, information asymmetry, the unsecured nature of loans as well as lack of rigid rules and regulations increase the credit risk in peer-to-peer lending. This paper proposes a credit scoring model using artificial neural networks in classifying peer-to-peer loan applications into default and non-default groups. The results indicate that the neural network-based credit scoring model performs effectively in screening default applications.

We are interested in discovering expressions for financial prediction using Nested Monte Carlo Search and Genetic Programming. Both methods are applied to learn from financial time series to generate non-linear functions for market volatility prediction. The input data, that is a series of daily prices of European S&P500 index, is filtered and sampled in order to improve the training process. Using some assessment metrics, the best generated models given by both approaches for each training sub-sample, are evaluated and compared. Results show that Nested Monte Carlo is able to generate better forecasting models than Genetic Programming for the majority of learning samples.

In 1997, Moody and Wu presented recurrent reinforcement learning (RRL) as a viable machine learning method within algorithmic trading. Subsequent research has shown a degree of controversy with regards to the benefits of incorporating technical indicators in the recurrent reinforcement learning framework. In 1991, Nison introduced Japanese candlesticks to the global research community as an alternative to employing traditional indicators within the technical analysis of financial time series. The literature accumulated over the past two and a half decades of research contains conflicting results with regards to the utility of using Japanese candlestick patterns to exploit inefficiencies in financial time series. In this paper, we combine features based on Japanese candlesticks with recurrent reinforcement learning to produce a high-frequency algorithmic trading system for the E-mini S&P 500 index futures market. Our empirical study shows a statistically significant increase in both return and Sharpe ratio compared to relevant benchmarks, suggesting the existence of exploitable spatio-temporal structure in Japanese candlestick patterns and the ability of recurrent reinforcement learning to detect and take advantage of this structure in a high-frequency equity index futures trading environment.

In this paper, we first show that there exists a day pattern in equities volatility and its volatility pattern is different from daily volume profile. To further emphasize on the most important volatility change during the day, we fold the continuous stock minute-by-minute data into n-by-p matrix, where n is number of days and p is number of minutes during trading hour, and decompose the matrix using principal component analysis (PCA). By examining the eigenvectors from the first several principal components, we can confirm the volatility day pattern and use eigenvectors as weight in distance metric in clustering step to generate and forecast volatility pattern. Clustering method K-Means and expectation maximization (EM) for Gaussian mixture model with three different distance metrics are implemented which enable us to optimizing clustering result. With clustered volatility patterns, when new observation comes in as stream, we compare the similarity under specific distance measure. New observation’s feature vectors with their loading factors are compared with centroids of clustered patterns as base. Forecasted volatility in the next period is calculated based on likelihood to most similar pattern and conditional probability of change of direction. This mechanism generates a predictive signal. To examine the practicality of this pattern recognition in volatility of equity market, we build a trading algorithm and did back test to check the accuracy and profitability of this idea. Realized volatility calculated by SPY and a representative for implied volatility VXX are treated separately and compared throughout the paper. As a result, test error, profit and loss and risk adjusted return are compared with performance by using fixed volatility profile, as well as comparing with GARCH(1,1) model for SPY realized volatility and ARMA(1,1) for VXX as implied volatility. Sharp ratio from weight adjusted investment strategy outperforms both.
propriate estimate for needed parameters we propose an alternating optimization algorithm, which finds a locally optimal parameter combination. The algorithm is based on the combination of two hierarchical versions of DBSCAN, which can be generated by fixing one parameter and iterating through possible values of the second parameter. Due to monotonicity of the neighborhood sets and the core-condition, successive levels of the hierarchy can efficiently be computed. An local optimal parameter combination can be determined using internal cluster validation measures. In this work we are comparing the measures edge-correlation and silhouette coefficient. For the latter we propose a density-based interpretation and show a respective computational efficient estimate to detect non-convex clusters produced by DBSCAN. Our results show, that the algorithm can automatically detect a good DBSCAN clustering on a variety of cluster scenarios.

10:10 [#1570188213] Scalable Hierarchical Clustering: Twister Tries with a Posteriori Trie Elimination
Cochez, Michael; Neri, Ferrante;

Exact methods for Agglomerative Hierarchical Clustering (AHC) with average linkage do not scale well when the number of items to be clustered is large. The best known algorithms are characterized by quadratic complexity. This is a generally accepted fact and cannot be improved without using specific of certain metric spaces. Twister tries is an algorithm that produces a dendrogram (i.e. outcome of a hierarchical clustering) which resembles the one produced by AHC, while only needing linear space and time. However, twister tries are sensitive to rare, but still possible, hash evaluations. These might have a disastrous effect on the final outcome. We propose the use of a metaheuristic algorithm to overcome this sensitivity and show how approximate computations of dendrogram quality can help to evaluate the heuristic within reasonable time. The proposed metaheuristic is based on an evolutionary framework and integrates a surrogate model of the fitness within it to enhance the algorithmic performance in terms of computational time.

10:30 [#1570191323] Overlapping Community Detection in Social Network Using Disjoint Community Detection
Meena, Jaswant; Devi, V. Susheela;

With increasing popularity and complexity of social networks, community detection in these networks has become an important research area. Several algorithms are available to detect overlapping community structures based on different approaches. Here we propose a two step genetic algorithm to detect overlapping communities based on node representation. First, we find disjoint communities and these disjoint communities are used to find overlapping communities. We use modularity as our optimization function. Experiments are performed on both artificial and real networks to verify efficiency and scalability of our algorithm.

10:50 [#1570192649] An Enhanced Quantum-Inspired Evolutionary Fuzzy Clustering
Bharill, Neha; Patel, Om; Tiwari, Aruna;

Clustering is one of the widely used knowledge discovery techniques to reveal the structures in a dataset that can be extremely useful for the analyst. In fuzzy based clustering algorithms, the procedure acquired for choosing the fuzziness parameter m, the number of clusters C and the initial cluster centroids is extremely important as it has a direct impact on the formation of final clusters. Moreover, the improper selection of these parameters may lead the algorithms to the local optima. In this paper, we proposed an Enhanced Quantum-Inspired Evolutionary Fuzzy C-Means (EQIE-FCM) algorithm to compute the global optimal value of these parameters. In EQIE-FCM, we utilize the quantum computing concept in combination with fuzzy clustering to evolve the different values of these parameters in several generations. However, in each generation these parameters are represented in terms of a quantum bit (Q). At each generation (g), the quantum bit of these parameters is updated using a quantum rotational gate. Through this, after several generations of evolution, we get the global optimal values of these parameters from a large quantum search space. The EQIE-FCM algorithm is applied on the Pima Indians Diabetes dataset and the performance of EQIE-FCM is compared with another Quantum-inspired Fuzzy Clustering (QIE-FCM) and other three fuzzy based evolutionary clustering algorithms from the literature. Extensive experiments indicate that the EQIE-FCM algorithm outperforms many baseline approaches and can be used an effective clustering algorithm.

11:10 [#1570192825] Maximum Clusterability Divisive Clustering
Hofmeyr, David; Pavlidis, Nicos;

The notion of clusterability is often used to determine how strong the cluster structure within a set of data is, as well as to assess the quality of a clustering model. In multivariate applications, however, the clusterability of a data set can be obscured by irrelevant or noisy features. We study the problem of finding low dimensional projections which maximise the clusterability of a data set. In particular, we seek low dimensional representations of the data which maximise the quality of a binary partition. We use this bi-partitioning recursively to generate high quality clustering models. We illustrate the improvement over standard dimension reduction and clustering techniques, and evaluate our method in experiments on real and simulated data sets.

11:30 [#1570192827] Collaborative Clustering: How to Select the Optimal Collaborators?
Rastin, Parisa; Cabanes, Gunal; Grozavu, Nistor; Bennani, Younes;

The aim of collaborative clustering is to reveal the common underlying structure of data spread across multiple data sites by applying clustering techniques. The idea of Collaborative Clustering is that each collaborator share some information about the segmentation (structure) of its local data and improve its own clustering with the information provided by the other collaborators. This paper analyses the impact of the Quality of the potential Collaborators to the quality of the collaboration.
for a Topological Collaborative Clustering Algorithm based on the learning of a Self-Organizing Map. Experimental analysis on four real vector data-sets showed that the diversity between collaborators impact the quality of the collaboration. We also showed that the internal indexes of quality are a good estimator of the increase of quality due to the collaboration.

11:50 [1570192955] A Comparative Study of Markov Network Structure Learning Methods Over Data Streams
Chandra, Swarpup; Karande, Vishal; Khan, Latifur;

Markov network is a widely used graphical representation of data in applications such as natural language and computational biology. This undirected graph consists of nodes and edges as attributes and its dependencies respectively. One major challenge in a learning task involving Markov network is to learn its structure, i.e. attribute dependencies, from data. This has been the subject of various studies in the recent past, which uses heuristics to estimate dependencies from data. In this paper, we highlight the challenges of Markov network structure learning, and review existing methods addressing these challenges. In particular, we study the scalability of these heuristics over streaming data where data instances are assumed to occur continuously. Furthermore, we propose a new heuristic based on clustering of features, consisting of attribute dependencies, that can seamlessly update the model structure as new data arrive in a stream. This clustering technique effectively reduces search space and uses fewer number of features to generate a single model. Weight learning and inference is performed at the end of each data chunk consisting of data instances arriving within a fixed time frame. We empirically evaluate the proposed heuristic by comparing the CMLL score, on various datasets (both streaming and non-streaming), with other state-of-the-art methods.

CICARE’15 Session: 1: Applications of Computational Intelligence and Informatics in Disease Diagnosis and Rehabilitation
Wednesday, December 9, 09:50–12:20, Room: 1.63
Chair: Jonathan Mwaura

09:50 [1570213002] Feature Reduction for Dimensional Emotion Recognition in Human-Robot Interaction
Banda, Ntombikayise; Engelbrecht, Andries; Robinson, Peter;

The introduction of social robots in human living spaces has brought to attention the need for robots to be equipped with emotion recognition capabilities to facilitate natural and social human-robot interactions. This paper explores the recognition of continuous dimensional emotion from facial expressions. It further investigates the use of principal component analysis (PCA), locality preserving projections (LPP) and factor analysis (FA) for reduction of the many features that are typically produced by facial feature extraction algorithms. The reduced features sets are modelled using Nonlinear AutoRegressive with eXogenous inputs Recurrent Neural Networks (NARX-RNN). The results show that PCA significantly outperforms both LPP and FA techniques, and that the NARX-RNN model is a powerful predictor of continuous emotion.

10:10 [1570197423] Smartphone-based Tele-Rehabilitation System for Frozen Shoulder Using a Machine Learning Approach
Ongvisatepaiboon, Kanmanus; Chan, Jonathan H.; Vanijja, Vajirasak;

Frozen shoulder is a very painful condition that affects patients’ daily life. Patients with frozen shoulder have to go to a hospital or medical center to get appropriate rehabilitation. Transportation to the hospital raises healthcare costs and the process can be time-consuming. We have developed a telerehabilitation system which allows patients to perform an at-home exercise. According to our existing system, it is only available for high-end smartphones with multiple sensors that include accelerometer, gyroscope, and magnetic field sensors. In this work, we propose a novel approach using machine learning to estimate the arm angle of rotation using only the accelerometer sensor. Results show that reasonable accuracy can be obtained so that it may be used with lower-end Android smartphone devices that only have an accelerometer available. A web-based interface enables the medical practitioner such as a physiotherapist to monitor and administer an appropriate rehabilitation program for more effective recovery.

10:30 [1570191481] A Decision Tree-Based Approach for Cardiovascular Dysautonomias Diagnosis: a Case Study
Idri, Ali; Kadi, Ilham;

Terms as knowledge Discovery from Databases (KDD), Data Mining (DM) and Machine Learning (ML), gain from day to day, an increasing significance in medical data analysis. They permit the identification, evaluation, and quantification of some less visible, intuitively unpredictable, by using generally large sets of data. Researchers have long been concerned with applying DM tools to improve data analysis on large data sets. DM has been increasingly used in medicine, particularly in cardiology. In fact, data mining applications can greatly benefits all parts involved in cardiology. Autonomic nervous system (ANS) is the part of the nervous system that is involved in homeostasis of the whole body functions. A malfunction in this system can lead to a cardiovascular dysautonomias. Thereby, a set of dynamic tests are adopted in ANS units to diagnose and treat patients with cardiovascular dysautonomias. In this paper, a case study was performed in order to construct a cardiovascular dysautonomias prediction system using data mining techniques and a dataset collected from an ANS unit of the Moroccan university hospital Avicenne. The prediction system is a decision tree-based classifier that was developed using C4.5 decision tree algorithm to automate the analysis procedure of ANS’s test results and make it easier for specialists. The performance of the generated decision trees was evaluated and the results obtained achieved high accuracy rates which
were very promising. In addition, a clinical validation of the developed system was carried out on new patients. In fact, a prototype of the developed system was implemented on JEE platform and deployed in the ANS unit so as to be validated clinically. The results were analyzed and thus the prototype was approved to be highly accurate, interpretable, time saving and easy to use.

**10:50 [1570210933]** A Novel Ontology and Machine Learning Inspired Hybrid Cardiovascular Decision Support Framework

**Hussain, Amir; Farooq, Kamran; Luo, Bin; Slack, Warner;**

Healthcare information management systems (HIMS) have a substantial amount of limitations such as rigidity and nonconformity to complex clinical processes like Electronic Healthcare records and effective utilisation of clinical practice guidelines to help provide effective clinical decision support. The conventional healthcare systems suffer from a general lack of intelligence, they are successful in offering basic patient management capabilities, but they do not offer consistent and holistic decision support capabilities for clinicians working under tight deadlines in a fast paced environment. The conventional healthcare information management systems are designed using branching logic based rigid architectures, which are hard to maintain and upgrade without considerable labour intensive effort. The proposed ontology and machine learning driven hybrid clinical decision support framework comprises of two key components (1) ontology driven clinical risk assessment and recommendation system and (2) machine learning driven prognostic system. The key aim of our research is to utilise information collected through the knowledge based ontology driven clinical risk assessment and recommendation system and non-knowledge based/evidence based machine learning driven prognostic system to deliver a holistic clinical decision support framework in the cardiovascular domain. The ontology driven clinical risk assessment and recommendation system could be used as a triage system for cardiovascular patients as a preventative solution, this could help clinicians prioritise patient referrals after reviewing a snapshot of patient’s medical history (collected through an ontology driven intelligent context aware information collection using standardised clinical questionnaires) containing patient demographics information, cardiac risk scores, cardiac chest pain score, medication and recommended lab tests details. The machine learning driven prognostic system is developed using a chest pain clinical case study identified by the consultant cardiologist, Professor Stephen Leslie from Raigmore Hospital in Inverness. The key aim of this clinical case study UK is to provide a clinical decision support mechanism for Raigmore Hospital’s Rapid Access Chest Pain Clinic (RACPC) patients by combining evidence, extrapolated through legacy patient data (based on machine learning driven techniques) to facilitate evidence based cardiovascular preventative care. The machine learning driven prognostic system provides cardiac chest pain prognosis through a cardiac chest pain specific prognostic model which is validated through consultant cardiologist from Raigmore Hospital. The cardiac chest pain prognostic model could help clinicians diagnose cardiac chest pain patients efficiently and could also help clinicians reduce load on overly prescribed angiography treatment in a cost effective manner. Additional two clinical case studies in the heart disease and breast cancer domains are considered for the development and clinical validation of the machine learning driven prognostic system. The proposed novel ontology and machine learning driven hybrid clinical decision support framework will also be validated in other application areas.

**11:10 [1570211245]** Solar Powered Wheel Chair for Physically Challenged People Using Surface EMG Signal

**Kaiser, M.; Shamim; Chowdhury, Zamshed Iqbal; Mamun, Shamim Al; Hussain, Amir; Mahmud, Mufti;**

This paper presents the design of low cost solar powered wheel chair for physically challenged people. The signals necessary to maneuver the wheel chair are acquired from different muscles of the hand using surface Electromyography (sEMG) technique. The raw sEMG signals collected from upper limb muscles are processed to extract the desired direction of movement for the wheel chair. The accuracy of the extracted EMG signals is found to be relatively high. A prototype is developed and tests verified the objective functionalities. The analysis of life cycle cost of the solar powered wheel chair is presented. It is found that the proposed wheel chair is financially feasible for developing countries.

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**Wednesday, December 9, 13:00–15:00**

MCDM’15 Session: 1:
Wednesday, December 9, 13:00–15:00, Room: 1.41
Chair: Hisao Ishibuchi, Co-chair: Sanaz Mostaghim

**13:00 [1570190115]** Comparative Study of Recent Multimodal Evolutionary Algorithms

**Pighetti, Romaric; Pallez, Denis; Precioso, Frederic;**

Multimodal Optimization (MMO) aims at identifying several best solutions to a problem whereas classical optimization converge oftenly to only one good solution. MMO has been an active research area in the past years and several new evolutionary algorithms have been developed to tackle multimodal problems. In this work, we compare extensively three recent evolutionary algorithms (MoBiDE, Multimodal NSGAII and MOMP3). Each algorithm uses multiobjective optimization, together with niching techniques to address scalar (single objective) MMO problems. We have fully re-implemented MoBiDE and MM-NSGAII in order to better evaluate their sensitivity to parameter changes and their strengths and weaknesses.
We have carefully evaluated all algorithms on the same benchmark functions and with the same parameters settings. The influence of the intrinsic parameters for each algorithm are stressed and the algorithms are also compared to a non-multimodal evolutionary algorithm to better highlight the impact of the multimodal adaptations. Moreover, full access to the detailed results and source code is granted on our website for the ease of reproducibility.

13:20 [1570192815] Using $\epsilon$-Dominance for Hidden and Degenerated Pareto-Fronts
Zille, Heiner; Mostaghim, Saman;

Scalable multi-objective test problems are known to be useful in testing and analyzing the abilities of algorithms. In this paper we focus on test problems with degenerated Pareto-fronts and provide an in-depth insight into the properties of some problems which show these characteristics. In some of the problems with degenerated fronts such as Distance Minimization Problem (DMP) with the Manhattan metric, it is very difficult to dominate some of the non-optimal solutions as the optimal solutions are hidden within a set of so called pseudo-optimal solutions. Hence the algorithms based on Pareto-domination criterion are shown to be inefficient. In this paper, we explore the pseudo-optimal solutions and examine how and why the use of $\epsilon$-dominance can help to achieve a better approximation of the hidden Pareto-fronts or of degenerated fronts in general.

We compare the performance of the -MOEA with 3 other algorithms (NSGA-II, NSGA-III and MOEA/D) and show that $\epsilon$-dominance performs better when dealing with pseudo-optimal kind of solutions. Furthermore, we analyze the performance on the WFG3 test problem and illustrate the advantages and disadvantages of $\epsilon$-dominance for this degenerated problem.

Snir, Alon; Samina, Barak; Moshakov, Amiram;

The set-based concept approach has been suggested as a means to simultaneously explore different design spaces at both the conceptual and the particular design levels. The type of exploration problem, which is dealt with here, aims to reveal the approximated concepts' fronts, within a Pareto relaxation zone. Based on a resolution-relaxation approach, a unique concept-based evolutionary algorithm has recently been suggested to tackle this problem. Here, we suggest a modification to that algorithm, which aims to provide an adaptive mechanism to distribute the computational resources among the evolved concepts under a given run-time limitation.

14:00 [1570194071] Relation Between Weight Vectors and Solutions in MOEA/D
Ishibuchi, Hisao; Doi, Ken; Masuda, Hiroyuki; Nojima, Yusuke;

An important implementation issue in MOEA/D (multiobjective evolutionary algorithm based on decomposition) is the specification of a scalarizing function. For its appropriate specification, it is necessary to understand the search behavior of MOEA/D for various settings of a scalarizing function. Especially, it is important to understand the relation between weight vectors and obtained solutions. The understanding of this relation is also very important for the incorporation of preference information into MOEA/D through weight vector specification. In this paper, we examine the mapping from weight vectors to solutions by monitoring which solution is obtained from each weight vector. MOEA/D with a number of different settings of a scalarizing function is applied to knapsack problems and DTLZ2 with 2-6 objectives. As a scalarizing function, we use the weighted sum, the weighted Tchebycheff and the PBI (penalty-based boundary intersection). We obtained some interesting observations from computational experiments. Among them are the existence of many duplicated solutions in the final population of MOEA/D, their positive effects on the search ability, and a dominant effect of the penalty parameter in the PBI on the search behavior.

14:20 [1570203017] Approximative Pareto Front Identification
Drugan, Madalina;

Techniques from multi-objective optimization are incorporated into the stochastic multi-armed bandit (MAB) problem to improve performance when the rewards obtained from pulling an arm are random vectors instead of random variables. We call this problem the stochastic multi-objective MAB (or MOMAB) problem. In this paper, we study the analytical and empirical proprieties of MOMABs with the goal of identifying multiple arms in the Pareto front that use the partial Pareto dominance relation to compare mean reward vectors. We introduce three algorithms: 1) Pareto Front Identification identifies the Pareto optimal arms using a fixed budget. 2) $\epsilon$-approximate Pareto Front Identification uses the Pareto $\epsilon$-dominance to identify a uniformly spread subset of the Pareto front. 3) Pareto Subfront Identification combines the last two algorithms to improve the accuracy of the $\epsilon$-approximation Pareto front. We experimentally compare the proposed algorithms on several Pareto MAB-problems.

