COMPLEX

Adaptive Systems

Engineering Cyber Physical Systems:

Machine Learning, Data Analytics and Smart Systems Architecting

San Jose, CA
November 2 - 4, 2015

Conference Program

Welcome to the Complex Adaptive Systems Conference

Cihan H. Dagli, Ph.D.
Conference Chair
Professor
Engineering Management
and Systems Engineering
Director of S&T's Systems
Engineering Graduate Program
INCOSE and IIE Fellow
International Journal
of General Systems
Intelligent Systems Area Editor
dagli@mst.edu

Welcome to this year's Complex Adaptive Systems Conference. Over the next three days, we will share our ideas, tools, methodologies and research results in the domains of Cyber Physical Systems, Data Science & Analytics, Business and Financial Analytics, and Intelligent & Adaptive Systems. Contributions to this conference, in the form of paper presentations and plenary sessions, will cultivate new ideas and advance all of our understanding of the complex systems of today.

We are pleased to announce that we have authors from 21 countries presenting 78 papers. On behalf of the organizing committee, I wish to thank all our authors for their contributions to the proceedings and to this conference.

A special recognition goes to our distinguished plenary speakers for presenting their current research and speaking to future research needs.

Further, I want to mention our conference sponsors, whose financial contributions and support allow us to continue to offer this annual conference. Their involvement enhances the collaboration between industry and academia.

In closing, I wish to express my gratitude to the conference organizing committee and paper referees. Your comments, suggestions and diligence in creating each track ensures a successful conference.

Sincerely,

Organizing Committee

General Conference Chair

Cihan H. Dagli, Missouri University of Science & Technology, *USA*

Organizing Committee Members

Amrita Basu, Lockheed Martin, *USA*

David Enke, Missouri University of Science & Technology, *USA*

Nil Ergin, Penn State University, *USA*

Marija Jankovic, CentraleSupélec, *France*

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Michael H. Nance, Lockheed Martin, *USA*

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Selahattin Ozcelik, Texas A&M University-Kingsville, *USA*

Rosemary Paradis, Lockheed Martin, *USA*

Ghaith A. Rabadi, Old Dominion University, *USA*

Garry Roedler, Lockheed Martin, *USA*

Mika Sato-Ilic, University of Tsukuba, *Japan*

Gursel Serpen, University of Toledo, *USA*

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Nuri Yilmazer, Texas A&M University-Kingsville, *USA*

Conference Support from Missouri University of Science & Technology

Latesha Zach, Conference Coordinator

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Rebecca Frisbee, Marketing/Publicity

Gavin Michael Jewell, Media Producer

Opening Welcome
Speaker: The MITRE Corporation's Glenda Turner

Glenda Turner is a senior principal systems engineer with the MITRE Corporation, a not-for-profit organization that operates seven federally funded research and development centers, where she co-leads the systems engineering capability areas for complex adaptive systems, system of systems engineering, and systems assurance engineering. Previously at MITRE, she served as the National Security Engineering Center Director of Integration for Space, Cyber, and Electronic Systems and Warfare.

Prior to joining MITRE, Ms. Turner enjoyed a military and civilian career in the Department of Defense in engineering and intelligence where she spent more than a decade on the staff of the Secretary of Defense working strategic and national leadership systems, continuity of government, homeland defense, and cyberspace operations.

Ms. Turner holds an MS in systems engineering from Johns Hopkins University, BS in computer science from Marycrest University, and she is a graduate of the National Defense University's advanced management program.

Conference Schedule at a Glance

Full Schedule starts on pg. 5

Monday, Nov. 2, 2015

8:00 a.m. – 5:00 p.m.
Registration *(Mediterranean Foyer)*

8:00 a.m. – 9:00 a.m.
Continental Breakfast *(Mediterranean Foyer)*

9:00 a.m. – 10:00 a.m.
Opening Session & Welcome *(Riviera/Granada)*
Speaker: Glenda Turner

**Plenary – When is Complex Too Complex?
Graph Energy and its Role in Proactive
Complexity Management of Cyber-physical
Systems.**
Speaker: *Olivier de Weck*

10:00 a.m. – 10:30 a.m.
Break *(Mediterranean Foyer)*

10:30 a.m. – 12:00 p.m.
Concurrent Technical Sessions
Intelligent & Adaptive Systems I
(Riviera/Granada)
Data Science & Analytics I *(Monte Carlo)*