14:40 [1570192469] Enhancing State-of-the-art Multi-objective Optimization Algorithms by Applying Domain Specific Operators
Ghoreishi, Newsha; Sørensen, Jan; Jørgensen, Bo;

To solve dynamic multi-optimization problems, optimization algorithms are required to converge quickly in response to changes in the environment without reducing the diversity of the found solutions. Most Multi-Objective Evolutionary Algorithms (MOEAs) are designed to solve static multi-objective optimization problems where the environment does not change dynamically. For that reason, the requirement for convergence in static optimization problems is not as time-critical as for dynamic optimization problems. Most MOEAs use generic variables and operators that scale to static multi-objective optimization problems. Problems emerge when the algorithms can not converge fast enough, due to scalability issues introduced by using too generic operators. This paper presents an evolutionary algorithm CONTROLEUM-GA that uses domain spe-
cific variables and operators to solve a real dynamic greenhouse climate control problem. The domain specific operators only encode existing knowledge about the environment. A comprehensive comparative study is provided to evaluate the results of applying the CONTROLEUM-GA compared to NSGAII, -NSGAII and -MOEA. Experimental results demonstrate clear improvements in convergence time without compromising the quality of the found solutions compared to other state-of-art algorithms.


Chair: Peter Sarlin

Chen, Kuan-Heng; Khashanah, Khaldoun;

Independent component analysis (ICA) is a statistical method for transforming multidimensional observed signals into components, which are statistically independent from each other, which is a case of redundancy reduction. In this paper, we implement FastICA proposed by Hyvarinen and Oja to investigate the relationship between systemic risk and ICA in the US financial market. We propose a systemic risk indicator based on observing the redundancy level of signals in running 10 variables including 10 S&P 500 sector indices. We find that not only the redundancy level of signals becomes larger during a crisis than during a normal period, but also the financial system becomes more vulnerable when the redundancy level grows up.


Rönqvist, Samuel; Sarlin, Peter;

News is a pertinent source of information on financial risks and stress factors, which nevertheless is challenging to harness due to the sparse and unstructured nature of natural text. We propose an approach based on distributional semantics and deep learning with neural networks to model and link text to a scarce set of bank distress events. Through unsupervised training, we learn semantic vector representations of news articles as predictors of distress events. The predictive model that we learn can signal coinciding stress with an aggregated index at bank or European level, while crucially allowing for automatic extraction of text descriptions of the events, based on passages with high stress levels. The method offers insight that models based on other types of data cannot provide, while offering a general means for interpreting this type of semantic-predictive model. We model bank distress with data on 243 events and 6.6M news articles for 101 large European banks.

13:40 [#1570193079] An Extreme Firm-Specific News Sentiment Asymmetry Based Trading Strategy

Liu, Anqi; Yang, Steve; Deane, Anil; Datta, Kaushik;

News sentiment has been empirically observed to have impact on financial market returns. In this study, we investigate firm-specific news from the Thomson Reuters News Analytics data from 2003 to 2014 and propose an optimal trading strategy based on a sentiment shock score and a sentiment trend score which measure extreme positive and negative sentiment levels for individual stocks. The intuition behind this approach is that the impact of events that generate extreme investor sentiment changes tends to have long and lasting effects to market movement and hence provides better prediction to market returns. We document that there exists an optimal signal region for both indicators. And we also show extreme positive sentiment provides better a signal than extreme negative sentiment, which presents an asymmetric market behavior in terms of news sentiment impact. The backtest results show that extreme positive sentiment generates robust and superior trading signals in all market conditions, and its risk-adjusted returns significantly outperform the S&P 500 index over the same time period.

14:00 [#1570193153] Learning Ordinary Differential Equations for Macroeconomic Modelling

Georgiev, Zhivko; Kazakov, Dimitar;

This article describes an empirical approach to the macroeconomic modelling of the Euro zone. Data for the period 1971–2007 has been used to learn systems of ordinary differential equations (ODE) linking inflation, real interest and output growth. The equation discovery algorithm LAGRAMGE was used in conjunction with a grammar defining a potentially large range of possible parametric equations. The coefficients of each equation are automatically fitted on the training data and the ones with the lowest error rates returned as a result. We have added a tool for out-of-sample error evaluation to the in-sample evaluation built in LAGRAMGE. The paper compares the performance of ODE models to previous work on the learning of ordinary equations for the same purpose.

14:20 [#1570193177] Sentiment Classification in the Financial Domain Using ν-SVM and Multi-Objective Optimisation

Sun, Fan; Belatreche, Ammar; Coleman, Sonya A; McGinley, Thomas; Li, Yuhua;

Online financial textual information containing a large amount of investor sentiment is growing rapidly and an effective solution to automate the sentiment classification of such large amounts of text would be extremely beneficial. A novel approach to sentiment classification is the application of multi-objective optimization combined with ν-SVM to improve the overall accuracy and hence we present a Multi-Objective Genetic Algorithm (MOGA) based approach to automatically adjust the free parameters of a -SVM classifier to optimise sentiment classification performance. The approach is implemented and tested using two online financial textual datasets and experimental results show that the overall classification accuracy has
14:40 [#1570193221] CrisisModeler: A Tool for Exploring Crisis Predictions
Holopainen, Markus; Sarlin, Peter;

The CrisisModeler tool presented in this paper allows for exploring financial crisis predictions. Despite wide interest in crisis prediction, little attention has been given to generalizable modeling solutions, real-time implementations, thorough comparisons among methods and interactive interfaces to explore models. This paper combines many approaches used in predicting financial crises within a fully-fledged framework for modeling and evaluation, and provides an implementation of a general-purpose tool with a web-based interactive interface to explore model output. We illustrate the use of the CrisisModeler with a case study on European banks, including a horse race of methods and investigations of different specifications. The case study illustrates the versatility and suitability of the tool for supporting exploration and communication of models for crisis prediction.

CIDM’15 Session: 4: Data Mining Applications
Wednesday, December 9, 13:00–15:00, Room: 1.62
Chair: Sascha Meudt

Idri, Ali; Hassani, Aya; Abran, Alain;

Software effort estimation is very crucial and there is always a need to improve its accuracy as much as possible. Several estimation techniques have been developed in this regard and it is difficult to determine which model gives more accurate estimation on which dataset. Among all proposed methods, the Radial Basis Function Neural (RBFN) networks models have presented promising results in software effort estimation. The main objective of this research is to evaluate the RBFN networks construction based on both hard and fuzzy C-means clustering algorithms using cross-validation approach. The objective of this replication study is to investigate if the RBFN-based models learned from the training data are able to estimate accurately the efforts of yet unseen data. This evaluation uses two historical datasets, namely COCOMO81 and ISBSG R8.

Chiba, Kazuhiisa; Yoda, Hideyuki; Ito, Shoma; Kanazaki, Masahiro;

Visualization of design space has been performed for researching and developing a single-stage launch vehicle with hybrid rocket engine by using design informatics, which has three points of view such as problem definition, optimization, and data mining. The primary objective of the present design is that the ascendancy of extinction-reignition, which is one of the beneficial point of hybrid rocket, for improving the downrange and the duration time in the lower thermosphere. Polypropylene and liquid oxygen with swirling flow are adopted as solid fuel and liquid oxidizer, respectively. The multidisciplinary design optimization was performed by using a hybrid evolutionary computation. Data mining was also implemented by using a scatterplot matrix. As a result, it is revealed that extinction-reignition extends the duration time though it does not give an effect on improving the downrange. Data-mining result also shows the physical mechanism of the design variables to improve the duration time on the visualization of design-space constitution.

13:40 [#1570191593] Using Twitter for Next-Place Prediction, with an Application to Crime Prediction
Wang, Mingjun; Gerber, Matthew;

This research focuses on two problems. First, we investigate the prediction of social media users’ spatial trajectories. Recent work on this task has focused on the use of cellular network traces and location-based social network services such as Foursquare, all of which emit structured geospatial information (e.g., cellular tower identifiers, GPS coordinates, and venue identifiers). Less attention has been paid to the rich textual content that users often publish in tandem with the structured information. We investigate methods of integrating textual content into existing next-place prediction models, and we demonstrate a significant improvement in next-place prediction compared to several baselines derived from published research. Second, we examine the correlation between these next-place predictions and the occurrence of crimes in a major United States city, with the goal of aiding future research into automatic crime prediction.

14:00 [#1570191950] Genetic Clustering Algorithm for Extractive Text Summarization
Benjumea, Sebastian Suarez; León, Elizabeth;

Automatic text summarization has become a relevant topic due to the information overload. This automatization aims to help humans and machines to deal with the vast amount of text data (structured and un-structured) offered on the web and deep web. In this paper a novel approach for automatic extractive text summarization called SENCLUS is presented. Using a genetic clustering algorithm, SENCLUS clusters the sentences as close representation of the text topics using a fitness function based on redundancy and coverage, and applies a scoring function to select the most relevant sentences of each topic to be part of the extractive summary. The approach was validated using the DUC2002 data set and ROUGE summary quality measures. The results shows that the approach is representative against the state of the art methods for extractive automatic text summarization.
14:20 #1570192513 Optimizing Seed Set for New User Cold Start
Wang, He-Da; Wu, Ji;

Users newly enter a recommender system can not get personalized recommendation due to the lack of personal profiles. An interview process that asks new users to rate a set of items (the seed set) will help user modeling and improve user experience. Traditional seed set generation approaches often concentrate on item-wise properties instead of aiming at finding the optimal seed set. We propose a simple random optimization technique to search for the optimal seed set, which considers the seed set as a whole and performs a random search by reducing the prediction error on validation set. By off-line experiments on the MovieLens 10M data set, we show that the proposed approach performs as well as the state-of-the-art method called GreedyExtend, and the proposed approach needs significantly less computational cost to reach the same prediction error as the best baseline on validation set.

14:40 #1570192589 Collaborative Filtering of Call for Papers
Wang, He-Da; Wu, Ji;

Call for papers (CFPs) are notifications of academic events that invite researchers to submit their works. Traditionally, CFPs are handed out to researchers by mailing lists and web pages. With the number of conferences increasing, finding, reading and filtering out relevant CFPs become time consuming and need the assistance from information retrieval techniques. In this paper, we employ collaborative filtering to match relevant CFPs to researchers. Non-personalized, neighborhood-based and class-based methods are applied in CFP recommendation. We also propose a hybrid approach that utilizes conference series and submission deadlines of CFPs. The experiments on WikiCFP data set show that the class-based method outperforms both neighborhood-based and non-personalized methods, whereas the proposed hybrid approach has the best overall performance.

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FOCI’15 Session: 1: Fuzzy Logic
Wednesday, December 9, 13:00–15:00, Room: 1.63
Chair: Pablo Cordero

13:00 #1570173287 An Open Source Matlab/Simulink Toolbox for Interval Type-2 Fuzzy Logic Systems
Taskin, Ahmet; Kumbasar, Tufan;

In the last two decades, we have witnessed that Interval Type-2 Fuzzy Logic Systems (IT2-FLSs) have been successfully implemented in various engineering areas. In this paper, we will introduce a free open source Matlab/Simulink toolbox for the development of IT2-FLSs for a wider accessibility to users beyond the type-2 fuzzy logic community. The presented IT2-FLS toolbox allows intuitive implementation of IT2-FLSs where it is capable to cover all the phases of its design. In order to allow users to easily construct IT2-FLSs, a GUI is developed which is similar to that of Matlab Fuzzy Logic Toolbox. We have embedded various Type Reduction (TR) methods in the toolbox since the TR method is the most important operation that must be taken into consideration. This gives the opportunity to the user to examine the performance of his/her IT2-FLS design with respect to the TR methods. We have also developed an IT2-FLS Simulink library so that the designer can perform various simulation analyses and can also investigate the effect of TR method on the performance of the IT2-FLS. Moreover, the developed IT2-FLS Matlab/Simulink toolbox contains an automatic connection between Matlab and Simulink environments. Once the user has finished the design of the IT2-FLS via the GUI, it is possible to export his/her design directly to Simulink via an automatic Simulink file generation. We believe that the availability of the developed free and open-source IT2-FLS Matlab/Simulink toolbox will be an important step for a wider deployment and development of IT2-FLSs.

13:20 #1570193009 Omega-algebras
Seselja, Branimir; Tepavcevic, Andreja;

In the framework of Omega-sets, where Omega is a complete lattice, we generalize the notion of an (universal) algebra, and we investigate its basic properties. Our techniques belong to the theory of lattice-valued (fuzzy) structures and we use cut-sets. An Omega-algebra is equipped with an Omega-valued equality instead of the classical one. We investigate identities and their satisfiability by these new structures. We prove that a set of identities holds on an Omega-algebra if and only if the cut-subalgebras over the corresponding cut-congruences of the Omega-valued equality satisfy the same identities in the classical setting.

13:40 #1570193137 L-E Fuzzy Boolean Algebras
Seselja, Branimir; Tepavcevic, Andreja;

We introduce a special notion of a generalized fuzzy Boolean algebra. The universe of this structure is an algebra with two binary, unary and two nullary operations (as usual), but which is not a crisp Boolean algebra in general. The fuzzy identities that are satisfied in this structure enable that the usual identities for Boolean algebras are approximately satisfied, where a fuzzy equivalence relation has a main role. This paper presents an initial investigation of these new structures and some preliminary considerations and conclusions are provided. The main result is that an L-E fuzzy Boolean algebra is an L-E fuzzy lattice.
A fuzzy extension of the classical functional dependency is shown which associates a degree not only to the attributes but also to the functional dependency, providing the maximum level of uncertainty in tables. For this proposal the kernel is the use of Simplification Logic for these fuzzy functional dependencies, which ensures a solid and efficient approach to manage them in the fuzzy extension considered. An algorithm to compute closures for this fuzzy functional dependencies is outlined and a normal form for fuzzy functional dependencies named direct-optimal basis is proposed.

During the last two decades, several fuzzy extensions of the pure logic language Prolog have been developed thus producing modern fuzzy logic languages which manage truth degrees beyond the simpler case of true, false. Such values are usually collected in lattices whose correct design require to take special care when deciding the top/bottom elements, establishing the ordering relation and so on. In this paper we describe a graphical tool devoted to assist the development of such structures. A crucial and distinguishing feature of the tool relies on its capability for generating code in form of Prolog clauses which can be directly imported by the fuzzy logic programming environment FLOPER developed too in our research group.

### Wednesday, December 9, 15:20–17:20

#### CIPLS’15 Session: 1:
Wednesday, December 9, 15:20–17:20, Room: 1.41
Chair: Bülent Çatay

15:20 [#1570192191] A Collaborative Lot-Sizing Problem with Production Limitations
Ziebuhr, Mario; Buer, Tobias; Kopfer, Herbert;

Manufacturing companies are using collaborative planning for the coordination of lot-sizing decisions in inter-organisational supply chains. By using collaborative planning, the members of a supply chain try to identify a production plan which results in lower costs compared to individual plans by simultaneously preserving their autonomy. A distributed lot-sizing problem with rivaling agents (DULR) is studied where each item can be produced by more than one member of the coalition (agent). Thereby it occurs that agents compete for the production quotas of items. However, the goal of this contribution is to extend the DULR by considering two types of items. One type can be produced by more than one agent, while the other one can only be produced by a certain agent due to contractual obligations. We denote the former type of items as concurrent item and the latter one as compulsory items. To solve the DULR with different types of items, an existing negotiation mechanism based on a simulated annealing is applied and modified. A benchmark study shows that the modified solution approach even outperforms the best-known approach for the DULR. Based on this finding, a second study is applied where the impact of compulsory items is investigated for the DULR.

15:40 [#1570192833] Adaptive IDEA for Robust Multiobjective Optimization. Application to the r-TSALBP-m/A
Chica, Manuel; Bautista, Joaquin; Damas, Sergio; Cordon, Oscar;

Robust optimization tries to find flexible solutions when solving problems with uncertain scenarios and vague information. In this paper we present a multiobjective evolutionary algorithm (EMO) to solve robust multiobjective optimization problems. This algorithm is a novel adaptive method able to evolve separate populations of robust and non robust solutions during the search. It is based on the existing infeasibility driven evolutionary algorithm (IDEA) and uses an additional objective to evaluate the robustness of the solutions. The original and adaptive IDEAs are applied to solve the rTSALBP-m/A, an assembly line balancing model that considers a set of demand production plans and includes temporal overloads of the stations of the assembly line with respect to these plans as robustness functions. Our results show that the proposed adaptive IDEA gets more robust non-dominated solutions for the problem. Also, we show that, for the case of the r-TSALBP-m/A, we can obtain Pareto fronts with a higher convergence when including robustness information during the search of the algorithm.

16:00 [#1570193101] The Influence of the Picking Times of the Components in Time and Space Assembly Line Balancing Problems: An Approach with Evolutionary Algorithms
Absina, Emanuél; Capodieci, Nicola; Cabri, Giacomo; Regattieri, Alberto; Gamberi, Mauro; Pilati, Francesco;

The balancing of assembly lines is one of the most studied industrial problems, both in academic and practical fields. The
workable application of the solutions passes through a reliable simplification of the real-world assembly line systems. Time
and space assembly line balancing problems consider a realistic versions of the assembly lines, involving the optimization of
the entire line cycle time, the number of stations to install, and the area of these stations. Components, necessary to complete
the assembly tasks, have different picking times depending on the area where they are allocated. The implementation in the
real world of a line balanced disregarding the distribution of the tasks which use unwieldy components can result unfeasible.
The aim of this paper is to present a method which balances the line in terms of time and space, hence optimizes the allocation
of the components using an evolutionary approach. In particular, a method which combines the bin packing problem with a
genetic algorithm and a genetic programming is presented. The proposed method can be able to find different solutions to
the line balancing problem and then evolve they in order to optimize the allocation of the components in certain areas in the
workstation.

16:20 [#157019233] Component Analysis Based Approach to Support the Design of Meta-heuristics for MLCLSP Providing Guidelines
Pessoa, Luis; Wagner, Carolin; Neto, Fernando Lima; Hellingrath, Bernd;

Today’s supply chain are highly complex and globally set-up underlying a constant change with increasing speed. This has
to be reflected by the planning processes and algorithms being utilized in the different stages of a supply chain. In the
context of production planning, meta-heuristics are usually applied due to their ability to handle high complex problems.
As a consequence, these algorithms require adaptation to the new scenario or even new solution approaches/strategies have
to be devised. However, designing a meta-heuristic of good performance for a problem is a hard task, since it requires deep
knowledge on the problem, as well as on the meta-heuristic side. Therefore, the existence of supporting guidelines for meta-
heuristics might ease and speed-up the adaptation or design of these algorithms to better cope with the problem. In this
paper, meta-heuristics are deconstructed into its components and an approach for component-based analysis is proposed
to gain knowledge about their performance and how they perform the search. Based on the results of this analysis, guidelines
can be devised. The proposed approach is applied for analyzing components of a good performing Genetic Algorithm (GA)
for multi-level capacitated lot sizing problem (MLCLSP) and initial guidelines for the construction of GA in the domain of
MLCLSP are generated.

ICES’15 Session: 1: Evolvable Robotic Systems
Wednesday, December 9, 15:20–17:20, Room: 1.42
Chair: Lukas Sekanina

15:20 [#157019278] Evolving Robust Robot Team Morphologies for Collective Construction
Nitschke, Geoff;

This research falls within evolutionary robotics and the larger taxonomy of cooperative multi-robot systems. A study
of comparative methods to adapt the behaviors and morphologies of simulated robot teams that must solve a collective
construction task is presented. Multiple versions of an indirect (developmental) encoding method for the artificial evolution
of (team) behaviors and morphologies were tested. The indirect encoding method was able to adapt team morphology (number
of sensors) and behavior (ANN controller connections and weights) that out-performed a team with fixed morphology and
adaptive behavior. Results also indicated that the developmental method was appropriate for evolving controllers that were
able to generalize to a range of team morphologies that solved the collective construction task with a high degree of task
performance

Nitschke, Geoff;

This is a study on the role of morphology (sensor configuration) and behavioral (control system) adaptation in simulated
robot teams that must accomplish cooperative tasks. The research objective was to elucidate the necessary features and
computational mechanics of a method that automates the behavior-morphology design of robot teams that must accomplish
cooperative tasks (tasks that cannot be optimally solved by individual robots). Results indicate that automating behavior
morphology design is beneficial as task complexity increases, compared to evolving behaviors in fixed morphology teams.
However, increased task complexity does not necessarily equate to the evolution of increased morphological complexity in
teams.

16:00 [#157017125] Evolution, Individual Learning, and Social Learning in a Swarm of Real Robots
Heinerman, Jacqueline; Rango, Massimiliano; Eiben, A.E.;

We investigate a novel adaptive system based on evolution, individual learning, and social learning in a swarm of physical
Thymio II robots. The system is based on distinguishing inheritable and learnable features in the robots and defining
appropriate operators for both categories. In this study we choose to make the sensory layout of the robots inheritable, thus
evolvable, and the robot controllers learnable. We run tests with a basic system that employs only evolution and individual
learning and compare this with an extended system where robots can disseminate their learned controllers. Results show
that social learning increases the learning speed and leads to better controllers.
Mwaura, Jonathan; Keedwell, Ed;

Current trends in evolutionary robotics (ER) involve training a neuro-controller using one of the various population based algorithms. The most popular technique is to learn the optimal weights for the neural network. There is only a limited research into techniques that can be used to fully encode a neural network (NN) and therefore evolve the architecture, weights and thresholds as well as learning rates. The research presented in this paper investigates how the chromosomes of the gene expression programming (GEP) algorithm can be used to evolve robotic neural controllers. The designed neuro-controllers are utilised in a robotic wall following problem. The ensuing results show that the GEP neural network (GEPNN) is a promising tool for use in evolutionary robotics.