12:00 p.m. – 1:30 p.m.
Luncheon & Afternoon Plenary *(Castillian)*

**Plenary – Exploiting Big Data in
Precision Medicine**
Speaker: *Amrita Basu*

1:30 p.m. – 3:00 p.m.
Concurrent Technical Sessions
Business & Financial Analytics *(Riviera/Granada)*
Intelligent & Adaptive Systems II *(Monte Carlo)*

3:00 p.m. – 3:30 p.m.
Break *(Mediterranean Foyer)*

3:30 p.m. – 5:00 p.m.
Concurrent Technical Sessions
Intelligent & Adaptive Systems III
(Riviera/Granada)
Data Science & Analytics II *(Monte Carlo)*

Tuesday, Nov. 3, 2015

8:00 a.m. – 5:00 p.m.
Registration *(Mediterranean Foyer)*

8:00 a.m. – 9:00 a.m.
Continental Breakfast *(Mediterranean Foyer)*

9:00 a.m. – 10:00 a.m.
Announcements & Session Convenes
(Riviera/Granada)

**Plenary – Deep Neural Networks and Their
Role in the Quest for Human-Like Brain Power**
Speaker: *Iveta Mrázová*

10:00 a.m. – 10:30 a.m.
Break *(Mediterranean Foyer)*

10:30 a.m. – 12:00 p.m.
Concurrent Technical Sessions
Cyber Physical Systems I *(Riviera/Granada)*
Data Science & Analytics III *(Monte Carlo)*

12:00 p.m. – 1:30 p.m.
Luncheon & Afternoon Plenary *(Castillian)*

**Plenary – Beyond Cyber-Physical Era:
What's Next?**
Speaker: *Sajal K. Das*

1:30 p.m. – 3:00 p.m.
Concurrent Technical Sessions
Cyber Physical Systems II *(Riviera/Granada)*
Intelligent & Adaptive Systems IV *(Monte Carlo)*

3:00 p.m. – 3:30 p.m.
Break *(Mediterranean Foyer)*

3:30 p.m. – 5:00 p.m.
Concurrent Technical Sessions
Cyber Physical Systems III *(Riviera/Granada)*
Intelligent & Adaptive Systems V *(Monte Carlo)*

6:30 p.m. – 7:00 p.m.
Cash Bar *(Mediterranean Foyer)*

7:00 p.m. – 9:30 p.m.
Banquet & Awards *(Castillian)*

**Banquet Plenary – Challenges for a Theory of
Complex Cognitive Work Systems**
Speaker: *Robert R. Hoffman*

Wednesday, Nov. 4, 2015

8:00 a.m. – 12:00 p.m.
Registration *(Mediterranean Foyer)*

8:00 a.m. – 9:00 a.m.
Continental Breakfast *(Mediterranean Foyer)*

9:00 a.m. – 10:00 a.m.
Announcements & Session Convenes
(Riviera/Granada)

**Plenary – Assistance Patterns: The DNA that
will make Digital Assistants Helpful**
Speaker: *Mike Calcagno*

10:00 a.m. – 10:15 a.m.
Break *(Mediterranean Foyer)*

10:15 a.m. – 12:00 p.m.
Concurrent Technical Sessions
Intelligent & Adaptive Systems VI
(Riviera/Granada)
Cyber Physical Systems IV *(Monte Carlo)*

12:00 p.m. – 1:15 p.m.
Luncheon & Afternoon Plenary *(Castillian)*

Plenary – Models are Complex Too
Speaker: *Antoine Rauzy*

1:15 p.m. – 3:00 p.m.
Concurrent Technical Sessions
Intelligent & Adaptive Systems VII
(Riviera/Granada)
Cyber Physical Systems V *(Monte Carlo)*

3:00 p.m. – 3:15 p.m.
Break *(Mediterranean Foyer)*

3:15 p.m. – 5:00 p.m.
Concurrent Technical Sessions
Cyber Physical Systems VI *(Riviera/Granada)*
Cyber Physical Systems VII *(Monte Carlo)*

5:00 p.m.
Conference Adjourns

Thank you sponsors

On behalf of the Complex Adaptive Systems
Conference Organizing Committee, we would
like to express our appreciation to this year's
esteemed sponsors.

Gold

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Olivier de Weck, PhD

Professor of Aeronautics
and Astronautics and
Engineering Systems
*Massachusettes Institute
of Technology, USA*

When is Complex Too Complex? Graph Energy and its Role in Proactive Complexity Management of Cyber-Physical Systems

Abstract: It is well known that artificial systems that enable modern society to function such as automobiles, printing systems, the electrical grid and medical devices amongst others are becoming more and more complex. This complexity often exceeds the cognitive abilities of a single human designer or even that of sophisticated product development organizations. In this talk I will review typical measures of complexity for cyber-physical systems and focus in particular on graph energy as a key measure, independent of the degree of abstraction of the system, to quantify structural complexity. Several invariants such as the P-point, where complexity exceeds a critical threshold, and the importance of the average nodal degree of <6> will be discussed as important foundations for a more proactive approach to complexity management in the development of cyber-physical systems and the emerging first law of systems engineering: Conservation of Complexity. I will advocate the establishment of "complexity" budgets similar to mass and power budgets in science and engineering.

Biography:

Olivier ("Oli") de Weck is an international leader in Systems Engineering research. He focuses on how complex man-made systems such as aircraft, spacecraft, automobiles, printers, consumer products and critical infrastructures are designed, manufactured and operated and how they evolve over time. His main emphasis is on the strategic properties of these systems that have the potential to maximize lifecycle value. His group has developed quantitative methods and tools that explicitly consider manufacturability, commonality, flexibility, robustness, and sustainability among other characteristics. Significant results include the Adaptive Weighted Sum (AWS) method for resolving tradeoffs amongst competing objectives, the Delta-Design Structure Matrix (ΔDSM) for technology infusion analysis, Time-Expanded Decision Networks (TDN) and the SpaceNet and HabNet simulation environments. These methods have impacted complex systems in space exploration (NASA, JPL), oil and gas exploration (BP) as well as sophisticated electro-mechanical products (e.g. Xerox, Pratt & Whitney, GM, DARPA). To date, he has authored three books and approximately 250 peer-reviewed papers. His book, *Engineering Systems: Meeting Human Needs in a Complex Technological World* was the bestseller at the MIT Press Bookstore in 2012 and has been translated to Japanese. He is a Fellow of INCOSE and an Associate Fellow of AIAA. Since January 2013, he serves as Editor-in-Chief of the journal, *Systems Engineering*. From 2011 to 2013 he served as Executive Director of the MIT Production in the Innovation Economy (PIE) project. He is currently co-director of the Center for Complex Engineering Systems (CCES) at KACST and MIT.

Conference Schedule

Monday, November 2, 2015   *Presentations are noted by corresponding page number in proceedings.*

Registration Desk Open
8:00 a.m. – 5:00 p.m.
Mediterranean Foyer

Continental Breakfast
8:00 a.m. – 9:00 a.m.
Mediterranean Foyer

Opening Session
9:00 a.m. – 10:00 a.m.
Riviera/Granada

Opening Welcome
Speaker: Glenda Turner
The MITRE Corporation

Morning Plenary
Speaker: Olivier de Weck, PhD

When is Complex Too Complex? Graph Energy and its Role in Proactive Complexity Management of Cyber-Physical Systems.

Olivier de Weck, PhD
Professor of Aeronautics and Astronautics and Engineering Systems, Massachusettes Insitute of Technology, USA

Break
10:00 a.m. – 10:30 a.m.
Mediterranean Foyer

Concurrent Sessions
10:30 a.m. – 12:00 p.m
(See schedule at right)

Concurrent Sessions   10:30 a.m. – 12:00 p.m.

Intelligent & Adaptive Systems: Deep Neural Networks
Riviera/Granada

Session Chair: Jonathan A. Cox
Sandia National Laboratories, USA

349 - **A Signal Processing Approach for Cyber Data Classification with Deep Neural Networks**
Jonathan A. Cox | Conrad D. James | James B. Aimone, *Sandia National Laboratories, USA*

422 - **Diagnosing Tropical Cyclone Rapid Intensification Using Kernel Methods and Reanalysis Dataset**
Andrew Mercer | Alexandria Grimes, *Mississippi State University, USA*

442 - **Computer-Assisted System to Generate a New Intelligent Rotary Dental Files IRDF Models**
Tamer M. Nassef, *Misr University for Science and Technology, Egypt*

454 - **Neural Network-Based Drug Abuse Treatment Optimization**
Jeff Cohen, *University of Connecticut, USA;*
Abby Ilumoka | Iman Salehi, *University of Hartford, USA*