16:40 [1570174311] A Multi-Agent System for Autonomous Adaptive Control of a Flapping-Wing Micro Air Vehicle
Greenwood, Garrison; Podhradsky, Michal; Gallagher, John; Matson, Eric;

Biomimetic flapping wing vehicles have attracted recent interest because of their numerous potential military and civilian applications. In this paper we describe the design of a multi-agent adaptive controller for such a vehicle. This controller is responsible for estimating the vehicle pose (position and orientation) and then generating four parameters needed for split-cycle control of wing movements to correct pose errors. These parameters are produced via a subsumption architecture rule base. The control strategy is fault tolerant. Using an online learning process an agent continuously monitors the vehicle's behavior and initiates diagnostics if the behavior has degraded. This agent can then autonomously adapt the rule base if necessary. Each rule base is constructed using a combination of extrinsic and intrinsic evolution. Details on the vehicle, the multi-agent system architecture, agent task scheduling, rule base design, and vehicle control are provided.

15:20 [1570167173] Study of Normalization and Aggregation Approaches for Consensus Network Estimation
Bellot, Pau; Salembier, Philippe; Oliveras, Albert; Meyer, Patrick;

Inferring gene regulatory networks from expression data is a very difficult problem that has raised the interest of the scientific community. Different algorithms have been proposed to try to solve this issue, but it has been shown that the different methods have some particular biases and strengths, and none of them is the best across all types of data and datasets. As a result, the idea of aggregating various network inferences through a consensus mechanism naturally arises. In this paper, a common framework to standardize already proposed consensus methods is presented, and based on this framework different proposals are introduced and analyzed in two different scenarios: Homogeneous and Heterogeneous. The first scenario reflects situations where the networks to be aggregated are rather similar because the are obtained with inference algorithms working on the same data, whereas the second scenario deals with very diverse networks because various sources of data are used to generate the individual networks. A procedure for combining multiple network inference algorithms is analyzed in a systematic way. The results show that there is a very significant difference between these two scenarios, and that the best way to combine networks in the Heterogeneous scenario is not the most commonly used. We show in particular that aggregation in the Heterogeneous scenario can be very beneficial if the individual networks are combined with our new proposed method ScaleLSum.

15:40 [1570171901] An Ansatz for a Theory of Living Systems
Chu, Dominique; Barnes, David;

Mathematical and computational modelling is now firmly established as an important tool in life sciences. However, it is not yet established as a source of biological knowledge on an equal footing with experimentation. Here we argue that there are now substantial opportunities for a new theoretical biology that not only benefits from experimental research but also influences this research. We argue that such a new theoretical biology would need to find the appropriate level of abstraction and combine aspects of Artificial Life and theoretical biophysics. We also provide an outline of a research agenda that could lead to experimentally testable insights into biological systems.

16:00 [1570184497] Effects of Several Bioinspired Methods on the Stability of Coevolutionary Complexification
Inden, Benjamin; Jost, Jürgen;

We study conditions for sustained growth of complexity in an abstract model of parasitic coevolution. Previous research has found that complexification is hard to achieve if the evolution of the symbiont population is constrained by the hosts but the evolution of the hosts is unconstrained, or, more generally, if the task difficulty is much higher for the symbionts than for the hosts. Here we study whether three bioinspired methods known from previous research on achieving stability in coevolution (balancing, niching, and reduced resistance) can restore complexification in such situations. We find that reduced resistance, and to a lesser degree niching, are successful if applied together with truncation selection, but not if applied together with fitness proportional selection.
Hamann, Heiko; Wahby, Mostafa; Schmickl, Thomas; Zahadat, Payam; Holstadler, Daniel; Stoy, Kasper; Risí, Sebastian; Faina, Andres; Veenstra, Frank; Kernbach, Serge; Kuksin, Igor; Kernbach, Olga; Ayres, Phil; Wojtaszek, Przemysław;

Besides the life-as-it-could-be driver of artificial life research there is also the concept of extending natural life by creating hybrids or mixed societies that are built from natural and artificial components. In this paper we motivate and present the research program of the project flora robotica. Our objective is to develop and to investigate closely linked symbiotic relationships between robots and natural plants and to explore the potentials of a plant-robot society able to produce architectural artifacts and living spaces. These robot-plant bio-hybrids create synergies that allow for new functions of plants and robots. They also create novel design opportunities for an architecture that fuses the design and construction phase. The bio-hybrid is an example of mixed societies between ‘hard’ artificial and ‘soft’ natural life, which enables an interaction between natural and artificial ecologies. They form an embodied, self-organizing, and distributed cognitive system which is supposed to grow and develop over long periods of time resulting in the creation of meaningful architectural structures. A key idea is to assign equal roles to robots and plants in order to create a highly integrated, symbiotic system. Besides the gain of knowledge, this project has the objective to create a bio-hybrid system with a defined function and application - growing architectural artifacts.

16:40 [1570191933] Using the Simulation of Ecological Systems to Explain the Wheel of Retailing
Ducan, Roderick; Bossomaier, Terry; D’Alessandro, Steven; Johnson, Craig; French, Kathrynn;

Understanding the change in retail structure has been a distinct challenge for many managers and policy analysts since the 1950s. Research has focused on concepts such as the wheel of retailing. However, this theory is more descriptive than explanatory of changes in market structure. In this paper we argue that changes in retail structure (discount stores, specialist stores, department stores and even malls versus online shopping), can be modelled using the ecological simulation concept of competing sessile species, with different growth rates and overgrowth rates based on changing suitability to the environment. Our results show that the application of the COMPETE model [see 1, 2] produce greater and a different diversity of retailers in larger compared to smaller shopping malls.

17:00 [1570193575] The Impact of Obstruction on a Model of Competitive Exclusion in Plants
Tsang, Jeffrey; Ashlock, Daniel A;

This study extends an earlier work on an agent based model of competitive exclusion in plants by adding obstructions to a toroidal agent world. The agents are called grid plants, whose genome specifies their pattern of growth and when they make seeds. Seed production is the figure of merit used to assess the success of grid plants. Barriers are found to substantially inhibit seed production, out of proportion to the amount of space they occupy. Two types of barriers are used, ones that occupy productive space in the simulation and ones that block growth between grids of the simulation but occupy no space. Both sorts of barriers are found to inhibit seed production well in excess of the physical space obstructed, nor is fraction of obstruction a strong determinant of the level of inhibition. There is a cooperative effect from both seed mortality and barriers: past some threshold dependent on both, the plants take much longer to achieve exponential growth, if at all. A very strong effect of nonlocal adaptation is apparent in the results, where plants evolved under increasing hardship are initially better adapted, even to other boards, but the effect reverses when evolutionary pressure becomes too high.

SIS’15 Session: 2: Ant Colony Optimization
Wednesday, December 9, 15:20–17:20, Room: 1.44
Chair: Ashraf Abdelbar, Co-chair: Shigeyoshi Tsutsui

15:20 [1570189623] A Comparative Study for Efficient Synchronization of Parallel ACO on Multi-core Processors in Solving QAPs
Tsutsui, Shigeyoshi; Fujimoto, Noriyuki;

This paper describes three types of parallel synchronization models of ant colony optimization (ACO) on multi-core processors in solving quadratic assignment problems (QAPs). These three models include (1) Synchronous Parallel (SP), (2) Asynchronous Parallel (AP), and Distributed Asynchronous Parallel (DAP). Parallel executions are studied up to 16-core. Among these models, the DAP shows the most promising results over various sizes of QAP instances. It also shows a good scalability capability up to 16-core.

15:40 [1570192483] Towards a Network Interpretation of Agent Interaction in Ant Colony Optimization
Kröner, Pavel; Gajdos, Petr; Zelinka, Ivan;

This work introduces a novel framework for a network interpretation of agent interaction in ant-inspired algorithms. A complex network interpretation of population dynamics is a recent trend in the research of population-based metaheuristic algorithms. Complex network models of nature-inspired methods enable the use of a wide variety of analytical methods from the areas of graph theory and network science in the field of computational intelligence. Agent interaction is in this approach cast into an evolving complex network with vertices representing individual agents and arcs with evolving weights.
corresponding to their interaction. This paper presents a generic framework for such network interpretation of ant interaction as well as its initial implementation for a sample problem, the travelling salesman problem. Initial computational experiments illustrate the proposed concepts and demonstrate the usefulness of network-based analysis of ant-inspired methods.

16:00 [#1570192887] A Gradient-Guided ACO Algorithm for Neural Network Learning
Abdelbar, Ashraf; Salama, Khalid;

The ACO-R algorithm is an Ant Colony Optimization (ACO) algorithm for real-valued optimization, and has been applied to neural network learning. Unlike many algorithms for neural network learning, ACO-R does not use gradient information at all in its operation. Also, unlike many discrete ACO algorithms, ACO-R does not allow for the incorporation of domain-specific heuristics. In this work, we present a gradient-guided variation of ACO-R that incorporates gradient information while retaining the core aspects of the ACO-R algorithm. Experimental results using 10-fold cross-validation with 20 UCI datasets indicate that our variation produces lower test set error than standard ACO-R, after a markedly smaller number of training generations.

16:20 [#1570192889] Ant Colony Optimization for First-order Rule Discovery
Ramirez, Rafael;

In the past, ant colony optimization has been applied to learning sets of propositional rules. In this paper, we present an algorithm for learning sets of first-order rules with ant colony optimization. First-order rules can sometimes provide a more intuitive and accurate concept description as they are more expressive than traditional propositional rules. As a case study, we apply our algorithm to expressive music performance modeling, one of the most challenging problems in music informatics, and compare our results with the results obtained by state-of-the-art first-order rule learning algorithms.

16:40 [#1570192901] Investigating Evaluation Measures in Ant Colony Algorithms for Learning Decision Tree Classifiers
Salama, Khalid; Abdelbar, Ashraf; Otero, Fernando;

Classification is a data mining task where the goal is to build, from labeled cases, a model that can be used to predict the class of unlabeled cases. Ant-Tree-Miner is a decision tree induction algorithm that is based on the Ant Colony Optimization (ACO) meta-heuristic. Ant-Tree-Miner\(M\) is a recently introduced adaptation of the ACO algorithm that learns multi-tree classification models. A multi-tree model consists of multiple decision trees, one for each class value, where each class-based decision tree is responsible for discriminating between its class value and all other values present in the class domain (one vs. all). In this paper, we investigate the use of 10 different classification quality evaluation measures in Ant-Tree-Miner\(M\), which are used for both candidate model evaluation and model pruning. Our experimental results, using 40 popular benchmark datasets, identify several quality functions that significantly improve on the simple Accuracy quality function that was previously used in Ant-Tree-Miner\(M\).

Thursday, December 10, 09:30–12:20

CIComms'15 Session: 1a: Special Session: Nature-inspired Antenna Systems
Thursday, December 10, 09:50–11:10, Room: 1.41
Chair: Randy Haupt, Co-chair: Paolo Rocca

09:50 [#1570196203] Surrogate-Assisted Optimization of Metamaterial Devices for Advanced Antenna Systems
Tenuti, Lorenzo; Salucci, Marco; Oliveri, Giacomo; Rocca, Paolo; Massa, Andrea;

The synthesis of metamaterial devices able to enhance the features (radiation, size, etc.) of advanced antenna system is addressed in this work through an innovative surrogate-assisted optimization strategy. The design technique, which belongs to the class of System-by-Design methodologies, integrates a multi-agent cooperative evolutionary optimization technique with a surrogate model used to predict the value of the cost function (mismatch between desired and obtained radiation features) without requiring full-wave numerical simulations at each iteration of the iterative search procedure. The effectiveness of the introduced approach is preliminary validated in the design of an inhomogeneous isotropic metamaterial lens devoted to the miniaturization of a linear array.

10:10 [#1570192027] Role of Boundary Dynamics in Improving Efficiency of Particle Swarm Optimization on Antenna Problems
Chakravorty, Pragnan; Mandal, Durbadal;

Attainment of global optimal solution and reduction of computational time and resources have always been a tradeoff issue in formulation of nature inspired algorithms; this tradeoff challenge has brought in a deluge of new algorithms proposing their efficacy over one another. Particle swarm optimization (PSO) algorithm and its variants are quite popular in optimizing antenna designs particularly due to their algorithmic simplicity and fast convergence rates. However, as a matter of the ever present tradeoff, fast convergence often leads to sub optimal solutions. In some recent researches it has been shown that a
class of boundary handling algorithms of PSO, known as position regulated boundary conditions (PRBCs), can minimize the tradeoff between fast convergence and accomplishment of global optimal solution; here, the performance of these boundary algorithms are compared with that of other established ones over three different optimization targets of antenna design namely, “Multi target optimization in linear antenna arrays”, “Inset feed position optimization of rectangular patch antennas” and “Edge feed position optimization of rectangular patch antennas”. Results show that the use of PRBCs in PSO leads to impressive improvement in the optimization efficiency in terms of lesser computational time and attainment of global optimal solution.

10:30 [#1570192687] Optimization of Antenna Arrays for SLL Reduction Towards Pareto Objectivity Using GA Variants
Das, Sudipta; Ram Harde, Gopi; Chakravorty, Pragnan Mandal, Durbadal Kar, Rajib; Ghoshal, Sakti Prasad;

One of the most striking aspects of nature inspired algorithms is their capability of reaching a pareto front, for a set number of objectives, with much lesser computational cost than the classical ones; this is primarily due to the intrinsic intelligence that they inherit from nature. In this paper, as a first example, optimization of linear antenna arrays with dipole element pattern is exemplified for side lobe (SLL) reduction with fixed main-lobe beam width using real coded genetic algorithm (RGA); though multi goal optimization seems to be possible with proper cost/fitness function formulation in linear arrays, such a task becomes extremely difficult when it comes to planar arrays; this calls for the use of multi objective variants of an algorithm to reach the pareto objectivity; as a second example non-dominated sorting genetic algorithm II (NSGA2) is considered as the optimization algorithm for SLL reduction and fixed main-lobe directivity for concentric regular hexagonal antenna arrays (CRHAA). The results show good outcome with respect to side lobe reduction and directivity.

10:50 [#1570177745] Optimizing an Antenna Array for Satellite Communications
Haupt, Randy;

Phased arrays steer their main beam electronically rather than by mechanical means. An array that communicates with satellites must have the ability to maintain contact with the satellite from horizon to zenith. The array, in particular its tilt angle, size, frequency, transmit power, and element spacing, determines the amount of signal received from the satellite during its orbit. This paper shows how to optimize the array design for a given satellite system using a genetic algorithm.

11:10 [#1570189837] An Adaptive Congestion Control and Fairness Scheduling Strategy for Wireless Mesh Networks
Sheikh, Sajid; Woluitter, Riaan; Engelbrecht, Herman A;

Wireless mesh networks (WMNs) are a promising technology for low cost deployments for telemetry networks in rural areas. The popular contention based carrier sense multiple access with collision avoidance (CSMA/CA) technique is widely used in WMN implementations as it does not require time synchronization compared to time division multiple access (TDMA). The IEEE 802.11e standard was introduced to provide data differentiation services to data on a network with data of different priority. With this standard, the enhanced distributed channel access (EDCA) technique for contention based services experiences an fairness problem where high data can starve lower priority data. CSMA/CA was originally developed for single-hop networks. Collisions tend to increase in multi-hop networks as the contention for the medium increases. To address the fairness and performance degradation with an increase in contention in multi-hop network problems, a novel adaptive congestion control and fairness scheduling (CCFS) strategy is proposed in this paper. The proposed strategy is simulated in OMNeT++ and the INETMANET library to ascertain the performance of the strategy. The strategy was compared with EDCA in terms of end-to-end latency, packet loss percentage and Jain’s fairness index. The proposed adaptive strategy is shown to reduce packet loss in most test cases as well as provide an overall more fair system with data of different priority when compared to EDCA.

11:30 [#1570190859] A Dec-POMDP Model for Congestion Avoidance and Fair Allocation of Network Bandwidth in Rate-Adaptive Video Streaming
Hemmati, Mahdi; Abdulsalam, Yassine; Shirmohammadi, Shervin;

We consider the problem of distributed rate adaptation among multiple video streaming sessions over the Internet from a decision-theoretic and computational intelligence point of view, and we design a multi-objective optimization model for network resources, seeking a fair and efficient distribution of end-users’ Quality of Experience (QoE). A social welfare function is developed to capture both fairness and efficiency objectives at the same time. Then, assuming a common altruistic goal for all network users, we propose a Decentralized Partially Observable Markov Decision Process (Dec-POMDP) model for finding the optimal network bandwidth allocation that leads to social welfare maximization. We show that the resulting optimal policy for the proposed model outperforms TCP-Friendly Rate Control (TFRC) protocol in terms of total utility and fairness.
Baghai-Wadji, Alireza;
Maxwell’s electrodynamical differential equations in general bi-anisotropic media have been split into an independent 4X4 diagonalized and a dependent 2X4 supplementary system of equations, referred to as the D- and S- forms, respectively. The forms have been utilized to construct standard singular Dyadic Green’s functions (DGFs). Problem-tailored expressions for the Dirac’s delta-function have been obtained using Fourier integral representations for the DGFs. The resulting expressions for the delta-function have been used to regularize the originating DGFs exponentially. On the other hand, employing standard finite-support basis- and testing functions, the DGFs have been regularized algebraically. Since the geneses of the exponential and algebraic regularization techniques are conceptually different they can be employed independently or in unison. Finally, frequency-, material- and geometry independent universal functions have been constructed for accelerated and highly performance-enhanced computation of the self- and mutual interactions in the method of moments applications.

ICES’15 Session: 2: Applications of Evolvable Systems
Thursday, December 10, 09:50–12:20, Room: 1.42
Chair: Garry Greenwood

09:50 [1570193195] Social-Insect-Inspired Networking for Autonomous Fault Tolerance
Rowlings, Matthew; Trefzer, Martin; Tyrrell, Andy;
As electronic hardware integration technologies develop there is an increasingly strong shift towards implementing complete systems within a single chip, extending the now established paradigm of System on Chip towards high density many-core systems by employing Networks on Chip (NoCs) to connect the processing elements. This brings many new challenges to fault-tolerant design when applied to embedded applications, but also opportunities for new approaches that can leverage the many-core fabric in ways that traditional system architectures could not exploit. This paper describes such an approach by adopting behavioural aspects of social insects as an inspiration towards autonomous, self-repairing systems. Each router in the NoC is considered as a member of a distributed colony and a simple adaptive controller is responsible for determining the behaviour of each node, relying only on a set of sensory inputs local to each node and small amounts of information shared between neighbours. This provides each node with a small amount of “intelligence” that, for this paper, has been implemented within a many-core hardware system to demonstrate an adaptive routing scheme which provides effective network traffic management through simple and decentralised agent-to-agent communications. The emergent behaviours of the network are then exploited to demonstrate an example of how fault tolerance could be supported within a many-core system without any pre-defined fault handling strategies. A discussion then follows on how the emergent behaviours of this system can be further inspired by social insect colonies to exhibit other autonomous and adaptive behaviours such as dynamic task allocation.

10:10 [1570192363] Neuromorphic Hardware Accelerated Adaptive Authentication System
Suri, Manan; Parmar, Vivek; Singla, Akshay; Nair, Surag; Malviya, Rishabh;
In this paper we present a multimodal authentication (person identification) system based on simultaneous recognition of face and speech data using a novel bio-inspired architecture powered by the CM1K chip. The CM1K chip has a constant recognition time irrespective of the size of the knowledge base, which gives massive time gains in learning and recognition over software implementations of similar methods. We demonstrate a system utilizing the CM1K chip as a neural network accelerator along with data pre-processing done by a desktop PC. The system realized consumes energy of the order: 668 J for learning and 487 J for recognition, while operating at 25 MHz. The classification test accuracy of the system is approximately 91%.

10:30 [1570192425] Evolution of Non-Cryptographic Hash Function Pairs for FPGA-Based Network Applications
Dobai, Roland; Korenek, Jan;
High-speed computer networks require rapid packet processing and flexibility which can be ensured by implementing network applications in field programmable gate arrays (FPGAs). Many network applications are based on fast lookup in hash tables. It is important to use such hash functions for these tables which utilize efficiently the limited memory resources of FPGAs. Cuckoo hashing improves this utilization by using more hash functions simultaneously. However, there is no known approach for selecting those functions which together produce the best results. Bio-inspired methods are used in this paper for evolving hash function pairs for FPGA-based network applications. The evolved hash functions are based on linear and non-linear feedback shift registers and can be efficiently implemented in FPGAs. The experiments were aimed at hashing of Internet Protocol addresses and it was shown that evolved solutions can achieve better table load factor in comparison with human-created solutions.