Data Science and Analytics: Clustering & Classification
Monte Carlo

Session Chair: Abhijit Gosavi
Missouri S&T, USA

11 - **Multidimensional Joint Scale and Cluster Analysis**
Mika Sato-Ilic, *University of Tsukuba, Japan*

18 - **Semi-Supervised Clustering for Sparsely Sampled Longitudinal Data**
Mariko Takagishi | Hiroshi Yadohisa, *Doshisha University, Japan*

38 - **Clustering Quality Improvement of k-means Using a Hybrid Evolutionary Model**
Jeyhun Karimov | Murat Ozbayoglu, *TOBB University of Economics and Technology, Turkey*

24 - **Analyzing Responses from Likert Surveys and Risk-Adjusted Ranking: A Data Analytics Perspective**
Abhijit Gosavi, *Misssouri S&T, USA*

Exploiting Big Data in Precision Medicine

Amrita Basu, PhD

Geonomics and Computational
Biology Lead
Lockheed Martin, USA

Abstract: Rapid advances in sequencing and proteomics are opening up new vistas of personalized biomedical data. To achieve the goals of the government's Precision Medicine Initiative and go from measurement to clinical translation, substantial gains still need to be made in methods of large-scale data integration, analysis and interpretation. It was recently suggested that only a small fraction of published results are reproducible, and research focus is biased towards well-studied genes and proteins. As biomedical research moves towards Big Data, data analytic tools and technology can delineate not just limited and well-studied relationships, but all links between disparate entities. For example, there is a growing demand and need to investigate the association between drugs, adverse effects, and genetic variation. To achieve this, we developed a platform that can rapidly identify drug-gene associations and adverse effects among FDA-approved drugs using genetic and phenotypic data, all within a common framework. In addition, we developed technology that can be used to classify positive versus negative responders to selected drugs using data derived from genome-wide association studies and phenotype data. We achieve high sensitivity and specificity when applying our method to the INVEST dataset. Our big data platform will enable scientists and clinicians to discover drug-gene correlations, identify biomarkers of rare and common disease, and continue to unlock the most complex structure in the known universe, human DNA.

Biography:

Amrita Basu is the Genomics and Computational Biology Lead at Lockheed Martin. Previously, she worked at the Broad Institute of Harvard and MIT on predictive modeling approaches for cancer drug discovery. Amrita holds a Bachelors degree in Electrical Engineering from Cornell University and a Ph.D. from Rockefeller University.

Conference Schedule

Monday, November 2, 2015   *Presentations are noted by corresponding page number in proceedings.*

Luncheon & Afternoon Plenary

12:00 p.m. – 1:30 p.m.
Castillian

Speaker:
Amrita Basu, PhD

Exploiting Big Data in Precision Medicine

Amrita Basu, PhD
Geonomics and Computational Biology Lead, Lockheed Martin, USA

Concurrent Sessions

1:30 p.m. – 3:00 p.m.
(See schedule at right)

Concurrent Sessions   1:30 p.m. – 3:00 p.m.

Business & Financial Analytics
Riviera/Granada

Session Chair: David Enke
Missouri S&T, USA

80 - **Noise Canceling in Volatility Forecasting Using an Adaptive Neural Network Filter**
Soheil Almasi Monfared | David Enke, *Missouri S&T, USA*

105 - **A Novel Theoretical Framework Formulated for Information Discovery from Number System and Collatz Conjecture Data**
Michael A. Idowu, *Abertay University, United Kingdom*

98 - **A Simulation-based Approach to Risk Assessment and Mitigation in Supply Chain Networks**
Mamadou Seck | Ghaith Rabadi | Christian Koestler, *Old Dominion University, USA*

85 - **Optimizing MACD Parameters via Genetic Algorithms for Soybean Futures**
Phoebe S. Wiles | David Enke, *Missouri S&T, USA*

Intelligent & Adaptive Systems:
Advances in Artificial Neural Networks
Monte Carlo

Session Chair: Fred Highland
Lockheed Martin IS&GS, USA

314 - **Adaptation of Spike-Timing-Dependent Plasticity to Unsupervised Learning for Polychronous Wavefront Computing**
Fred Highland | Corey B. Hart, *Lockheed Martin IS&GS, USA*

322 - **Simulation Tool for Asynchronous Cortical Streams (STACS): Interfacing with Spiking Neural Networks**
Felix Wang, *University of Illinois at Urbana-Champaign, USA*

328 - **Autoregressive Hidden Markov Model and the Speech Signal**
Jacob D. Bryan | Stephen E. Levinson, *University of Illinois at Urbana-Champaign, USA*

334 - **Adaptive Filtering Using Complex Data and Quaternions**
Tokunbo Ogunfunmi, *Santa Clara University, USA*

Conference Schedule

Monday, November 2, 2015   *Presentations are noted by corresponding page number in proceedings.*

Break
3:00 p.m. – 3:30 p.m.
Mediterranean Foyer

Concurrent Sessions
3:30 p.m. – 5:00 p.m.
(See schedule at right)

Concurrent Sessions   3:30 p.m. – 5:00 p.m.

Intelligent & Adaptive Systems: Computational Intelligence
Riviera/Granada

Session Chair: Walker H. Land
Retired, Binghamton University, USA

381 - Predicting with Confidence: Extensions to the GRNN Oracle Enabling Quantification of Confidence in Predictions
Walker H. Land | J. David Schaffer, *Binghamton University, USA*

367 - Synthetic Rating on Talent Evaluation-Similarity of Subsets
Shijun Tang | Rajan Alex, *West Texas A&M University, USA*

388 - Fuzzy Inference Algorithm Based on Quantitative Association Rules
Ling Wang | Ji-Yuan Dong | Shu-Lin Li,
University of Science and Technology Beijing, China

373 - Instantaneous Modelling and Reverse Engineering of Data-Consistent Prime Models in Seconds
Michael A. Idowu, *Abertay University, United Kingdom*

Data Science & Analytics: Knowledge Extraction & Discovery
Monte Carlo

Session Chair: Murat Ozbayoglu
TOBB University of Economics and Technology, Turkey

66 - Biometric Knowledge Extraction for Multi-Factor Authentication and Key Exchange
Phillip H. Griffin, *Griffin Information Security, USA*

72 - Extracting Meaningful Entities from Human-Generated Tactical Reports
Jinhong K. Guo | David Van Brackle | Nicolas LoFaso | Martin O. Hofmann,
Lockheed Martin Advanced Technology Laboratories, USA

32 - An Interactive Algorithm to Construct an Appropriate Nonlinear Membership Function Using Information Theory and Statistical Method
Takashi Hasuike, *Waseda University, Japan;*
Hideki Katagiri, *Hiroshima University, Japan;*
Hiroe Tsubaki, *National Statistics Center, Japan*

92 - Analyzing Stakeholders Using Fuzzy Cognitive Mapping
Patrick Hester, *Old Dominion University, USA*

Conference Morning Plenary Speaker

Tuesday, November 3, 2015 | 9:00 a.m. – 10:00 a.m. | Riviera/Granada

Deep Neural Networks and Their Role in the Quest for Human-Like Brain Power

Iveta Mrázová, PhD

Associate Professor and Head of the Department of Theoretical Computer Science and Mathematical Logic
Charles University, Czech Republic

Abstract: The long-term interest in cognitive sciences has been enhanced by several strong impulses to contemporary computer science – in particular by large government initiated brain research projects. Other developments shift the area even more from the traditional von Neumann computing paradigm towards true connectionism implemented in silicon, too. New imaging technologies allow to follow the brain activity even at the individual neuron´s level. Inexpensive graphics processing units are becoming a common option for learning large-scale deep neural networks and currently unveiled brain-inspired chip architectures let us think of constructing complex cognitive algorithms mimicking the function of biological brains. Perhaps the first deep artificial neural network incorporating some neurophysiological insights was the Neocognitron. Recent brain-inspired models of artificial neural networks include especially the so-called Deep Belief Networks and Convolutional Neural Networks. Both types of networks comprise several layers of functional neurons and both of them proved to be able to beat human performance in various areas of 2D image recognition. These models are, however, expected to yield superior results also for many other tasks ranging from language understanding and translation to multimedia data processing, among others.

While the majority of classical image processing techniques is based on carefully pre-selected image features, deep neural networks are designed to learn local features autonomously with minimum or no advanced pre-processing. The representations formed in their hidden layers resemble a hierarchy combining simpler features found at lower layers into more complex features detected at higher layers. Deep networks can be moreover trained by means of unlabeled data collected, e.g., from the internet. The found features can then be used as common building blocks for new images if labeled data is scarce.