10:50 [1570192409] An Investigation of Underlying Physical Properties Exploited by Evolution in Nanotubes Materials
Nichele, Stefano; Lykkeb, Odd Rune; Tuft, Gunnar;
Computational materials, e.g. single-wall carbon nanotubes and polymer nanocomposites, have been evolved to solve complex computational problems. Such blobs of material have been treated as a black box, e.g. some input is encoded, some configu-
ration signals are evolved to “program” the material machine, and some output is decoded. However, how the computation is performed, i.e. which physical properties are exploited by evolution to solve a given computational task, is not well understood. The general idea is that some underlying physical properties of the chosen material are exploited, e.g. capacitance, resistance, voltage potential, signal frequency, etc. In this paper we investigate which practical strategies are exploited by evolution on a simple (non-abstract) task: maximize or minimize amplitudes of output signals when square waves are used as input. This allows identifying an evolvability range for materials with different physical characteristics, e.g. nanotubes concentration. Inspection of evolved solutions shows that the strategies used by evolution to exploit physical properties are often unanticipated. This work is done within the European Project NASCENCE.

11:10 [#1570192401] Modelling Epigenetic Mechanisms to Capture Dynamical Topological Morphology: Applications in Edge Detection
Turner, Alexander; Trefzer, Martin; Tyrrell, Andy;

EpiNet is a novel computational model which is able to perform dynamic topological modification autonomously throughout execution. This approach is inspired by the functionality of eukaryotic gene regulation, specifically that of chromatin modification which is able to modify its structure dynamically, altering the structure of gene regulatory networks. In this work we utilise the dynamic properties of epiNet when applied to two different methods of edge detection, and analyse these networks and their dynamical properties via structural and dynamical systems analysis.

11:30 [#1570183955] Simultaneous Improvement to Signal Integrity and Electromagnetic Interference in High-Speed Transmission Lines
Yasunaga, Moritoshi; Yoshihara, Ikuo;

Branched traces are strictly prohibited in the routing of printed circuit boards (PCBs) for high-speed data transfer, because they cause serious degradation of the signal integrity (SI) and excessive electromagnetic interference (EMI). If this strong design constraint can be removed, the number of degrees of freedom increases dramatically, and the operation speed in PCBs is expected to be improved significantly. In an attempt to overcome the SI degradation that occurs due to characteristic impedance mismatching, we previously proposed the bio-inspired segmental transmission line (STL), and we demonstrated its effectiveness. In this paper, we apply the STL to a branched trace for high-speed data transfer, and we use genetic algorithms to try to simultaneously improve its SI and EMI. Some branched STL prototypes are fabricated and evaluated; the results, which include eye diagrams and electromagnetic emission intensities, show a big improvement in SI and EMI in branched traces.

CIASG’15 Session: 2: Simulation, Operations and Control
Thursday, December 10, 09:50–12:20, Room: 1.43
Chair: Komla Folly

09:50 [#1570193063] Co-Simulation Platform for Characterizing Cyber Attacks in Cyber Physical Systems
Sadi, Mohammad; Ali, Mohd Hasan; Dasgupta, Dipankar; Abercrombie, Robert; Kher, Shubhalaxmi J;

Smart grid is a complex cyber physical system containing numerous and variety of sources, devices, controllers and loads. Communication/Information infrastructure is the backbone of the smart grid system where different grid components are connected with each other through this structure. Therefore, the drawbacks of the information technology related issues are also becoming a part of the smart grid. Further, smart grid is also vulnerable to the grid related disturbances. For such a dynamic system, disturbance and intrusion detection is a paramount issue. This paper presents a Simulink and OPNET based co-simulated platform to carry out a cyber-intrusion in a cyber-network for modern power systems and smart grids. The cyber attack effect is also characterized for the physical power system. The effectiveness of the co-simulated platform is demonstrated by the IEEE 30 bus power system model. The distributed denial of service attack was carried out in the cyber network to see its effect on the physical network. Different physical fault situations in the test system are considered and the results indicate the effectiveness of the proposed co-simulated scheme.

10:10 [#1570191787] Stochastic Optimization for Combined Economic and Emission Dispatch with Renewables
Rahmani-andebili, Mehdi; Venayagamoorthy, G. Kumar;

Environmental issues of thermal power plants and depletion of natural energy resources are the main motivations for applying renewable energy sources (RESs) in power system. Therefore, it is important to consider RESs when performing combined economic and emission dispatch (CEED). In this study, in the variability and uncertainties concerned with RESs and load demand are addressed with batteries installed in the power system as energy storage systems and stochastic optimization applied to solve the problem. A case study is presented to demonstrate the economic and environmental benefits achieved as a result.

10:30 [#1570193043] VPP Energy Resources Management Considering Emissions: The Case of Northern Portugal 2020 to 2050
Soares, João; Borges, Nuno; Lobo, Cristina; Vale, Zita;

In SGs context, Distributed Generation (DG) based on renewable sources represents an alternative paradigm of energy supply
and the opportunity for significant reduction in CO2 emissions. However, strict emissions regulations might impact profit seeking Virtual Power Plants (VPP) operation. This paper addresses energy management at distribution level and evaluates if electricity emissions are worth to be considered in different time horizons. A realistic case study is developed for a chosen area of the northern region of Portugal, namely one part of the distribution grid from Vila Real managed by a VPP, with estimated penetration of Electric Vehicles (EV), several Distributed Generation (DG), Demand Response (DR) and Energy Storage Systems (ESS). The considered characteristics of the case study took into account several studies and the forecasts made in the literature. For 2030 it is expected an average CO2 grid emission of 50 kgCO2/MWh in Portugal. The repository-based multi-objective Particle Swarm Optimization (MOPSO) is used to tackle the developed optimization problem. Three scenarios are evaluated for the profit seeking VPP in 2020, 2030 and 2050 perspectives.

10:50 [#1570197617] Stochastic Model Predictive Control Based Economic Dispatch for Hybrid Energy System Including Wind and Energy Storage Devices
Zhang, Yan; Wang, Rui; Zhang, Tao; Liu, Yajie; Guo, Bo; Liao, Tianjun;
In this paper, a stochastic model predictive control (SMPC) approach is proposed to schedule a hybrid energy system (HES) which composes a battery energy storage system (BESS) and a wind farm. The SMPC is used to control the charge and discharge of the BESS to minimize the operation costs and maximum the selling power revenue for the HES owner with considering wind production and electricity price forecast uncertainties. Case study is employed to assess the performance of the SMPC approach and simulation results show that this approach proposed in this paper is effective and feasible.

11:10 [#1570197757] Development of Optimal PI Controllers for a Grid-Tied Photovoltaic Inverter
Arzani, Ali; Arunagirinathan, Paranietharan; Venayagamoorthy, G. Kumar;
Power electronic interfaces (PEIs) play a significant role in integrating distributed energy sources (DER) into the electric power grid. In fact, as solution to grid integration of photovoltaic arrays, voltage source inverters (VSI) are widely utilized as the PEI entity. The VSI is controlled by a set of proportional-integral (PI) controllers, which require optimal tuning in order to guarantee smooth a PV-system is exposed to severe meteorological conditions e.g. sudden cloud covers. Hence, developing a practical robust tuning method for optimizing the PV-inverter set of controllers i.e. the DC-link voltage controller, the reactive power controller, and the decoupled current controller becomes of paramount importance. This paper employs a computational intelligence (CI) approach to optimally tune these controllers based on online operation performance of the PV-System. The CI approach used effectively used for searching the inverter’s PI controllers’ parameters is the particle swarm optimization (PSO). The simulation results conclude the superiority of this approach in comparison to conventional inverter PI controller tuning methods; enhancing the PV-System transient and steady-state step-response over a wide operating range of irradiance.

11:30 [#1570193105] Multi-machine Power System Stabilizer Design Based on Population Based Incremental Learning
Dombo, Dereck A; Folly, Komla;
Population Based Incremental Learning (PBIL) is one of the Evolutionary Algorithms that has received increasing attention in recent years in solving optimization problems and it has been found to be very effective. However recent studies have shown that PBIL with fixed learning rate may suffer from loss of diversity which can lead to premature convergence. In this paper, Population Based Incremental Learning with adaptive learning rate (APBIL) is used to overcome the issues of premature convergence in PBIL. Frequency and time domain simulation results are presented to show the effectiveness of the APBIL algorithm.

SIS’15 Session: 3: Particle Swarm Optimization II
Thursday, December 10, 09:50–12:20, Room: 1.44
Chair: Sanaz Mostaghim

09:50 [#1570196169] Dynamic Vector-evaluated PSO with Guaranteed Convergence in the Sub-swarms
Helbig, Ma¨rd; Engelbrecht, Andries;
Optimisation problems with more than one objective, of which at least at least one changes over time and at least two are in conflict with one another, are referred to as dynamic multi-objective optimisation problems (DMOOPs). The dynamic vector evaluated particle swarm optimisation (DVEPSO) algorithm is a co-operative particle swarm optimisation (PSO)-based algorithm and each of its sub-swarms solves only one objective function. The sub-swarms then share knowledge with one another through the particles’ velocity update. The default DVEPSO algorithm uses global best (gbest) PSOs as its sub-swarms. The guaranteed convergence PSO (GCPSO) algorithm prevents stagnation by forcing the global best particle to search within a defined region for a better solution. Using GCPSO results in proven convergence to at least a local optimum. Therefore, it is guaranteed that DVEPSO will converge to at least a local Pareto-optimal front (POF). This study investigates the effect of using GCPSOs as sub-swarms of DVEPSO. The results indicate that the GCPSO version of DVEPSO outperforms the gbest PSO DVEPSO on type I DMOOPs and in slowly changing environments.
10:10 [1570190193] Co-operative Vector-Evaluated Particle Swarm Optimization for Multi-objective Optimization
Maltese, Justin; Ombuki-Berman, Beatrice; Engelbrecht, Andries;

Vector-evaluated particle swarm optimization is a particle swarm optimization variant which employs multiple swarms to solve multi-objective optimization problems. Recently, three variants of particle swarm optimization which utilize co-operative principles were shown to improve performance in single-objective environments. This work proposes co-operative vector-evaluated particle swarm optimization algorithms, which employ co-operative particle swarm optimization variants within vector-evaluated particle swarm optimization swarms. Performance of the proposed algorithms is compared with the standard vector-evaluated particle swarm optimization algorithm using various knowledge transfer strategies. A comparison of the best performing co-operative vector-evaluated particle swarm optimization variants is also made against well-known multi-objective PSO algorithms. Each co-operative vector-evaluated particle swarm optimization variant significantly out-performs standard vector-evaluated particle swarm optimization with respect to the hypervolume metric, with two of three variants also yielding improved solution distribution. The results indicate that co-operation is a powerful tool which enhances hypervolume and solution distribution of the original vector-evaluated particle swarm optimization algorithm, allowing co-operative vector-evaluated particle swarm optimization variants to successfully compete with top multi-objective PSO optimization algorithms.

10:30 [1570190219] High-Dimensional Multi-objective Optimization Using Co-operative Vector-Evaluated Particle Swarm Optimization with Random Variable Grouping
Maltese, Justin; Engelbrecht, Andries; Ombuki-Berman, Beatrice;

Vector-evaluated particle swarm optimization (VEPSO) is a particle swarm optimization (PSO) variant which employs multiple swarms to solve multi-objective optimization problems (MOPs). Each swarm optimizes a single objective and information is passed between swarms using a knowledge transfer strategy (KTS). The recently proposed co-operative VEPSO (CVEPSO) algorithm has been shown to improve the performance of VEPSO by decomposing the search space into subspaces of lower dimensionality. However, the effectiveness of CVEPSO is heavily dependent on the strategy used to group variables together, because isolating dependent variables leads to performance degradation. This paper explores the use of a random grouping technique within CVEPSO to increase the probability of allocating interacting variables to the same subcomponent. The results demonstrate that random grouping significantly improves performance of the CVEPSO algorithm, especially in high-dimensional environments. Additionally, CVEPSO with random grouping is shown to perform competitively with other top multi-objective optimization algorithms.

10:50 [1570195045] A Parallel Implementation of Multiobjective Particle Swarm Optimization Algorithm Based on Decomposition
Li, Jin-Zhou; Chen, Wei-Neng; Zhang, Jun;

Multiobjective particle swarm optimization based on decomposition (MOPSO/D) is an effective algorithm for multiobjective optimization problems (MOPs). This paper proposes a parallel version of MOPSO/D algorithm using both message passing interface (MPI) and OpenMP, which is abbreviated as MO-MOPSO/D. It adopts an island model and divides the whole population into several subspaces. Based on the hybrid of distributed and shared-memory programming models, the proposed algorithm can fully use the processing power of today’s multicore processors and even a cluster. The experimental results show that MO-MOPSO/D can achieve speedups of 2x on a personal computer equipped with a dual-core four-thread CPU. In terms of the quality of solutions, it can perform similarly to the serial MOPSO/D but greatly outperform NSGA-II. An additional experiment is done on a cluster, and the results show the speedup is not obvious for small-scale MOPs and it is more suitable for solving highly complex problems.

11:10 [1570182049] On the Performance of Particle Swarm Optimization Algorithms in Solving Cheap Problems
Al-Dujaili, Abdullah; Taweer, Muhammad Rizwan; Sundaram, Suresh;

Eight variants of the Particle Swarm Optimization (PSO) algorithm are discussed and experimentally compared among each other. The chosen PSO variants reflect recent research directions on PSO, namely parameter tuning, neighborhood topology, and learning strategies. The Comparing Continuous Optimizers (COCO) methodology was adopted in comparing these variants on the noiseless BBOB testbed. Based on the results, we provide useful insights regarding PSO variants’ relative efficiency and effectiveness under a cheap budget of function evaluations; and draw suggestions about which variant should be used depending on what we know about our optimization problem in terms of evaluation budget, dimensionality, and function structure. Furthermore, we propose possible future research directions addressing the limitations of latest PSO variants. We hope this paper would mark a milestone in assessing the state-of-the-art PSO algorithms, and become a reference for swarm intelligence community regarding this matter.

11:30 [1570188293] Frequency Distribution of Candidate Solutions in Angle Modulated Particle Swarms
Leonard, Beanie; Engelbrecht, Andries;

This paper investigates the frequency distribution of candidate solutions in the search space when angle modulation is applied to particle swarm optimization (PSO). It is shown that angle modulated particle swarm optimisers (AMPSO) have non-uniform solution frequency distributions. A new technique is introduced to ensure that the frequency distribution of candidate solutions is uniform. The new technique is compared with AMPSO and three AMPSO variants, as well as binary
Recent developments in the field of gene sequencing technology greatly accelerated discovery of mutations that cause various genetic disorders. At the same time, a typical sequencing experiment generates a large number of candidate mutations, hence detecting single or few causative variants is still a formidable problem. Many computational methods have been proposed to assist this process, from which a large portion employ statistical learning in some form. Consequently, each newly designed algorithm is routinely compared to other competing systems in hope to demonstrate advantageous performance. In this work we review and discuss several issues related to the current practice of evaluation of mutation prioritization algorithms and suggest possible directions for improvements.
09:50 [1570178547] Constructing Probable Explanations of Nonconformity: A Data-aware and History-based Approach
Alizadeh, Mahdi; de Leoni, Massimiliano; Zannone, Nicola;
Auditing the execution of business processes is becoming a critical issue for organizations. Conformance checking has been proposed as a viable approach to analyze process executions with respect to a process model. In particular, alignments provide a robust approach to conformance checking in that they are able to pinpoint the causes of nonconformity. Alignment-based techniques usually rely on a predefined cost function which assigns a cost to every possible deviation. Defining such a cost function, however, is not trivial and is prone to imperfection that can result in inaccurate diagnostic information. This paper proposes an alignment-based approach to construct probable explanations of nonconformity. In particular, we show how cost functions can be automatically computed based on historical logging data and taking into account multiple process perspectives. We implemented our approach as a plug-in of the ProM framework. Experimental results show that our approach provides more accurate diagnostics compared to existing alignment-based techniques.

10:10 [1579193019] Efficient Process Discovery From Event Streams Using Sequential Pattern Mining
Hassani, Marwan; Siccha, Sergio; Richter, Florian; Seidl, Thomas;
Process mining is an emerging research area that applies the well-established data mining solutions to the challenging business process modeling problems. Mining streams of business processes in the real time as they are generated is a necessity to obtain an instant knowledge from big process data. In this paper, we introduce an efficient approach for exploring and counting process fragments from a stream of events to infer a process model using the Heuristics Miner algorithm. Our novel approach, called StrProM, builds prefix-trees to extract sequential patterns of events from the stream. StrProM uses a batch-based approach to continuously update and prune these prefix-trees. The final models are generated from those trees after applying a novel decay mechanism over their statistics. The extensive experimental evaluation demonstrates the superiority of our approach over a state-of-the-art technique in terms of execution time using a real dataset, while delivering models of a comparable quality.

10:30 [1570193159] The Analysis of a Real Life Declarative Process
Slaats, Tijs; Debois, Søren;
There remain heated discussions on the usability of declarative process notations. Most investigations have focused on the understandability of the notation by the users, driven by lab experiments and workshops with practitioners unfamiliar with the paradigm. One of the main challenges has been the lack of industrial adoption of declarative notations. However, in 2014 the Danish software developer Exformatics implemented a flexible grant application system for the Danish foundation Dreyersfond, controlled by a declarative model and process engine. In this paper we investigate the usability of declarative process notations based on the logs generated by this system. In particular we investigate if the users employed the flexibility granted by the declarative model in practice and use process discovery techniques on the log to find out if they produce a flow-based model that can compete with the original declarative model.

10:50 [1570192573] Improving SVM Training Sample Selection Using Multi-Objective Evolutionary Algorithm and LSH
Pighetti, Romaric; Palles, Denis; Precioso, Frédéric;
In this paper, we propose a new framework hybridizing a Support Vector Machine (SVM), a Multi-Objective Genetic Algorithm (MOGA) and a Locality Sensitive Hashing (LSH). The goal is to tackle fine-grained classification challenges which means classifying many classes with high similarities between classes and poor similarities inside one class. SVM is used for its ability of learning multi-class problem from very few training data. MOGA is used for optimizing training samples used by SVM so as to improve its learning rate. As data define a discrete set of instances and not a continuous solution space, LSH is used for mapping “optimal solutions” obtained by MOGA onto the closest real instances contained in the dataset. We evaluate our method for content-based image classification on the standard image database Caltech256 (i.e. 30000 images distributed in 256 classes). Experiments shows that our method outperforms reference approaches.

11:10 [1570192717] Subclass Marginal Fisher Analysis
Maronidis, Anastasios; Tefas, Anastasios; Pitas, Ioannis;
Subspace learning techniques have been extensively used for dimensionality reduction (DR) in many pattern classification problem domains. Recently, Discriminant Analysis (DA) methods, which use subclass information for the discrimination be-
between the data classes, have attracted much attention. As DA methods are strongly dependent on the underlying distribution of the data, techniques whose functionality is based on neighbourhood information among the data samples have emerged. For instance, based on the Graph Embedding (GE) framework, which is a platform for developing novel DR methods, Marginal Fisher Analysis (MFA) has been proposed. Although MFA surpasses the above distribution limitations, it fails to model potential subclass structure that might lie within the several classes of the data. In this paper, motivated by the need to alleviate the above shortcomings, we propose a novel DR technique, called Subclass Marginal Fisher Analysis (SMFA), which combines the strength of subclass DA methods with the versatility of MFA. The new method is built by extending the GE framework so as to include subclass information. Through a series of experiments on various real-world datasets, it is shown that SMFA outperforms in most of the cases the state-of-the-art demonstrating the potential of exploiting subclass neighbourhood information in the DR process.

11:30 [ID1570192883] Multivariate Time Series Classification Using Dynamic Time Warping Templates
Seto, Skyler; Zhang, Wenyu; Zhou, Yichen;

Accurate and computationally efficient means for classifying human activities have been the subject of extensive research efforts. Most current research focuses on extracting complex features to achieve high classification accuracy. We propose a template selection approach based on Dynamic Time Warping, such that complex feature extraction and domain knowledge is avoided. We demonstrate the predictive capability of the algorithm on both simulated and real smartphone data.

11:50 [ID1570193235] Evolving Workflow Graphs Using Typed Genetic Programming
Kren, Tomas; Pilat, Martin; Neruda, Roman;

When applying machine learning techniques to more complicated datasets, it is often beneficial to use ensembles of simpler models instead of a single, more complicated, model. However, the creation of ensembles is a tedious task which requires a lot of human interaction and experimentation. In this paper, we present a technique for construction of ensembles based on typed genetic programming. The technique describes an ensemble as a directed acyclic graph, which is internally represented as a tree evolved by the genetic programming. The approach is evaluated in a series of experiments on various datasets and compared to the performance of simple models tuned by grid search, as well as to ensembles generated in a systematic manner.