Biography:

Iveta Mrázová is an Associate Professor and Head of the Department of Theoretical Computer Science and Mathematical Logic at Faculty of Mathematics and Physics, Charles University in Prague, Czech Republic. She graduated from F. Schiller University in Jena, Germany in 1989 and received her Ph.D. from the Institute of Computer Science of the Czech Academy of Sciences in Prague in 1997. During 2002-2003, she was a Fulbright fellow at Missouri University of Science and Technology in Rolla, USA. Her research interests include artificial intelligence, machine learning and data mining. She has published more than 50 research papers focused mainly on the areas of artificial neural networks and knowledge extraction.

Conference Schedule

Tuesday, November 3, 2015   *Presentations are noted by corresponding page number in proceedings.*

Registration Desk Open
8:00 a.m. – 5:00 p.m.
Mediterranean Foyer

Continental Breakfast
8:00 a.m. – 9:00 a.m.
Mediterranean Foyer

Session Convenes
9:00 a.m. – 10:00 a.m.
Riviera/Granada

Announcements

Morning Plenary

Speaker: Iveta Mrázová, PhD

Deep Neural Networks and Their Role in the Quest for Human-Like Brain Power

Iveta Mrázová, PhD
Associate Professor and Head of the Department of Theoretical Computer Science and Mathematical Logic, Charles University, Czech Republic

Break
10:00 a.m. – 10:30 a.m.
Mediterranean Foyer

Concurrent Sessions
10:30 a.m. – 12:00 p.m.
(See schedule at right)

Concurrent Sessions   10:30 a.m. – 12:00 p.m.

Cyber Physical Systems: Cyber Security
Riviera/Granada

Session Chair: Douglas A. Bodner
Georgia Institute of Technology, USA

221 - Using Discrete Event Simulation to Model Attacker Interactions with Cyber and Physical Security Systems
Casey Perkins | George Muller,
Pacific Northwest National Laboratory, USA

227 - Cyber Security Challenges within the Connected Home Ecosystem Futures
Abdullahi Arabo, *University of West England, United Kingdom*

267 - Towards an Adaptive Model for Collaborative Simulation: From System Design to Lessons Learned. A Use Case from Aircraft Industry
Laura Roa Castro, *IRT SystemX, France;*
Julie Stal-Le Cardinal, *Centrale-Supélec, France;*
Martine Callot, *Airbus Group Innovations, France*

233 - Mitigating Counterfeit Part Intrusions with Enterprise Simulation
Douglas A. Bodner, *Georgia Institute of Technology, USA*

Data Science & Analytics:
Social Network Data & Collective Analytics
Monte Carlo

Session Chair: Iveta Mrázová
Charles University, Czech Republic

52 - Czech Insolvency Proceedings Data: Social Network Analysis
Iveta Mrázová | Peter Zvirinský,
Charles University, Czech Republic

361 - An Improved Continuous-Action Extended Classifier Systems for Function Approximation
Omid Saremi | Masoud Shariat Panahi, *University of Tehran, Iran;*
Amin Sabzehzar, *University of Nevada, Reno, USA*

60 - Dynamics of the Schelling Social Segregation Model in Networks
Vasco Cortez | Sergio Rica,
Universidad Adolfo Ibáñez, Chile

46 - Using Data Mining Algorithms for Developing a Model for Intrusion Detection System (IDS)
Solane Duque | Mohd Nizam bin Omar,
University Utara Malaysia, Oman

Conference Afternoon Plenary Speaker

Tuesday, November 3, 2015 | 12:00 p.m. – 1:30 p.m. | Castillian

Beyond Cyber-Physical Era: What's Next?

Sajal K. Das, PhD

IEEE Fellow, Daniel St. Clair
Endowed Chair, and Chair of
Computer Science Department
*Missouri University of
Science and Technology, USA*

Abstract: We live in an era of "Internet of Things" where our physical and personal environments are becoming increasingly smarter as they are immersed with sensing, networking, computing and communication capabilities. The availability of rich mobile devices like smartphones and wireless sensors have also empowered humans as an integral part of cyber-physical systems. This synergy has led to cyber-physical-social convergence exhibiting complex interactions, interdependencies and adaptations among devices, machines, systems/environments, users, human behavior, and social dynamics. In such a connected and mobile world, almost everything can act as information source, analyzer and decision maker. This talk will highlight some of the emerging research challenges and opportunities in cyber-physical-social convergence, and then present some novel solutions to tackle them. It will also reflect on a fundamental question: "What's Next?"