FOCI'15 Session: 2: Evolutionary Computation and Machine Learning
Thursday, December 10, 09:50–12:20, Room: 1.63
Chair: Pietro Oliveto

09:50 [ID1570169921] Improving Convergence in Cartesian Genetic Programming Using Adaptive Crossover, Mutation and Selection
Kalkreuth, Roman; Rudolph, Guenter; Krone, Joerg;

Genetic programming (GP) can be described as a paradigm which opens the automatic derivation of programs for problem solving. GP as popularized by Koza uses tree representation. The application of GP takes place on several types of complex problems and became very important for Symbolic Regression. Miller and Thomson introduced a new directed graph representation called Cartesian Genetic Programming (CGP). We use this representation for very complex problems. CGP enables a new application on classification and image processing problems. Previous research showed that CGP has a low convergence rate on complex problems. Like in other approaches of evolutionary computation, premature convergence is also a common issue. Modern GP systems produce population statistics in every iteration. In this paper we introduce a new adaptive strategy which uses population statistics to improve the convergence of CGP. A new metric for CGP is introduced to classify the healthy population diversity. Our strategy maintains population diversity by adapting the probabilities of the genetic operators and selection pressure. We demonstrate our strategy on several regression problems and compare it to the traditional algorithm of CGP. We conclude this paper by giving advices about parameterization of the adaptive strategy.

10:10 [ID1570179501] Measuring Saturation in Neural Networks
Rakitianskaia, Anna; Engelbrecht, Andries;

In the neural network context, the phenomenon of saturation refers to the state in which a neuron predominantly outputs values close to the asymptotic ends of the bounded activation function. Saturation damages both the information capacity and the learning ability of a neural network. The degree of saturation is an important neural network characteristic that can be used to understand the behaviour of the network itself, as well as the learning algorithm employed. This paper suggests a measure of saturation for bounded activation functions. The suggested measure is independent of the activation function range, and allows for direct comparisons between different activation functions.

10:30 [ID1570192193] Hybrid Approach for TSP Based on Neural Networks and Ant Colony Optimization
Mueller, Carsten; Kiehne, Niklas;

This research article presents a hybrid approach based on an intelligent combination of artificial ants and neurons. Research on different parameter combinations are performed, in order to find the best performing parameter settings. The obtained insights are then subsumed into an intelligent architecture consisting of ACO and SOM.
An Evolutionary Approach to the Discovery of Hybrid Branching Rules for Mixed Integer Solvers

Petursson, Kjartan; Runarsson, Thomas;

An evolutionary algorithm is used to search for problem specific branching rules within the branch-and-bound framework. For this purpose an instance generator is used to create training data for an integer programming problem, in particular the multi-dimensional 0/1 knapsack problem. An extensive experimental study will illustrate that new and more effective rules can be found using evolutionary computation.

Population-Based Incremental Learning with Immigrants Schemes in Changing Environments

Mavrovouniotis, Michalis; Yang, Shengxiaog;

The population-based incremental learning (PBIL) algorithm is a combination of evolutionary optimization and competitive learning. PBIL has been successfully applied to dynamic optimization problems (DOPs). It is well known that maintaining the population diversity is important for PBIL to adapt well to dynamic changes. However, PBIL faces a serious challenge when applied to DOPs because at early stages of the optimization process the population diversity is decreased significantly. It has been shown that random immigrants can increase the diversity level maintained by PBIL algorithms and enhance their performance on some DOPs. In this paper, we integrate elitism-based and hybrid immigrants into PBIL to address slightly and severely changing DOPs. Based on a series of dynamic test problems, experiments are conducted to investigate the effect of immigrants schemes on the performance of PBIL. The experimental results show that the integration of elitism-based and hybrid immigrants with PBIL always improves the performance when compared with a standard PBIL on different DOPs. Finally, the proposed PBILs are compared with other peer evolutionary algorithms and show competitive performance.

Graph Embedding Exploiting Subclasses

Maronidis, Anastasios; Tefas, Anastasios; Pitas, Ioannis;

Recently, subspace learning methods for Dimensionality Reduction (DR), like Subclass Discriminant Analysis (SDA) and Clustering-based Discriminant Analysis (CDA), which use subclass information for the discrimination between the data classes, have attracted much attention. In parallel, important work has been accomplished on Graph Embedding (GE), which is a general framework unifying several subspace learning techniques. In this paper, GE has been extended in order to integrate subclass discriminant information resulting to the novel Subclass Graph Embedding (SGE) framework. The kernelization of SGE is also presented. It is shown that SGE comprises a generalization of the typical GE including subclass DR methods. In this context, the theoretical link of SDA and CDA methods with SGE is established. The efficacy and power of SGE has been substantiated by comparing subclass DR methods versus a diversity of unimodal methods all pertaining to the SGE framework via a series of experiments on various real-world data.

Towards A Generic Computational Intelligence Library: Preventing Insanity

Pamparà, Gary; Engelbrecht, Andries;

This paper proposes a library for computational intelligence using functional programming to address the complexities in algorithm implementation and highlighting specific concerns that are often ignored in the algorithm descriptions. Useful abstractions, common in the paradigm of functional programming, are used to make implementation specific of algorithms part of the algorithm definition, resulting in the tracking of these effects, together with the control of the effects. Effects, requiring management within an algorithm, include the use of pseudo-random number generators, writing data to files or the console, or providing the control parameter configuration of the algorithm in an experiment. By defining the units of work for an algorithm in a general and generic form, composition of these different algorithmic units is possible, thereby creating larger, more complex computational units. The software library providing such reusable, peer-reviewed composable computational unit, is called CIlib.

Thursday, December 10, 14:00–15:00
14:20 [1570193215] Enhancing Environmental Surveillance Against Organised Crime with Radial Basis Neural Networks
Napoli, Christian; Tramontana, Emiliano; Woźniak, Marcin;
A huge amount of data concerning the position of individual is often gathered in surveillance scenarios, to prevent crimes or to collect evidence of unlawful behaviour. Given the abundance of data available, detectives need advanced analysis means in order to set apart the interesting locations. This paper proposes a solution that makes use of radial basis neural networks to find the points of interests, i.e. locations that have been used for meeting, for surveilled people whose paths have been traced. In our solution newly gathered data will be analysed in order to find points of interest, and will also be given to our neural network for further training. Our results show that the proposed approach is accurate enough and can improve the unaided search for meeting points between observed individuals.

14:40 [1570202855] A New Two-Stage Approach to the Multiaspect Text Categorization
Zadrożny, Sławomir; Kacprzyk, Janusz; Gajewski, Marek;
We consider a particular type of text categorization problem which we refer to as the multiaspect classification. It is inspired by some practical scenario of business documents management in a company but has a broader application potential. A distinguishing feature of the new problem considered is the existence of two schemes of classification. The first one is based on the traditional, static set of text categories, possibly arranged into a hierarchy. The second one is based on a dynamic structure of sequences of documents, referred to as cases, identified within each category. While the former problem may be addressed using one of the well known techniques of text categorization (classification), the latter seems to require some distinct approaches due to the fact that the set of cases is unknown in advance, as well as due to the assumed limited number of training documents, if a case should be interpreted as a classic category. In the paper, we discuss the problem in a more detail as well as show the applicability of an intuitively appealing two stage approach to solving the problem of such a multiaspect text categorization.

14:00 [1570192267] An Evolutionary Strategy Based State Assignment for Area-Minimization Finite State Machines
Tao, Yanyun; Zhang, Lijun; Zhang, Yuzhen;
Most published results show that area reduction of the finite-state machines(FSMs) is achieved by optimizing the state assignment. In order to minimize two-level and multilevel area of FSMs, an evolutionary strategy based state assignment, called ESSA, is proposed in this study. Two cost functions(i.e. fitness functions) are defined for two-level and multilevel area minimization. A new selection strategy and a new mutation are proposed in HES, which are specifically designed based on the analysis of the search space and individual’s distribution. The selection strategy sorts out parental individuals based on the crowding distance and fitness, and mutation uses ‘replacement’, ‘2-exchange’ and ‘shifting’ operators, which is controlled by the hamming distance constraint, to generate offspring from the parental individuals. Experimental results show ESSA achieves a significant reduction of area to the previous publications in terms of number of cubes and literals in most benchmarks.

14:20 [1570192079] Designing Polymorphic Circuits with Periodical Weight Adjustment
Liang, Houjun; Xie, Rui; Chen, Liang;
A polymorphic circuit can perform two or more functions under different conditions without the need of extra components. Those functions can be activated by environmental signals, such as temperature, power supply voltage, illumination, and so on. So far, existent evolutionary algorithms can only evolve polymorphic circuits of small scales. In this paper, the periodical weight adjustment method is proposed for the Evolutionary Strategy to evolve polymorphic circuits. The experimental results demonstrate that the Evolutionary Strategy with the periodical weight adjustment can perform better than existent evolutionary techniques for polymorphic circuits.

14:40 [1570191729] Investigation of Replicating Tiles in Cellular Automata Designed by Evolution Using Conditionally Matching Rules
Bidlo, Michal;
In this paper we investigate the evolutionary design of replicating tiles in cellular automata. In particular, various sizes of the tiles will be considered whose replication ought to be performed by satisfying a given arrangement of the tiles with respect to each other. The goal is to determine the abilities of the genetic algorithm in combination with conditionally matching rules used for representing the transition functions of cellular automata to find solutions for tiles consisting of up to a hundred of cells. A comparative study will be presented considering the success rate, computational effort and complexity of the obtained solutions as the main values of interest. It will be shown that, in addition to the tile size and the number of states of the cellular automaton, the probability of finding a correct solution is also substantially influenced by the arrangement.
style. The results show that the tile arrangement that may be considered as the simplest one does not have to necessarily be easily realisable by the genetic algorithm as a transition function for a cellular automaton.

**SDE’15 Session: 1: Algorithmic Aspects of Differential Evolution**
Thursday, December 10, 14:00–15:00, Room: 1.43
Chair: Ferrante Neri, Co-chair: Suresh Sundaram

14:00 [#1570191777] A Population Adaptation Mechanism for Differential Evolution Algorithm
Aalto, Johanna; Lampinen, Jouni;

In the original Differential Evolution algorithm three different control parameter values must be pre-specified by a user. These parameters are the population size, the crossover constant and the mutation scale factor. Control parameters affect strongly the performance and reliability of the algorithm. However, choosing good parameters can be very difficult for a user. In this paper a new adaptive Differential Evolution algorithm called Cumu-DE is proposed. The aim of the algorithm is to be a user friendly and reliable adaptation algorithm with moderate convergence speed. In the proposed algorithm, the so called effective population size is adapted automatically using mechanism based on probability mass function. The actual population size is kept fixed. Even though we talk about two different population sizes, we have only one population. The effective population size describes the effective part of the actual population. The more we get successful trials, the smaller the effective population is and vice versa. The algorithm was initially evaluated by using the set of 25 benchmark functions provided by CEC2005 special session on real-parameter optimization. It was compared with the results of standard DE/rand/1/bin. The proposed algorithm Cumu-DE proved to be significantly faster due to its average of FES in four cases and significantly slower in six cases. Additionally, Cumu-DE was significantly more reliable in six cases and significantly less reliable in none. These results are demonstrating the potential of the proposed adaptation approach.

Gajdos, Petr; Krömer, Pavel; Zelinka, Ivan;

The dynamics of population-based metaheuristic algorithms, such as the differential evolution, can be represented by evolving complex networks. The differential evolution is a widely-used real parameter optimization method with excellent results and many real-world applications. The search for hidden relationships, behaviors, and patterns in complex networks representing populational metaheuristics can provide an interesting information about the underlying optimization processes. Various methods for visual network investigation and mining became very popular in the last decade and represent a natural set of tools for such analyses. Here, we introduce a new approach for the visual analysis of such network with a special emphasis on network readability. The proposed method is universal and can be applied to any type of complex network modelling any algorithm applied to any problem.

14:40 [#1570187733] Continuous Parameter Pools in Ensemble Differential Evolution
Iacca, Giovanni; Caraffini, Fabio; Neri, Ferrante;

Ensemble of parameters and mutation strategies differential evolution (EPSDE) is an elegant promising optimization framework based on the idea that a pool of mutation and crossover strategies along, with associated pools of parameter settings, can flexibly adapt to a large variety of problems when a simple success based rule is introduced. Modern versions of this scheme successfully attempts to improve upon the original performance at the cost of a high complexity. One of most successful implementations of this algorithmic scheme is the Self-adaptive Ensemble of Parameters and Strategies Differential Evolution (SaEPSDE). This paper operates on the SaEPSDE, reducing its complexity by identifying some algorithmic components that we experimentally show as possibly unnecessary. The result of this de-constructing operation is a novel algorithm imple-

**CIASG’15 Session: 3: Demand Response**
Thursday, December 10, 14:00–15:00, Room: 1.44
Chair: Zita Vale

14:00 [#1570193059] Demand Response Shifting Management Applied to Distributed Generation and Pumping
Sousa, Diogo; Faria, Pedro; Vale, Zita;

Recent energy policies in countries around the world, including in Europe, point to the need to integrate growing amounts of distributed generation in electric power systems. This situation led to several changes in the operation and planning of power systems. This paper presents a methodology focusing on demand response programs, distributed generation and pumping, which is aimed to be used by a Virtual Power Player, who is able to manage the available resources minimizing the operation costs. The influence of demand response shifting management, in which was possible to shift load from a critical period to other more benefic, was also taken into account. In this paper it was used Artificial Intelligence, Artificial Neural Networks.
14:20 [#1570193199] Economic Impact of Demand Response in the Scheduling of Distributed Energy Resources
Spinola, João; Faria, Pedro; Vale, Zita;

Demand Response (DR) allows consumers to participate in energy markets, thus assuming an active role. However, the need of an aggregator capable of managing these resources and making decisions accordingly with the objectives of such resources has not been fully addressed. The aggregator activities are complex, and therefore, in the need of intelligent support to accomplish reasonable solutions. This paper proposes a methodology to evaluate the advantages of using DR programs in the resource rescheduling while classification and regression trees are introduced to support the aggregator in terms of scheduling and tariffs definition. Often these techniques are used to help the aggregator decide, as they also learn through training. Focus is given to the use of trees to predict and decide, the consumers’ prices and reduction levels to apply, respectively. The case study has 548 distributed generators, 10 external suppliers and 20310 consumers.

14:40 [#1570192893] Quantum Particle Swarm Optimization Applied to Distinct Remuneration Approaches in Demand Response Programs
Pereira, Fabio; Soares, João; Faria, Pedro; Vale, Zita;

The development of demand response programs has been allowing to improve power system performance in several ways, both in terms of the management of electricity markets, as well as regarding benefits in its operation. In order to model the remuneration for the participation of consumers in the scheduling of resources, this paper proposes a methodology based on the use of four incentive-based tariffs for the remuneration of demand response participation. It considers steps, quadratic, constant and linear remuneration. The optimization model enables Virtual Power Players to minimize operation costs, considering different critical situations of management and operation. The optimization problem has been solved by Quantum Particle Swarm Optimization. The case study concerns 168 consumers, classified into 5 consumer types, 118 distributed generation resources and 4 external suppliers.
Model-Based Outlier Detection for Object-Relational Data

This paper extends unsupervised statistical outlier detection to the case of object-relational data, based on probabilistic modeling. Object-relational data represent a complex heterogeneous network, which comprises objects of different types, links among these objects, also of different types, and attributes of these links. This special structure prohibits a direct vectorial data representation. We apply state-of-the-art probabilistic modeling techniques for object-relational data that construct a graphical model (Bayesian network), which compactly represents probabilistic associations in the data. We propose a new metric, based on the learned object-relational model, that quantifies the extent to which the individual association pattern of a potential outlier deviates from that of the whole population. The metric is based on the likelihood ratio of two parameter vectors: One that represents the population associations, and another that represents the individual associations.

Our method is validated on synthetic datasets and on real-world data sets about soccer matches and movies. Compared to baseline methods, our novel transformed likelihood ratio achieved the best detection accuracy on all datasets.

Modeling Feature Relevances From Metric Learning

Powerful metric learning algorithms have been proposed in the last years which do not only greatly enhance the accuracy of distance-based classifiers and nearest neighbor database retrieval, but which also enable the interpretability of these operations by assigning explicit relevance weights to the single data components. Starting with the work, it has been noticed, however, that this procedure has very limited validity in the important case of high data dimensionality or high feature correlations: the resulting relevance profiles are random to a large extend, leading to invalid interpretation and fluctuations of its accuracy for novel data. While the work proposes a first cure by means of L2-regularisation, it only preserves strongly relevant features, leaving weakly relevant and not necessarily unique features undetected. In this contribution, we enhance the technique by an efficient linear programming scheme which enables the unique identification of a relevance interval for every observed feature, this way identifying both, strongly and weakly relevant features for a given metric.

Multiple Graph-Kernel Learning

Kernels for structures, including graphs, generally suffer of the diagonally dominant gram matrix issue, the effect by which the number of sub-structures, or features, shared between instances are very few with respect to those shared by an instance with itself. A parametric rule is typically used to reduce the weights of largest (more complex) sub-structures. The particular rule which is adopted is in fact a strong external bias that may strongly affect the resulting predictive performance. Thus, in principle, the applied rule should be validated in addition to the other hyper-parameters of the kernel. Nevertheless, for the majority of graph kernels proposed in literature, the parameters of the weighting rule are fixed a priori. The contribution of this paper is two-fold. Firstly, we propose a Multiple Kernel Learning (MKL) approach to learn different weights of different bunches of features which are grouped by complexity. Secondly, we define a notion of kernel complexity, namely Kernel Spectral Complexity, and we show how this complexity relates to the well-known Empirical Rademacher Complexity for a natural class of functions which include SVM. The proposed approach is applied to a recently defined graph kernel and evaluated on several real-world datasets. The obtained results show that our approach outperforms the original kernel on all the considered tasks.

What is the Right Context for an Engineering Problem: Finding Such a Context is NP-Hard

In the general case, most computational engineering problems are NP-hard. So, to make the problem feasible, it is important to restrict this problem. Ideally, we should use the most general context in which the problem is still feasible. In this paper, we prove that finding such most general context is itself an NP-hard problem. Since it is not possible to find the appropriate context by utilizing some algorithm, it is therefore necessary to be creative – i.e., to use some computational intelligence techniques. On three examples, we show how such techniques can help us come up with the appropriate context. Our analysis explains why it is beneficial to take knowledge about causality into account when processing data, why sometimes long-term predictions are easier than short-term ones, and why often for small deviations, a straightforward application of a seemingly optimal control only makes the situation worse.
When a student performed only some of the steps needed to solve a problem, this student gets partial credit. This partial credit is usually proportional to the number of stages that the student performed. This may sound reasonable, but in engineering education, this leads to undesired consequences: for example, a student who did not solve any of the 10 problems on the test, but who successfully performed 9 out of 10 stages needed to solve each problem will still get the grade of A ("excellent"). This may be a good evaluation of the student’s intellectual ability, but for an engineering company that hires this A-level student, this will be an unexpected disaster. In this paper, we analyze this problem from the viewpoint of potential loss to a company, and we show how to assign partial credit based on such loss estimates. Our conclusion is that this loss (and thus, the resulting grade) depend on the size of the engineering company. Thus, to better understand the student’s strengths, it is desirable, instead of a single overall grade, to describe several grades corresponding to different company sizes.
15:20 [1570190559] Upper Limb Motor Skills Evaluation in Patients with Early Multiple Sclerosis Using the IDEA System
Pino, Alexandros; Kouroupetroglu, Georgios; Papatheodorou, Nikolaos; Andreadou, Elisabeth; Papageorgiou, Charalampos;

Upper limb functionality is an integral part of everyday interaction with the environment right from the very first minutes of human life. This paper investigates the experimental application of the IDEA (Input Device Evaluation Application) system on patients with multiple sclerosis at an early stage and without clinically overt motor deficits, in order to assess their upper limbs’ motor skills. The objective of the current study is to test the sensitivity and reliability of the IDEA system regarding the evaluation of multiple kinetic parameters of upper limbs. 29 patients who were hospitalized in the Demyelinating Diseases Section of Eginition Hospital’s Neurological Clinic and 25 healthy participated in the experiments. Data derived from the experiment are complemented with demographics. The acquired results analysis reveals that the IDEA system sensitivity is high enough to predict the presence of early upper limb multiple sclerosis with a 69.1% success rate.

15:40 [1570191633] Metric-Based Heuristic Space Diversity Management in a Meta-Hyper-Heuristic Framework
Grobler, Jacomine; Engelbrecht, Andries;

This paper investigates various strategies for the management of heuristic space diversity within the context of a meta-hyper-heuristic algorithm. In contrast to all previously developed heuristic space diversity management strategies, this paper makes use of a heuristic space diversity metric to monitor heuristic space diversity throughout the optimization run and trigger the need for increased or decreased heuristic space diversity. Three different heuristic space diversity management strategies are evaluated. Maintaining a high level of heuristic space diversity throughout the optimization run is shown to be the best performing strategy. Good performance is also demonstrated with respect to a state-of-the-art multi-method algorithm, another successful diversity controlling meta-hyper-heuristic and the best-performing constituent algorithm.

16:00 [1570194635] Evolving Non-linear Stacking Ensembles for Prediction of Go Player Attributes
Moudrík, Josef; Neruda, Roman;

The paper presents an application of non-linear stacking ensembles for prediction of Go player attributes. An evolutionary algorithm is used to form a diverse ensemble of base learners, which are then aggregated by a stacking ensemble. This methodology allows for an efficient prediction of different attributes of Go players from sets of their games. These attributes can be fairly general, in this work, we used the strength and style of the players.

16:20 [1570196317] Acoustic Event Classification Using Ensemble of One-Class Classifiers for Monitoring Application
Tripathi, Achyut;

In this paper we investigate the application of ensemble of one-class classifiers to the problem of acoustic event classification. We present some initial results that are based on acoustic signals emitted by different litter causing material when contacted by human. When a person interacts with objects made with specific material, characteristic sounds are produced as a result of the interactions. We consider such interactions or activities as atomic events. We propose application of ensemble of one-class fuzzy rule-based classifiers to the problem of identification of activities that can cause possible litter in the public places. The experimental results show that the classifier gives satisfactory results and at the same time has low false alarm rate. The results are comparable to widely used one-class SVM. Moreover, the method is adaptive and suitable for incremental learning.

16:40 [1570197809] Block Sparse Representations in Modified Fuzzy C-Regression Model Clustering Algorithm for TS Fuzzy Model Identification
Dam, Tanmoy; Deb, Alok;

In this paper, a novel objective function based clustering algorithm has been introduced by considering linear functional relation between input-output data and geometrical shape of input data. Noisy data points are counted as a separate class and remaining good data points in the data set are considered as good clusters. This noise clustering concept has been taken into the proposed objective function to obtain the fuzzy partition matrix of product space data. Block orthogonal matching pursuit algorithm is applied to determine the optimal number of rules from the over specified number of rules (clusters). The obtained fuzzy partition matrix is used to determine the premise variable parameters of TS fuzzy model. Once, the premise variable parameters and optimal number of rules (clusters) are identified then formulate the rule construction for identification of linear coefficients of consequence parameters. The effectiveness of proposed algorithm has been validated on a benchmark model.
Hanseed, Aboubakar; Kononova, Anna; Corne, David;

Many-parameter optimization remains hard, especially when presented with a complex, rugged, non-differentiable optimization landscape. The engineering of stochastic black box optimization methods, particularly evolutionary algorithms (EAs), represents the most common and successful approach to trying to solve such problems, and currently several strategies are being explored to improve performance when the number of parameters is large (in the region of 1000 parameters is now typical). Prominent among these techniques are variants of differential evolution, while one of the main algorithm engineering strategies being explored is the concept of ‘co-operative co-evolution’ (CC), which involves successively optimizing subsets of the design parameters, with an organized approach occasionally reconciling these ‘subspace’ optimizations. Recent work has shown that combining CC with fitness inheritance (FI) - a technique heretofore rarely explored in the context of large-scale optimization - can reliably lead to faster and better performance. However that work was done in the context of a simple underlying EA (allowing us to be more confident that the benefits were due primarily to the combination of CC and FI). Here we explore the extent to which CC and FI provides added value when engineered together in the context of more sophisticated, so-called state of the art underlying algorithms, pre-adorned with a variety of additional enhancements. To that end, in this paper we explore SaNSDE, and DECC-DML - two recent high-performance techniques in the field of large-scale optimization. We also explore two basic adaptive parameter setting strategies for the FI component. We find that engineering FI (and CC, where it otherwise wasn’t) into these algorithms can provides either competitive or improved results.

15:40 [#1570189303] Improved Constructive Cooperative Coevolutionary Differential Evolution for Large-Scale Optimisation
Glorieux, Emile; Svesson, Bo; Danielsson, Fredrik; Lennartson, Bengt;

The Differential Evolution (DE) algorithm is widely used for real-world global optimisation problems in many different domains. To improve DE’s performance on large-scale optimisation problems, it has been combined with the Cooperative Coevolution (CCDE) algorithm. CCDE adopts a divide-and-conquer strategy to optimise smaller subcomponents separately instead of tackling the large-scale problem at once. DE then evolves a separate subpopulation for each subcomponent but there is cooperation between the subpopulations to co-adapt the individuals of the subpopulations with each other. The Constructive Cooperative Coevolution (C3DE) algorithm, previously proposed by the authors, is an extended version of CCDE that has a better performance on large-scale problems, interestingly also on non-separable problems. This paper proposes a new version, called the Improved Constructive Cooperative Coevolutionary Differential Evolution (C3iDE), which removes several limitations with the previous version. A novel element of C3iDE is the advanced initialisation of the subpopulations. C3iDE initially optimises the subpopulations in a partially co-adaptive fashion. During the initial optimisation of a subpopulation, only a subset of the other subcomponents is considered for the co-adaptation. This subset increases stepwise until all subcomponents are considered. The experimental evaluation of C3iDE on 36 high-dimensional benchmark functions (up to 1000 dimensions) shows an improved solution quality on large-scale global optimisation problems compared to CCDE and DE. The greediness of the co-adaptation with C3iDE is also investigated in this paper.

16:00 [#1570182065] DE vs. PSO: A Performance Assessment for Expensive Problems
Al-Dujaili, Abdullah; Tuweer, Muhammad Rizwan; Sundaram, Suresh;

This paper investigates the suitability of the Particle Swarm Optimization (PSO) and the Differential Evolution (DE) algorithms in solving expensive optimization problems. Eight PSO variants, and eight DE variants are experimentally compared among each other. The Comparing Continuous Optimizers (COCO) methodology was adopted in comparing these variants on the noiseless BBOB testbed. Based on the results, we provide useful insights regarding the algorithms’ relative efficiency and effectiveness under an expensive budget of function evaluations, and draw suggestions about which algorithm should be used depending on what we know about our optimization problem in terms of evaluation budget, dimensionality, and function structure. Furthermore, we propose possible future research directions addressing the algorithms limitations. Overall, DE variants perform well in low dimensions, whereas in higher dimensions, several PSO variants surpass DE algorithms. Among the top performers, JADE and γPSO are the robust algorithms for solving expensive budget problems.

16:20 [#1570191503] Adaptive Differential Evolution Applied to Point Matching 2D GIS Data
Khan, Noel; Neri, Ferrante; Ahmadi, Samad;

The impetus behind data analytics and integration is the need for greater insight and data visibility, but since a growing share of our data is multi-media, there is a parallel need for methods that can align that data. This paper explores registration and referencing techniques that are used to combine spatial datasets and are used here to georeference map images to 2D GIS models. The intent of this effort was not to discover novel or optimal solutions to this problem, but rather to gain and share insight into the design choices and tradeoffs between functional and nonfunctional requirements to such problems. Accordingly, this paper provides a cross section of the dominant means, their strengths and weaknesses, and trajectory of research in this domain. More detailed treatment is given to knowledge representation, objective function, and the
We introduce a combination of the problem of partitioning a set of vertices of a bipartite graph into disjoint subsets of

Pesch, Erwin

Intermodal Transport

16:20 [1570193183] An Integrated Matching and Partitioning Problem with Applications in
effectiveness of the VNS algorithm, we compare these solutions to those achieved by VNS. Our preliminary experiments show
on Solomon’s benchmark problems for the VRP with Time-Windows and solve them using IBM ILOG CPLEX. To test the
present the 0-1 mixed integer programming formulation of the problem. Since the arising VRP is NP-hard, we then develop a
minimize the total distance. In this paper, we apply a holistic approach that optimizes both objectives simultaneously. We
consider several state-of-the-art Ant Colony Optimization (ACO) techniques from the literature, including the Min-Max Ant
that PACO outperforms the others. Subsequently, we introduce a new pheromone matrix initialization approach for PACO
(P1-PACO) that uses information extracted from the problem instance at hand and enforces pheromone assignments to edges
that form feasible building blocks of tours. Our computational tests show that P1-PACO performs better than PACO. To
further enhance its performance, we hybridize it with a local search method. The resulting algorithm is efficient in producing
high quality solutions and outperforms similar hybrid ACO techniques.

15:20 [1570196189] Hybrid PACO with Enhanced Pheromone Initialization for Solving the
Vehicle Routing Problem with Time Windows
Shi, Wei; Weise, Thomas; Chiong, Raymond; Çatay, Bülent;

The Vehicle Routing Problem with Time Windows (VRPTW) is a well-known combinatorial optimization problem found
in many practical logistics planning operations. While exact methods designed for solving the VRPTW aim at minimizing
the total distance traveled by the vehicles, heuristic methods usually employ a hierarchical objective approach in which the
primary objective is to reduce the number of vehicles needed to serve the customers while the secondary objective is to
minimize the total distance. In this paper, we apply a holistic approach that optimizes both objectives simultaneously. We
consider several state-of-the-art Ant Colony Optimization (ACO) techniques from the literature, including the Min-Max Ant
that PACO outperforms the others. Subsequently, we introduce a new pheromone matrix initialization approach for PACO
(P1-PACO) that uses information extracted from the problem instance at hand and enforces pheromone assignments to edges
that form feasible building blocks of tours. Our computational tests show that P1-PACO performs better than PACO. To
further enhance its performance, we hybridize it with a local search method. The resulting algorithm is efficient in producing
high quality solutions and outperforms similar hybrid ACO techniques.

15:40 [1570191475] Comparing a Weiszfeld’s-based Procedure and (1 + 1)-es for Solving the
Planar Single-Facility Location-Routing Problem
van Heiningen, Pepijn; Reehuis, Edgar; Bäck, Thomas;

We compare two iterative methods for solving the Planar Single-Facility Location-Routing Problem (PSFLRP), involving
optimizing the continuous-valued location of a single depot by iteratively solving instances of the Vehicle Routing Problem
(VRP). An Ant Colony Optimization (ACO) algorithm is used for solving the routing problem, a procedure using Weiszfeld’s
algorithm and a simple Evolution Strategy (ES) are applied to the overlying locational problem. Weiszfeld’s algorithm is
used to iteratively find the geometric median of the end-points, i.e., each subtour’s first and last stop from the depot. This
approach is compared to a classical (1+1)-ES employing the 1/5-th success rule. The two methods are evaluated on common
instances of the PSFLRP, showing that for obtaining comparable total lengths, the Weiszfeld’s-based procedure requires less
VRP evaluations (by the ACO algorithm) than the ES.

16:00 [1570196173] Crew Constrained Home Care Routing Problem with Time Windows
Tozlu, Başak; Daldal, Rebi; Çatay, Bülent; Unluyurt, Tonguc;

This paper addresses the Vehicle Routing Problem (VRP) of a Home Health Care (HCC) service provider that serves patients
requesting different types of care. In this problem, HCC services are provided by two types of personnel, nurses and health
aides, and the number of each type of personnel is limited. Each patient must be visited exactly once even if her servicing
requires both personnel and is associated with a strict time window during which the service must be provided. We first
present the 0-1 mixed integer programming formulation of the problem. Since the arising VRP is NP-hard, we then develop a
Variable Neighborhood Search (VNS) algorithm to solve it. Next, we randomly generate a set of small-sized instances based
on Solomon’s benchmark problems for the VRP with Time-Windows and solve them using IBM ILOG CPLEX. To test the
effectiveness of the VNS algorithm, we compare these solutions to those achieved by VNS. Our preliminary experiments show
that VNS is able to find good results fast, yet the HCC crew constraints may compromise the problem.

16:20 [1570181509] An Integrated Matching and Partitioning Problem with Applications in
Intermodal Transport
Pesch, Erwin; Kress, Dominik; Meiswinkel, Sebastian;

We introduce a combination of the problem of partitioning a set of vertices of a bipartite graph into disjoint subsets of
restricted size and the Min-Max Weighted Matching Problem. The resulting problem has applications in intermodal transport. We propose a mathematical model and prove the problem to be NP-hard in the strong sense. Two heuristic frameworks that decompose the problem into its partitioning and matching components are presented. Additionally, we analyze a basic implementation of tabu search and a genetic algorithm for the integrated problem. All algorithms outperform standard optimization software. Moreover, the decomposition heuristics outperform the classical metaheuristic approaches for the integrated problem.

CIFER’15 Session: 3: Portfolio Optimization & Hedging Strategies & The Bitcoin Market & Market Games
Thursday, December 10, 15:20-17:00, Room: 1.61
Chair: Katherine Malan

15:20 [#1570191785] Constraint Handling Methods for Portfolio Optimization Using Particle Swarm Optimization
Reid, Stuart; Malan, Katherine;

Given a portfolio of securities, portfolio optimization aims to optimize the proportion of capital allocated to each security such that either the risk of the portfolio is minimized for a given level of expected return, expected return is maximized for a given risk budget, or the risk-adjusted expected return of the portfolio is maximized. Extensions to the portfolio optimization problem can result in it becoming more difficult to solve which has prompted the use of computational intelligence optimization methods over classical optimization methods. The portfolio optimization problem is subject to two primary constraints namely, that all of the capital available to the portfolio should be allocated between the constituent securities and that the portfolio remain long only and unleveraged. Two popular methods for finding feasible solutions when using classical optimization methods are the penalty function and augmented Lagrangian methods. This paper presents two new constraint handling methods namely, a portfolio repair method and a preserving feasibility method based on the barebones particle swarm optimization (PSO) algorithm. The purpose is to investigate which constraint handling techniques are better suited to the problem solved using PSO. It is shown that the particle repair method outperforms traditional constraint handling methods in all tested dimensions whereas the performance of the preserving feasibility method tends to deteriorate as the dimensionality of the portfolio optimization problem is increased.

15:40 [#1570193201] Order Routing and Arbitrage Opportunities in a Multi-Market Trading Simulation
Todd, Andrew; Beling, Peter; Scherer, William;

In this paper we introduce a simple model of multi-market trading. An identical security trades on two independent trading platforms. Prices and quotes are connected only by the strategic behavior of traders. The experimental design varies the degree to which traders monitor and act on information from both markets. We report on the degree of integration between the two markets as measured by the availability of arbitrage opportunities and the percentage of volume that trade throughs better quotes. Finally, we discuss the limits of integration with respect to our modeling assumptions.

16:00 [#1570193549] Bitcoin Market Return and Volatility Forecasting Using Transaction Network Flow Properties
Yang, Steve; Kim, Jinhyoung;

Bitcoin, as the foundation for a secure electronic payment system, has drawn broad interests from researchers in recent years. In this paper, we analyze a comprehensive Bitcoin transaction dataset and investigate the interrelationship between the flow of Bitcoin transactions and its price movement. Using network theory, we examine a few complexity measures of the Bitcoin transaction flow networks, and we model the joint dynamic relationship between these complexity measures and Bitcoin market variables such as return and volatility. We find that a particular complexity measure of the Bitcoin transaction flow is significantly correlated with the Bitcoin market return and volatility. More specifically we document that the residual diversity or freedom of Bitcoin network flow scaled by the total system throughput can significantly improve the predictability of Bitcoin market return and volatility.

16:20 [#1570194993] Discrete-time Quadratic-Optimal Hedging Strategies for European Contingent Claims
Subramanian, Easwar; Bhat, Sanjay;

We revisit the problem of optimally hedging a European contingent claim (ECC) using a hedging portfolio consisting of a risky asset that can be traded at pre-specified discrete times. The objective function to be minimized is either the second-moment or the variance of the hedging error calculated in the market probability measure. The main outcome of our work is to show that unique solutions exist in a larger class of admissible strategies under integrability and non-degeneracy conditions on the hedging asset price process that are weaker than popular descriptions provided previously. Specifically, we do not require the hedging asset price process to be square-integrable, and do not use the bounded mean-variance trade off assumption. Our criterion for admissible strategies only requires the cumulative trading gain, and not the incremental trading gains, to be square integrable. We derive explicit expressions for the second-moment and the variance of the hedging error to arrive at the respective optimal hedging strategies. Further, we explain the connections between our work and those of the previous formulations.
We examine retailers that maximize their relative profit, which is the (absolute) profit relative to the average profit of the other retailers. Customer behavior is modeled by a multinomial logit (MNL) demand model. Although retailers with low retail prices attract more customers than retailers high retail prices, the retailer with the lowest retail price, according to this model, does not attract all the customers. We provide first and second order derivatives, and show that the relative profit, as a function of the own price, has a unique local maximum. Our experiments show that relative profit maximizers “beat” absolute profit maximizers, i.e. they outperform absolute profit maximizers if the goal is to make a higher profit. These results provide insight into market simulation competitions, such as the Power TAC.

CIDM’15 Session: 8: Special Session: Partially Supervised Learning
Thursday, December 10, 15:20–17:00, Room: 1.62
Chair: Sascha Meudt

16:40 [#1570197811] Winning in Retail Market Games: Relative Profit and Logit Demand
Hoogland, Jasper; Weerdt, Mathijs De; Poutre, Han La;

We examine retailers that maximize their relative profit, which is the (absolute) profit relative to the average profit of the other retailers. Customer behavior is modeled by a multinomial logit (MNL) demand model. Although retailers with low retail prices attract more customers than retailers high retail prices, the retailer with the lowest retail price, according to this model, does not attract all the customers. We provide first and second order derivatives, and show that the relative profit, as a function of the own price, has a unique local maximum. Our experiments show that relative profit maximizers “beat” absolute profit maximizers, i.e. they outperform absolute profit maximizers if the goal is to make a higher profit. These results provide insight into market simulation competitions, such as the Power TAC.
15:20 [1570169177] Computational Intelligence for Efficient Numerical Design of Structures with Uncertain Parameters
Graf, Wolfgang; Götz, Marco; Leichsenring, Ferenc; Kaliske, Michael;

An important task in engineering is the numerical design of structures. The current state of technology is characterized by deterministic thinking and practices. Fact is that all available data and information are characterized by uncertainty. An adequate consideration is necessary. The contribution gives an overview about approaches and methods for the numerical structural design, which consider the uncertainty of the data (a priori and design parameters). As the basis of the uncertainty modeling, the definition of polymorphic uncertainty models is proposed, to take real-world scenarios into account. Polymorphic uncertainty models allow the incorporation of the uncertainty characteristics variability (randomness), imprecision and incompleteness simultaneously. The direct consideration of data uncertainty in design tasks is for the optimization and the solution of the inverse problem not possible, due to the missing of rules for comparing uncertain quantities. An efficient approach is the formulation of surrogate models, differing in the order of evaluation uncertainty and solving the optimization task. This contribution presents the real present passive (“wait-and-see”) and active (“here-and-now”) approach for numerical design tasks analyzed with optimization or solving the inverse problem. The advantages and disadvantages of each concept are pointed out and the applicability, especially in early stages of design is demonstrated. Furthermore, numerical structural analysis, assessments, replacement models and reduction methods with uncertain data are outlined, leading to an efficient numerical design and to practical engineering solutions. This contribution demonstrates algorithms and methods for the numerical design concepts under consideration of polymorphic uncertainty models, by applying different surrogate models. Surrogate models allow the application of an appropriate uncertainty model. Suitable approaches for increasing numerical efficiency are reduction methods and replacement models among others. Reduction methods include model reduction, reducing the number of function calls and the complexity (e.g., the dimensionality with sensitivities). Replacement models are, e.g., physically motivated and analytical metamodels. Analytical metamodel can be distinguished into approximation and classification methods. Numerically efficient classification algorithms are, e.g., Support Vector Machines or Self-Organizing Maps. Efficient approximate metamodels are, e.g., Artificial Neural Networks, Radial Basis Function Networks, and Extreme Learning Machines. The applicability of approach are demonstrated by means of engineering examples.

15:40 [1570192365] Acceptance-based Software Architecture Deployment for Improvement of Existing Applications
Klee, Hannes; Buchholz, Michael; Materna, Torben; Dietmayer, Klaus;

A lot of approaches are already published to solve software architecture deployment problems. Most of them are intended for academic use and assume that the software components can be deployed freely on the hardware components. But for an improvement of existing applications, non-functional constraints will have a high influence on the acceptance of the automatically generated solutions. In this paper, the organization of the engineers and their tasks as well as the amount of changes regarding to a currently applied system are considered. To gain a smart and reduced interface between hardware components, a method is presented to reduce the communication overhead for an existing architecture. Additionally, the deployment problem is restricted by the amount of changes in comparison to an initial deployment. This approach is tested on a realistic case study to show that it is possible to achieve high improvements with only small changes of the system.

16:00 [1570192821] A Clustering Approach to a Major-Accident Data Set: Analysis of Key Interactions to Minimise Human Errors
Moura, Raphael; Doell, Christoph; Beer, Michael; Kruse, Rudolf;

This work aims to scrutinise a proprietary dataset containing major accidents occurred in high-technology facilities, in order to disclose relevant features and indicate a path to the recognition of the genesis of human errors. The application of a tailored Hierarchical Agglomerative Clustering method will provide means to understand data and identify key similarities among accidents and significant interfaces between human factors, the organisational environment and the technology. Conclusions to improve the human performance based on the clustering results are then discussed.

16:20 [1570192983] Computational Intelligence for Structural Identifications
Al-Hussein, Abdullah; Haldar, Achintya;

Structural health assessment using the structural identification concept using measured dynamic response information in time domain was considered to be not possible in the late seventies. With the help of comprehensive analytical and laboratory investigations, the research team at the University of Arizona conclusively documented that the above statement is not correct. In fact, they showed that the concept has several advantages over other available methods. Considering the implementation potential, the concept appeared to be very desirable. The team proposed several intelligent schemes to address many challenges. They used mathematical concepts used in other disciplines, extensively modified them and proposed few novel concepts. Some of them are briefly presented in this paper and their novelties are described with the help of several informative examples. The concepts presented in the paper cross the disciplinary boundaries and showcase benefits of computational intelligence.
16:40 [#1570192987] Fault Diagnosis and Evaluation of the Performance of the Overcurrent Protection in Radial Distribution Networks Based on Wavelet Transform and Rule-based Expert System
Alves, Helton do Nascimento;

This paper presents a fault diagnosis algorithm in radial distribution networks. The input data are the currents of the feeder per phase, monitored only in the substation. An algorithm based on Discrete Wavelet Transform (DWT) is used to detect, classify and locate the faults at the moment they occur. This algorithm takes advantage of the special properties of the wavelet transform to differentiate waves’ signature produced by a system under normal conditions, under disturbances related to power quality problem and under faults involving short-circuit conditions. A rule-based expert system (RBES) is developed to evaluate the performance of the overcurrent protection system during a fault. The main application of the proposed algorithm is to assist in the operation during a fault, and supervise the protection system. Simulation results using ATP/EMTP for a 282-bus non-transposed real feeder are included.

SIS’15 Session: 4: Other Swarm Intelligence Algorithms
Thursday, December 10, 15:20–17:00, Room: Audi 2
Chair: Robert G Reynolds, Co-chair: Yue-jiao Gong

15:20 [#1570192867] Differential Evolution with Random Walk Mutation and an External Archive for Multimodal Optimization
Zhang, Yu-Hui; Gong, Yue-jiao; Zhang, Jun;

Locating multiple optima of a problem is an important and challenging task for many real-world applications. In this paper, a random walk mutation strategy is proposed for differential evolution (DE) to handle multimodal optimization problems. The mutation strategy is able to find a balance between exploitation and exploration. First, the neighborhood and fitness information of individuals is incorporated into mutation to guide the formation of donor vectors. This facilitates the evolution of individuals toward their nearby optima. Second, the exploration ability of the mutation strategy is preserved by simulating a random walk process. Moreover, an archive technique is designed to detect converged subpopulations. The converged individuals are then reinitialized to search for other optima. This enhance the algorithm’s exploration ability. Meanwhile, found optima can be maintained throughout the optimization process by using the archive technique. The random walk mutation strategy and the archive technique are integrated with DE to make a competitive multimodal algorithm. The resulting algorithm is tested on a recently proposed benchmark function set. Experimental results show that the proposed algorithm is able to provide better performance than a number of state-of-the-art multimodal algorithms.

15:40 [#1570191961] The Impact of Subcultures in Cultural Algorithm Problem Solving
Reynolds, Robert G; Gawasneh, Yousof; Salaymeh, Areej;

Cultural Algorithms are computational models of social evolution based upon principle of Cultural Evolution. A Cultural Algorithm consists of a Belief Space consisting of a network of active and passive knowledge sources and a Population Space of agents. The agents are connected via a social fabric over which information used in agent problem solving is passed. The knowledge sources in the Belief Space compete with each other in order to influence the decision making of agents in the Population Space. Likewise, the problem solving experiences of agents in the Population Space are sent back to the Belief Space and used to update the knowledge sources there. It is a dual inheritance system in which both the Population and Belief spaces evolve in parallel. In this paper we compare three different social fabrics (homogeneous, heterogeneous and Sub-Cultures) over a wide range of problem complexities. The performances of these three different evolutionary approaches are compared relative to a variety of benchmark landscapes of varying entropy, from static to chaotic. We show that as the number of independent processes that are involved in the production of a landscape increases, the more advantageous subcultures are in directing the population to a solution.

16:00 [#1570171835] A Modified Chaotic Firefly Algorithm for Solving Discrete Logarithm Problem and Analysis
Mishra, Mohit; Chaturvedi, Utkarsh; Shukla, K K; Yampolskiy, Roman;

In this paper, we present a modified version of firefly algorithm that shows considerable potential in solving discrete logarithm problem, a mathematical function used in public-key cryptography like Diffie-Hellman Key Exchange and ElGamal Encryption. Firefly Algorithm has been experimentally proved to have outperformed a number of metaheuristics like the popular Particle Swarm Optimization. While solving the problem of finding discrete logarithm, we also evaluate the effectiveness of the algorithm and its modified version in solving such cryptographic problems. Observations show significant potential of Firefly Algorithm in solving small instances of the problem, while it calls for further research in scaling up the effectiveness of the algorithm in solving bigger instances of the problem. Simultaneously, we also analyze the convergence of the modified algorithm.
IEEE World Congress on Computational Intelligence

25-29 July 2016, Vancouver, Canada

The IEEE World Congress on Computational Intelligence (IEEE WCCI) is the largest technical event in the field of computational intelligence. The IEEE WCCI 2016 will host three conferences: The 2016 International Joint Conference on Neural Networks (IJCNN 2016), the 2016 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE 2016), and the 2016 IEEE Congress on Evolutionary Computation (IEEE CEC 2016). The conference aims to provide a forum for researchers from all over the world to discuss and present their research findings on computational intelligence.

IEEE WCCI 2016 will be held at the Vancouver Convention Centre, Vancouver, Canada. Vancouver is Canada's Pacific gem, offering a winning combination of world-class hotels, meeting venues, and restaurants in a setting of spectacular beauty. Few convention cities can offer such a wide range of cosmopolitan amenities in a downtown core that is safe, clean, pedestrian friendly, and stunning in its backdrop of mountains and ocean.

IJCNN is the flagship conference of the International Neural Network Society and the IEEE Computational Intelligence Society. It covers a wide range of topics in the field of neural networks, from biological neural network modeling to artificial neural computation.

FUZZ-IEEE is the foremost conference in the field of fuzzy systems. It covers all topics in fuzzy systems, from theory to applications.

IEEE CEC is a major event in the field of evolutionary computation, and covers all topics in evolutionary computation from theory to applications.

Call for Papers

Papers for IEEE WCCI 2016 should be submitted electronically through the Congress website at www.wcci2016.org, and will be refereed by experts in the fields and ranked based on the criteria of originality, significance, quality and clarity.

Call for Tutorials

IEEE WCCI 2016 will feature pre-Congress tutorials, covering fundamental and advanced topics in computational intelligence. A tutorial proposal should include title, outline, expected enrollment, and presenter/organizer biography. Inquiries regarding tutorials should be addressed to Tutorials Chairs.

Call for Special Session Proposals

IEEE WCCI 2016 solicits proposals for special sessions within the technical scope of the three conferences. Special sessions, to be organized by internationally recognized experts, aim to bring together researchers in special focused topics. Cross-fertilization of the three technical disciplines and newly emerging research areas are strongly encouraged. Inquiries regarding special sessions and proposals should be addressed to Special Sessions Chairs.

Call for Competition Proposals

IEEE WCCI 2016 will host competitions to stimulate research in computational intelligence. A competition proposal should include descriptions of the problem(s) addressed, evaluation procedures, and a biography of the organizers. Inquiries regarding competitions should be addressed to the Competitions Chair.

Important Dates

- **15 Nov 2015**: Special Session & Workshop Proposals Deadline
- **15 Dec 2015**: Competition & Tutorial Proposals Deadline
- **15 Jan 2016**: Paper Submission Deadline
- **16 Mar 2016**: Paper Acceptance Notification Date
- **15 Apr 2016**: Final Paper Submission & Early Registration Deadline
- **25-29 Jul 2016**: IEEE WCCI 2016, Vancouver, Canada
Call for Papers

The 2016 IEEE Symposium Series on Computational Intelligence (IEEE SSCI 2016) will be held in Athens, Greece, a city full of arts, philosophy and historical attractions. SSCI is a flagship annual international conference on computational intelligence sponsored by the IEEE Computational Intelligence Society, promoting all aspects of theory, algorithm design, applications and related emerging techniques. As a tradition, IEEE SSCI 2016 will co-locate a number of symposiums, each dedicated to a special topic related to computational intelligence, thereby providing a unique platform for promoting cross-fertilization. SSCI 2016 will be featured by cross-symposium tutorials, keynote speeches, panel discussions, PhD consortiums, oral presentations and poster sessions. Student grants, Best paper Awards and Student Best Paper Award will be given.

Symposiums

- ADPLR Adaptive Dynamic Programming and Reinforcement Learning, Dongbin Zhao, Madalina Drugan
- CIASG Computational Intelligence Applications in Smart Grid, G.K Venayagamoorthy
- CIBD Computational Intelligence in Big Data, Yonghong Peng, Yaochu Jin, Marios Polycarpou
- CICA Computational Intelligence in Control and Automation, Xiao-Jun Zeng
- CICARE Computational Intelligence in Healthcare and e-health, Amir Hussain, Jonathan Wu
- CICS Computational Intelligence in Cyber Security, Dipankar Dasgupta
- CIDM Computational Intelligence in Data Mining, Carlotta Domeniconi, Friedhelm Schwenker, Zhi-Hua Zhou
- CIDUE Computational Intelligence in Dynamic and Uncertain Environments, Shengxiang Yang, Robi Polikar, Michalis Mavrovouniotis, Yaochu Jin
- CIEG Computational Intelligence in E-Government, Xin Ye, Haoxiang Xia, Dujuan Wang, Yanzhang Wang
- CIEL Computational Intelligence and Ensemble Learning, P.N. Suganthan, Nik Pal, Xin Yao
- CIES Computational Intelligence for Engineering Solutions, Michaer Beer, Rudolf Kruse, Vladik Kreinovich
- CIFeR Computational Intelligence for Financial Engineering and Economics, Nikos Loukeris, Ronald R. Yager, Robert Golan
- CIHLI Computational Intelligence for Human-like Intelligence, Jacek Mandziuk
- CIMISIVP Computational Intelligence for Multimedia, Signal and Vision Processing, Khan Iftekharuddin
- CIPLS Computational Intelligence in Production and Logistics Systems, Bulent Catak, Raymond Chiong, Patrick Siarry
- CIRZAT Computational Intelligence in Robotic Rehabilitation and Assistive Technologies, Guilherme N. DeSouza, Georgios Kouropouloglou
- CISDA Computational Intelligence for Security and Defense Applications, Rafael Falcon, Marco Cococciini, Rami Abielmona
- CISND Computational Intelligence in Scheduling and Network Design, Ruibin Bai, Rong Qu, Nelsiha Pillay, Hisao Ishibuchi
- CIVTS Computational Intelligence in Vehicles and Transportation Systems, Dipti Srinivasan
- DL Deep Learning, Alessandro Sperduti, Xue-wen Chen, Jose Principe
- EALS Evolving and Autonomous Learning Systems, Plamen Angelov, Dimitar Filev, Nik Kasabov
- FASLIP Computational Intelligence in Feature Analysis, Selection, and Learning in Image and Pattern Recognition, Bing Xue, Mengjie Zhang, Hisao Ishibuchi, and Brijesh Verma
- FOCl Foundations of Computational Intelligence, Manuel Ojeda, Pietro Oliveto, Leonardo Franco
- IA Computational Intelligence on Intelligent Agents, Hani Hagras, Vincenzo Loia
- ICES International Conference on Evolvable Systems, Andy M Tyrrell, Martin Trefzer
- IntECS Computational Intelligence for Embedded and Cyberphysical Systems, Cesare Alippi, Giacomo Boracchi and Manuel Roveri
- ISIC Independent Computing, Qiangfu Zhao, Robert Kozma, Cheng-Hsiung Hsieh, Neil Y. Yen
- MBEA Model-Based Evolutionary Algorithms, Ran Cheng, Aimin Mavrovouniotis, Nik Pal, Xin Yao
- MCDM Multicriteria Decision-Making, Piero Bonissone, Kaisa Miettinen, Yaochu Jin
- RiIS2016 Robotic Intelligence in Informationally Structured Space, Loo Chu Kiong, Janos Botzheim, Hiroyuki Masuta
- SNCI Symposium on Neuromorphic Systems and Cyborg Intelligence, Huajin Tang, Garrick Orchard, Ali A. Minai, Zhaohui Wu
- SDE Symposium on Differential Evolution, Swagatam Das, Janez Brest, Ferrante Neri
- SIS Swarm Intelligence Symposium, Yuhui Shi, P.N. Suganthan
Scope of the Conference

Swarm intelligence is the discipline that deals with the study of self-organizing processes both in nature and in artificial systems. Researchers in ethology and animal behavior have proposed a number of models to explain interesting aspects of social insect behavior such as self-organization and shape-formation. Recently, algorithms and methods inspired by these models have been proposed to solve difficult problems in many domains.

An example of a particularly successful research direction in swarm intelligence is ant colony optimization, the main focus of which is on discrete optimization problems. Ant colony optimization has been applied successfully to a large number of difficult discrete optimization problems including the traveling salesman problem, the quadratic assignment problem, scheduling, vehicle routing, etc., as well as to routing in telecommunication networks. Another interesting approach is that of particle swarm optimization, that mainly focuses on continuous optimization problems. Here too, a number of successful applications can be found in the recent literature. Swarm robotics is another relevant field. Here, the focus is on applying swarm intelligence techniques to the control of large groups of cooperating autonomous robots.

ANTS 2016 will give researchers in swarm intelligence the opportunity to meet, to present their latest research, and to discuss current developments and applications. The three-day conference will be held in Brussels, Belgium, on September 7–9, 2016.

Relevant Research Areas

ANTS 2016 solicits contributions dealing with any aspect of swarm intelligence. Typical, but not exclusive, topics of interest are:

- Behavioral models of social insects or other animal societies that can stimulate new algorithmic approaches.
- Empirical and theoretical research in swarm intelligence.
- Application of swarm intelligence methods, such as ant colony optimization or particle swarm optimization, to real-world problems.
- Theoretical and experimental research in swarm robotics systems.

Publication Details

Conference proceedings will be published by Springer in the LNCS series. The journal Swarm Intelligence will publish a special issue dedicated to ANTS 2016 that will contain extended versions of the best research works presented at the conference. Further details will soon be published on the web site.

Conference Location

Auditorium R42.4.502, Solvay Brussels School of Economics and Management, Campus du Solbosch, Université Libre de Bruxelles, Av. F.D. Roosevelt 42, 1050 Brussels, Belgium.
Swarm Intelligence
Editor-in-Chief: M. Dorigo

- Publishes original research articles and reviews on theoretical, experimental, and practical aspects of swarm intelligence
- Offers reports on advances in the understanding and utilization of systems based on the principles of swarm intelligence
- Features articles combining experimental and theoretical work

Swarm Intelligence is the principal peer reviewed publication dedicated to reporting research and new developments in this multidisciplinary field. The journal publishes original research articles and occasional reviews on theoretical, experimental, and practical aspects of swarm intelligence. It offers readers reports on advances in the understanding and utilization of systems that are based on the principles of swarm intelligence. Emphasis is given to such topics as the modeling and analysis of collective biological systems; application of biological swarm intelligence models to real-world problems; and theoretical and empirical research in ant colony optimization, particle swarm optimization, swarm robotics, and other swarm intelligence algorithms. Articles often combine experimental and theoretical work.

Impact Factor: 2.16 (2014), Journal Citation Reports®, Thomson Reuters

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- Find submission information
# Index of Authors

## Symbols

<table>
<thead>
<tr>
<th>Author</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Çatay, Bülent</td>
<td>140</td>
</tr>
<tr>
<td>Znidaršič, Martin</td>
<td>132</td>
</tr>
</tbody>
</table>

## A

<table>
<thead>
<tr>
<th>Author</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aalto, Johanna</td>
<td>134</td>
</tr>
<tr>
<td>Abdelbar, Ashraf</td>
<td>123</td>
</tr>
<tr>
<td>Abdullah, Hayati</td>
<td>99</td>
</tr>
<tr>
<td>Abdulsalam, Yassine</td>
<td>124</td>
</tr>
<tr>
<td>Abercrombie, Robert</td>
<td>69, 70, 103</td>
</tr>
<tr>
<td>Abraham, Ajith</td>
<td>90</td>
</tr>
<tr>
<td>Ahran, Alain</td>
<td>117</td>
</tr>
<tr>
<td>Ahmadi, Samad</td>
<td>130</td>
</tr>
<tr>
<td>Ackelin, Uwe</td>
<td>132</td>
</tr>
<tr>
<td>Aioli, Fabio</td>
<td>136</td>
</tr>
<tr>
<td>Akhtar, Zahid</td>
<td>100</td>
</tr>
<tr>
<td>Akpa, Nelson Ebot Enon</td>
<td>90</td>
</tr>
<tr>
<td>Al-Dujaili, Abdullah</td>
<td>128, 129</td>
</tr>
<tr>
<td>Al-Hussein, Abdullah</td>
<td>123</td>
</tr>
<tr>
<td>Alasalmi, Tuomo</td>
<td>93</td>
</tr>
<tr>
<td>Alexandridis, Antonis</td>
<td>110</td>
</tr>
<tr>
<td>Ali, Mohd Hasan</td>
<td>126</td>
</tr>
<tr>
<td>Alippi, Cesare</td>
<td>108</td>
</tr>
<tr>
<td>Alizadeh, Mahdi</td>
<td>130</td>
</tr>
<tr>
<td>Alnaami, Khaled</td>
<td>91</td>
</tr>
<tr>
<td>Alsina, Emmanuel</td>
<td>119</td>
</tr>
<tr>
<td>Alves, Helton do Nascimento</td>
<td>144</td>
</tr>
<tr>
<td>Amaratunga, Gehan A. J.</td>
<td>110</td>
</tr>
<tr>
<td>Andreadou, Elisabeth</td>
<td>138</td>
</tr>
<tr>
<td>Arunagirinathan, Paranietharan</td>
<td>127</td>
</tr>
<tr>
<td>Arzani, Ali</td>
<td>127</td>
</tr>
<tr>
<td>Ashlock, Daniel A</td>
<td>122</td>
</tr>
<tr>
<td>Asprou, Markos</td>
<td>109</td>
</tr>
<tr>
<td>Asua, Estibaliz</td>
<td>107</td>
</tr>
<tr>
<td>Ayoade, Gbadebo</td>
<td>91</td>
</tr>
<tr>
<td>Ayres, Phil</td>
<td>122</td>
</tr>
</tbody>
</table>

## B

<table>
<thead>
<tr>
<th>Author</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bäck, Thomas</td>
<td>140</td>
</tr>
<tr>
<td>Bachoo, Asheer</td>
<td>102</td>
</tr>
<tr>
<td>Backhaus, Andreas</td>
<td>99</td>
</tr>
<tr>
<td>Baghail-Wadjji, Alireza</td>
<td>125</td>
</tr>
<tr>
<td>Bagheri, Zahra</td>
<td>92</td>
</tr>
<tr>
<td>Ballester, Enrique Munoz</td>
<td>100</td>
</tr>
<tr>
<td>Banda, Ntombiayise</td>
<td>113</td>
</tr>
<tr>
<td>Barnes, David</td>
<td>121</td>
</tr>
<tr>
<td>Bautista, Joaquin</td>
<td>119</td>
</tr>
<tr>
<td>Beer, Michael</td>
<td>143</td>
</tr>
<tr>
<td>Belatreche, Ammar</td>
<td>110, 116</td>
</tr>
<tr>
<td>Beling, Peter</td>
<td>141</td>
</tr>
<tr>
<td>Bellot, Pau</td>
<td>121</td>
</tr>
<tr>
<td>Belz, Julian</td>
<td>101</td>
</tr>
<tr>
<td>Benjumea, Sebastian Suarez</td>
<td>117</td>
</tr>
<tr>
<td>Bennani, Younes</td>
<td>112</td>
</tr>
<tr>
<td>Bharill, Neha</td>
<td>112</td>
</tr>
<tr>
<td>Bhat, Sanjay</td>
<td>141</td>
</tr>
<tr>
<td>Bidlo, Michal</td>
<td>133</td>
</tr>
<tr>
<td>Biehl, Michael</td>
<td>126</td>
</tr>
<tr>
<td>Bontempini, Gianluca</td>
<td>94</td>
</tr>
<tr>
<td>Booyse, Martinus J</td>
<td>59, 102, 109</td>
</tr>
<tr>
<td>Boracchi, Giacomo</td>
<td>107</td>
</tr>
<tr>
<td>Borges, Nuno</td>
<td>126</td>
</tr>
<tr>
<td>Bossoamaier, Terry</td>
<td>63, 80, 122</td>
</tr>
<tr>
<td>Bottesch, Thomas</td>
<td>99</td>
</tr>
<tr>
<td>Botzheim, János</td>
<td>93, 97</td>
</tr>
<tr>
<td>Boussaid, Farid</td>
<td>97</td>
</tr>
<tr>
<td>Braune, Christian</td>
<td>111</td>
</tr>
<tr>
<td>Bruwer, Frederick</td>
<td>102</td>
</tr>
<tr>
<td>Bu, Li</td>
<td>108</td>
</tr>
<tr>
<td>Buchholz, Michael</td>
<td>143</td>
</tr>
<tr>
<td>Buer, Tobias</td>
<td>119</td>
</tr>
<tr>
<td>Burda, Michal</td>
<td>129</td>
</tr>
<tr>
<td>Byanjankar, Ajay</td>
<td>111</td>
</tr>
<tr>
<td>Cabanes, Gual</td>
<td>112</td>
</tr>
<tr>
<td>Cabrera, Inna</td>
<td>119</td>
</tr>
<tr>
<td>Cabri, Giacomo</td>
<td>119</td>
</tr>
<tr>
<td>Caelen, Olivier</td>
<td>94</td>
</tr>
<tr>
<td>Cangelosi, Angelo</td>
<td>92</td>
</tr>
<tr>
<td>Capodieci, Nicola</td>
<td>119</td>
</tr>
<tr>
<td>Caraffini, Fabio</td>
<td>134</td>
</tr>
<tr>
<td>Carroll, Johnson</td>
<td>102</td>
</tr>
<tr>
<td>Cazenave, Tristan</td>
<td>61, 85, 111</td>
</tr>
<tr>
<td>Cazzolato, Ben</td>
<td>92</td>
</tr>
<tr>
<td>Cebertio, Martine</td>
<td>136</td>
</tr>
<tr>
<td>Chaitamantan, Supatcha</td>
<td>90</td>
</tr>
<tr>
<td>Chakravorty, Pragnan</td>
<td>123</td>
</tr>
<tr>
<td>Chakravorty, Pragnan Mandal, Durbadal Kar, Rajib</td>
<td>124</td>
</tr>
<tr>
<td>Chan, Jonathan H</td>
<td>113</td>
</tr>
<tr>
<td>Chandorkar, Mandar</td>
<td>105</td>
</tr>
<tr>
<td>Chandra, Swarup</td>
<td>113</td>
</tr>
<tr>
<td>Chaturvedi, Utkarsh</td>
<td>144</td>
</tr>
<tr>
<td>Chen, Kuan-Heng</td>
<td>116</td>
</tr>
<tr>
<td>Chen, Liang</td>
<td>133</td>
</tr>
<tr>
<td>Chen, Wei-Neng</td>
<td>128</td>
</tr>
<tr>
<td>Chiba, Kazuhisa</td>
<td>117</td>
</tr>
<tr>
<td>Chica, Manuel</td>
<td>119</td>
</tr>
<tr>
<td>Chin, Wei Hong</td>
<td>97</td>
</tr>
<tr>
<td>Chiong, Raymond</td>
<td>140</td>
</tr>
<tr>
<td>Chowdhury, Zaman Iqbal</td>
<td>114</td>
</tr>
<tr>
<td>Chu, Dominique</td>
<td>121</td>
</tr>
<tr>
<td>Cochez, Michael</td>
<td>112</td>
</tr>
<tr>
<td>Coleman, Souya A</td>
<td>110, 116</td>
</tr>
<tr>
<td>Collet, Timothé</td>
<td>106</td>
</tr>
<tr>
<td>Cordero, Pablo</td>
<td>119</td>
</tr>
<tr>
<td>Cordon, Oscar</td>
<td>119</td>
</tr>
<tr>
<td>Corne, David</td>
<td>139</td>
</tr>
<tr>
<td>Costa, Edson</td>
<td>89</td>
</tr>
<tr>
<td>Cramer, Sam</td>
<td>110</td>
</tr>
<tr>
<td>D'Alessandro, Steven</td>
<td>122</td>
</tr>
<tr>
<td>Daldal, Rebi</td>
<td>140</td>
</tr>
<tr>
<td>Dam, Tamnoy</td>
<td>89, 138</td>
</tr>
<tr>
<td>Damas, Sergio</td>
<td>119</td>
</tr>
<tr>
<td>Danielsson, Fredrik</td>
<td>139</td>
</tr>
<tr>
<td>Das, Sudipta</td>
<td>124</td>
</tr>
<tr>
<td>Dasgupta, Dipankar</td>
<td>103, 126</td>
</tr>
<tr>
<td>Datta, Kaushik</td>
<td>116</td>
</tr>
<tr>
<td>Davis, Jesse</td>
<td>129</td>
</tr>
<tr>
<td>De Hauwere, Yann-Michaël</td>
<td>106</td>
</tr>
<tr>
<td>de Leoni, Massimiliano</td>
<td>130</td>
</tr>
<tr>
<td>De Moo, Bart</td>
<td>105, 129</td>
</tr>
<tr>
<td>Deane, Anil</td>
<td>116</td>
</tr>
<tr>
<td>Deb, Alok</td>
<td>89, 138</td>
</tr>
<tr>
<td>Debois, Søren</td>
<td>130</td>
</tr>
<tr>
<td>Last Name</td>
<td>First Name</td>
</tr>
<tr>
<td>-----------</td>
<td>------------</td>
</tr>
<tr>
<td>Meiswinkel, Sebastian</td>
<td>140</td>
</tr>
<tr>
<td>Mensik, Pavel</td>
<td>140</td>
</tr>
<tr>
<td>Meyer, Patrick</td>
<td>121</td>
</tr>
<tr>
<td>Mezei, Jozef</td>
<td>111</td>
</tr>
<tr>
<td>Michaelides, Michalis P</td>
<td>107</td>
</tr>
<tr>
<td>Mideksa, Dida</td>
<td>90</td>
</tr>
<tr>
<td>Mikut, Ralf</td>
<td>61, 86</td>
</tr>
<tr>
<td>Milis, George M.</td>
<td>107, 109</td>
</tr>
<tr>
<td>Mishra, Mohit</td>
<td>144</td>
</tr>
<tr>
<td>Mlamo, Cynthia</td>
<td>100</td>
</tr>
<tr>
<td>Mohanty, Manoranjan</td>
<td>89</td>
</tr>
<tr>
<td>Mokbel, Bassam</td>
<td>136</td>
</tr>
<tr>
<td>Mora, Angel</td>
<td>119</td>
</tr>
<tr>
<td>Moreno, Gines</td>
<td>119</td>
</tr>
<tr>
<td>Moshairov, Amir</td>
<td>115</td>
</tr>
<tr>
<td>Mostaghim, Sanaz</td>
<td>115</td>
</tr>
<tr>
<td>Motoyoshi, Tatsuo</td>
<td>92</td>
</tr>
<tr>
<td>Moudrik, Josef</td>
<td>138</td>
</tr>
<tr>
<td>Moura, Raphael</td>
<td>143</td>
</tr>
<tr>
<td>Mueller, Carsten</td>
<td>134</td>
</tr>
<tr>
<td>Murphey, Yi Lu</td>
<td>102</td>
</tr>
<tr>
<td>Mwaara, Jonathan</td>
<td>121</td>
</tr>
</tbody>
</table>

| N | Nag, Abhijit Kumar | 103 |
| Nair, Suraj | 126 |
| Nakamoto, Hiroyuki | 92 |
| Napoli, Christian | 133, 137 |
| Narayanan, Vignesh | 107 |
| Navarin, Nico | 136 |
| Navarro, Javier | 142 |
| Nel, Philip J C | 109 |
| Nelles, Oliver | 109, 103 |
| Nerli, Ferrante | 112, 134, 139 |
| Neruda, Roman | 131, 135, 138 |
| Neto, Fernando Lima | 120 |
| Nguyen, Hung T | 136 |
| Nichele, Stefano | 145 |
| Nienaber, Sonja | 102 |
| Nienhuijs, Simon | 128 |
| Nigam, Aditya | 89 |
| Nikolaides, Nikos | 104 |
| Nishikubo, Daisuke | 92 |
| Nitschke, Geoff | 120 |
| Niu, Haifeng | 108 |
| Nojima, Yusuke | 115 |
| Nowé, Ann | 106 |
| Nowak, Bartosz | 137 |
| Nowicki, Robert | 137 |
| Nez, Alfredo | 109 |

| O | O’Carroll, David C | 92 |
| Obo, Takenori | 106 |
| Ojeda-Aciego, Manuel | 119 |
| Oliveras, Albert | 121 |
| Oliveri, Giacomo | 125 |
| Ombugi-Berman, Beatrice | 96, 128 |
| Ouncharoen, Rujira | 146 |
| Ogvisatapeafoom, Kanmanus | 113 |
| Orciuoli, Francesco | 108 |
| Oshima, Toru | 92 |
| Otero, Fernando | 124 |
| Othman, Mohd | 109 |
| P | Palenzuela, bon | 114, 130 |
| Palm, Guenther | 99, 124 |
| Pamparà, Gary | 132 |
| Papayiotaou, Christos | 107, 109 |
| Papageorgiou, Charalampos | 138 |
| Papatheodorou, Nikolaos | 138 |
| Parente, Mimmo | 108 |
| Parmar, Vivek | 129 |
| Patel, Om | 91, 12 |
| Patel, Vikram | 91 |
| Paul, Andreas | 91 |
| Pavlidis, Nicos | 112 |
| Peng, Yonghong | 105 |
| Pereira, Fabio | 135 |
| Perreault, Logan J | 92 |
| Pesch, Erwin | 54, 28, 140 |
| Peskova, Klara | 135 |
| Person, Luis | 120 |
| Peters, Jan | 127, 82 |
| Petursson, Kjartan | 132 |
| Pietquin, Olivier | 106 |
| Pighetti, Romaric | 114, 130 |
| Pilat, Martin | 131, 135 |
| Pilati, Francesco | 119 |
| Pino, Alexandros | 138 |
| Pitas, Ioannis | 103, 130, 132 |
| Piuri, Vincenzo | 100 |
| Polap, Dawid | 137 |
| Podhadrsky, Michal | 121 |
| Podotcan, Vid | 132 |
| Polack, Senja | 132 |
| Polycarpou, Marios | 107, 109 |
| Popovic, Dusan | 129 |
| Poutr, Han La | 142 |
| Pozzolo, Andrea Dal | 94 |
| Prasad, Mukesh | 89 |
| Prasad, Om Kumar | 89 |
| precious, Frederic | 130 |
| Precioso, Frederic | 114 |
| Pretorius, Christiana | 97 |

| Q | Qiu, Xueheng | 110 |
| R | Rönqvist, Samuel | 116 |
| Raghavan, Krishnan | 105 |
| Rahmani-andebili, Mehdi | 126 |
| Rakitianskaia, Anna | 131 |
| Ram Hardel, Gopi | 124 |
| Ramirez, Rafael | 123 |
| Rango, Massimiliano | 120 |
| Rasool, Zeeshan | 91 |
| Rastin, Parisa | 142 |
| Rattani, Ajita | 100 |
| Raval, Muthul | 104 |
| Reehuis, Edgar | 140 |
| Regattieri, Alberto | 119 |
| Reid, Stuart | 141 |
| Ren, Ye | 110 |
| Reynolds, Robert G | 108, 114 |
| Riahi, Fatemeh | 136 |
| Richter, Florian | 130 |
| Rietz, Ren | 91 |
| Risi, Sebastian | 122 |
Robinson, Peter ........................................ 113
Rocca, Paolo ........................................ 123
Rodríguez-Jiménez, Jose Manuel ...................... 119
Rodríguez-Lorenzo, Estrella .......................... 119
Roli, Fabio ............................................ 96
Romanowski, Jakub .................................. 129
Roveri, Manuel ....................................... 107
Rowlings, Matthew ................................... 125
Roy, Arunava ......................................... 103
Rudolph, Guenter ..................................... 131
Runarsson, Thomas ................................... 132
Ruozzi, Nicholas ...................................... 91
Ruing, Juha ............................................ 93

S
Sánchez, Gracia ........................................ 104
Sorensen, Jan ........................................... 110
Sabourin, Robert ...................................... 106
Sadi, Mohammad ...................................... 126
Saeez, Doris ............................................ 106
Salama, Khalid ........................................ 127
Salaymeh, Areej ....................................... 144
Salembier, Philippe .................................. 121
Salucci, Marco ........................................ 123
Samina, Barak ........................................ 154
Sander, Thomas ....................................... 108
Saputra, Azhar Aulia .................................. 97
Sarlin, Peter ........................................... 116
Scaillet, Olivier ....................................... 45
Schels, Martin ........................................ 108
Scherer, Ralaf ......................................... 129
Scherer, William ..................................... 141
Schimbinschi, Florin ................................ 104
Schmickl, Thomas .................................... 122
Schomaker, Lambert ................................ 144
Schulte, Oliver ........................................ 156
Schulz, Alexander .................................... 156
Schuster, Franka ...................................... 109
Schwenker, Friedhelm ................................ 142
Sciacivico, Guido ..................................... 104
Scotti, Fabio .......................................... 106
Seidl, Thomas ........................................ 130
Seiffert, Udo .......................................... 99
Sekanina, Lukas ...................................... 157
Sekiyama, Kosuke .................................... 108
Semenkin, Eugene ................................... 194
Serra, Ginalber ........................................ 129
Seselja, Branimir ..................................... 118
Seto, Skyler ........................................... 133
Sforza, Gianluca ...................................... 100
Sheikh, Sajid .......................................... 124
Sheppard, John W. ................................... 107
Shi, Wei .................................................. 140
Shirmohammadi, Shervin .............................. 122
Shukla, K K ............................................ 144
Shyam, Devadeep .................................... 106
Shynekivench, Yauheniya ......................... 110
Siccha, Sergio .......................................... 130
Siddiqui, Asim ......................................... 134
Sifrim, Alejandro ..................................... 129
Sinclair, Marion ....................................... 89
Singananallu, Sai Kalyan Ranga ..................... 122
Singh, Jagendra ....................................... 89
Singla, Akshay ......................................... 125
Shaats, Tijs ............................................ 136

Slack, Warner ........................................ 114
Smid, Jakub ........................................... 135
Snir, Alon .............................................. 115
Soares, João .......................................... 126
Song, Qiang ............................................ 116
Sopov, Evgenii ........................................ 142
Sousa, Diogo .......................................... 134
Sperduti, Alessandro ................................ 136
Spinola, João .......................................... 135
Sriboonchitta, Songsak ............................... 136
Stanovov, Vladimir .................................. 144
Stoy, Kasper .......................................... 122
Subramanian, Easwar ................................. 141
Subramanian, Kartick ................................. 144
Suganathan, Ponnuthurai Nagarathnam ............ 110
Sulaiman, Noor ...................................... 109
Sulistijono, Indra Adji .............................. 107
Sun, Fan ............................................... 116
Sun, Jianyong ......................................... 135
Sun, Ying ............................................... 101
Sundaram, Suresh .................................... 128
Suri, Manan .......................................... 125
Surinta, Olarik ........................................ 95
Suttala, Jaakko ........................................ 93
Suykens, Johan ....................................... 105
Svensson, Bo ........................................ 139
Szkatua, Grażyna ..................................... 135

T
Tang, Dalai ............................................ 103
Tang, Ke .............................................. 156
Tang, Tiong Yew ..................................... 103
Tanweer, Muhammad Rizwan ....................... 129
Tao, Yanyun .......................................... 133
Taskin, Almet ......................................... 118
Tefas, Anastasios ..................................... 132
Tenuti, Lorenza ....................................... 123
Tepavcevic, Andreja .................................. 118
Thiam, Patrick ........................................ 145
Thornton, Monica .................................... 107
Tiwari, Aruna ......................................... 142
Toda, Yuichiro ........................................ 107
Todd, Andrew ......................................... 147
Tozlu, Başak .......................................... 140
Tramontana, Emiliano ............................... 133
Trefzer, Martin ....................................... 125
Tripathi, Achyut ...................................... 138
Tsang, Jeffrey ......................................... 122
Tsapanos, Nikolaos .................................. 104
Tsutsui, Shigeyoshi .................................. 122
Tufte, Gunnar ......................................... 125
Turner, Alexander .................................. 126
Tyrrell, Andy ......................................... 125

U
Unluyurt, Tonguc ..................................... 140
Ushio, Toshimitsu .................................... 105

V
Vázquez, Carlos ...................................... 119
Vaerenbergh, Kevin Van ......................... 106
Vale, Zita .............................................. 146
van de Steeg, Michiel ................................ 106
van de Woflshaar, Jos ................................. 104
van der Merwe, Brink ............................... 109
van Heiningen, Pepijn ......................... 110

153
<table>
<thead>
<tr>
<th>Name</th>
<th>Page(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>van Rooyen, Gert-Jan</td>
<td>102</td>
</tr>
<tr>
<td>van Zyl, Elre</td>
<td>96</td>
</tr>
<tr>
<td>Vanijja, Vajirasak</td>
<td>113</td>
</tr>
<tr>
<td>Veenstra, Frank</td>
<td>122</td>
</tr>
<tr>
<td>Veltman, Franka</td>
<td>109</td>
</tr>
<tr>
<td>Venayagamoorthy, G. Kumar</td>
<td>109, 126, 127</td>
</tr>
<tr>
<td>Vinagre, Eugénia</td>
<td>109</td>
</tr>
<tr>
<td>Visser, Job</td>
<td>129</td>
</tr>
<tr>
<td>Vitacolonna, Nicola</td>
<td>104</td>
</tr>
<tr>
<td>von Korff, Modest</td>
<td>98</td>
</tr>
<tr>
<td>Wagner, Carolin</td>
<td>120</td>
</tr>
<tr>
<td>Wagner, Christian</td>
<td>132</td>
</tr>
<tr>
<td>Wahby, Mostafa</td>
<td>122</td>
</tr>
<tr>
<td>Walędzik, Karol</td>
<td>137</td>
</tr>
<tr>
<td>Wang, He-Da</td>
<td>118</td>
</tr>
<tr>
<td>Wang, Mingjun</td>
<td>117</td>
</tr>
<tr>
<td>Wang, Rui</td>
<td>108, 127</td>
</tr>
<tr>
<td>Wang, Yan</td>
<td>103</td>
</tr>
<tr>
<td>Wang, Zi-Jia</td>
<td>96</td>
</tr>
<tr>
<td>Waris, Faisal</td>
<td>108</td>
</tr>
<tr>
<td>Weerdt, Mathijs De</td>
<td>142</td>
</tr>
<tr>
<td>Wei, Yawei</td>
<td>109</td>
</tr>
<tr>
<td>Weise, Thomas</td>
<td>140</td>
</tr>
<tr>
<td>While, Lyndon</td>
<td>97</td>
</tr>
<tr>
<td>White, Lyndon</td>
<td>97</td>
</tr>
<tr>
<td>Wiederman, Steven D</td>
<td>92</td>
</tr>
<tr>
<td>Wiering, Marco</td>
<td>94, 106</td>
</tr>
<tr>
<td>Wilbik, Anna</td>
<td>129</td>
</tr>
<tr>
<td>Woźniak, Marcin</td>
<td>133, 135</td>
</tr>
<tr>
<td>Wojtaszek, Przemyslaw</td>
<td>122</td>
</tr>
<tr>
<td>Wohluter, Riaan</td>
<td>124</td>
</tr>
<tr>
<td>Woodford, Grant</td>
<td>97</td>
</tr>
<tr>
<td>Wu, Ji</td>
<td>118</td>
</tr>
<tr>
<td>Xie, Rui</td>
<td>133</td>
</tr>
<tr>
<td>Yahyaa, Saba</td>
<td>107</td>
</tr>
<tr>
<td>Yampolskiy, Roman</td>
<td>144</td>
</tr>
<tr>
<td>Yang, Shengxiang</td>
<td>132</td>
</tr>
<tr>
<td>Yang, Steve</td>
<td>116, 141</td>
</tr>
<tr>
<td>Yao, Xin</td>
<td>34, 71</td>
</tr>
<tr>
<td>Yasunaga, Moritoshi</td>
<td>126</td>
</tr>
<tr>
<td>Yoda, Hideyuki</td>
<td>117</td>
</tr>
<tr>
<td>Yoshihara, Ikuo</td>
<td>126</td>
</tr>
<tr>
<td>Zadrożyń, Sławomir</td>
<td>133, 137</td>
</tr>
<tr>
<td>Zahadat, Payam</td>
<td>122</td>
</tr>
<tr>
<td>Zaka, Masood</td>
<td>103</td>
</tr>
<tr>
<td>Zannone, Nicola</td>
<td>130</td>
</tr>
<tr>
<td>Zekri, Ahmed</td>
<td>103</td>
</tr>
<tr>
<td>Zelinka, Ivan</td>
<td>123, 134</td>
</tr>
<tr>
<td>Zha, Yabin</td>
<td>108</td>
</tr>
<tr>
<td>Zhan, Zhi-hui</td>
<td>96</td>
</tr>
<tr>
<td>Zhang, Jun</td>
<td>125, 144</td>
</tr>
<tr>
<td>Zhang, Lijun</td>
<td>133</td>
</tr>
<tr>
<td>Zhang, Tao</td>
<td>108, 127</td>
</tr>
<tr>
<td>Zhang, Wenyu</td>
<td>131</td>
</tr>
<tr>
<td>Zhang, Xiaoyu</td>
<td>108</td>
</tr>
<tr>
<td>Zhang, Yan</td>
<td>127</td>
</tr>
<tr>
<td>Zhang, Yong</td>
<td>101</td>
</tr>
<tr>
<td>Zhang, Yongquan</td>
<td>135</td>
</tr>
<tr>
<td>Zhang, Yu-Hui</td>
<td>96, 144</td>
</tr>
<tr>
<td>Zhang, Yuzhen</td>
<td>133</td>
</tr>
<tr>
<td>Zhao, Dongbin</td>
<td>108</td>
</tr>
<tr>
<td>Zhao, Hong</td>
<td>102</td>
</tr>
<tr>
<td>Zhao, Rui</td>
<td>101</td>
</tr>
<tr>
<td>Zhou, Yichen</td>
<td>131</td>
</tr>
<tr>
<td>Ziebuhr, Mario</td>
<td>119</td>
</tr>
<tr>
<td>Zille, Heiner</td>
<td>115</td>
</tr>
<tr>
<td>Zvara, Peter</td>
<td>129</td>
</tr>
</tbody>
</table>