Biography:

Sajal K. Das is an IEEE Fellow, and is the Chair of Computer Science Department and Daniel St. Clair Endowed Chair in Computer Science at the Missouri University of Science and Technology, Rolla, USA. During 2008-2011, he served the US National Science Foundation as a Program Director in the division of Computer Networks and Systems. Prior to 2013 he was a University Distinguished Scholar Professor of Computer Science and Engineering and founding director of the Center for Research in Wireless Mobility and Networking (CReWMaN) at the University of Texas at Arlington. His current research interests include theory and practice of wireless and sensor networks, mobile and pervasive computing, cyber-physical systems and smart environments including smart grid and smart healthcare, distributed and cloud computing, security and privacy, biological and social networks, applied graph theory and game theory. Dr. Das has published extensively in these areas with more than 600 research articles in high quality journals and refereed conference proceedings, and 51 invited book chapters. He coauthored four books – Smart Environments: Technology, Protocols, and Applications (2005), Handbook on Securing Cyber-Physical Critical Infrastructure: Foundations and Challenges (2012), Mobile Agents in Distributed Computing and Networking (2012), and Principles of Cyber-Physical Systems (2015). His h-index is 66 with more than 18,500 citations according to Google Scholar. Dr. Das holds 5 US patents and received 10 Best Paper Awards in prestigious conferences such as ACM MobiCom'99, IEEE PerCom'06 and IEEE SmrtGridComm'12. He is also a recipient of numerous awards for teaching, mentoring and research including the IEEE Computer Society's Technical Achievement Award for pioneering contributions to sensor networks and mobile computing, Lockheed Martin Teaching Excellence Award, and Graduate Dean's Award of Excellence for mentoring doctoral students. Dr. Das serves as the Editor in Chief of the Pervasive and Mobile Computing journal, and as Associate Editor of *IEEE Transactions on Mobile Computing, ACM Transactions on Sensor Networks, Journal of Parallel and Distributed Computing,* and *Journal of Peer to Peer Networking and Applications*. He is a co-founder of IEEE WoWMoM, IEEE PerCom, and ICDCN conferences.

Conference Schedule

Tuesday, November 3, 2015 *Presentations are noted by corresponding page number in proceedings.*

Luncheon & Afternoon Plenary

12:00 p.m. – 1:30 p.m.
Castillian

Speaker: Sajal K. Das, PhD

Beyond Cyber-Physical Era: What's Next?

Sajal K. Das, PhD
IEEE Fellow, Daniel St. Clair Endowed Chair, and Chair of Computer Science Department, Missouri S&T, USA

Concurrent Sessions

1:30 p.m. – 3:00 p.m.
(See schedule at right)

Break

3:00 p.m. – 3:30 p.m.
Mediterranean Foyer

Concurrent Sessions   1:30 p.m. – 3:00 p.m.

Cyber Physical Systems: Systems Modeling & Design I
Riviera/Granada

Session Chair: Chris Orlowski
George Washington University, USA

261 - A Systemic Approach to Re-inforce Development and Operations Functions in Delivering an Organizational Program
Syed W. Hussaini, *Tata Consultancy Services, India*

287 - Using a Systemic Perspective to Support Engineering Change Management
Julian Wilberg | Fatos Elezi | Udo Lindemann, *Technische Universität München, Germany;*
Iris D. Tommelein, *University of California, Berkeley, USA*

281 - How System Errors Affect Aircrew Resource Management (CRM)
Justin Y. Adkins | Kevin MacG. Adams, *University of Maryland University College, USA;* Patrick T. Hester, *Old Dominion University, USA*

293 - A Framework for Implementing Systems Engineering Leading Indicators for Technical Reviews and Audits
Chris Orlowski | Paul Blessner | Timothy Blackburn | Bill Olson, *George Washington University, USA*

Intelligent & Adaptive Systems: Machine Learning
Monte Carlo

Session Chair: Claude Turner
Norfolk State University, USA

395 - Determination of Rule Patterns in Complex Event Processing Using Machine Learning Techniques
Nijat Mehdiyev | Julian Krumeich | Dirk Werth | Peter Loos, *German Research Center for Artificial Intelligence, Germany;* David Enke, *Missouri S&T, USA*

402 - A Normalization Process to Standardize Handwriting Data Collected from Multiple Resources for Recognition
Wen-Li Wang, *Penn State Erie, The Behrend College, USA;* Mei-Huei Tang, *Gannon University, USA*

416 - A Wavelet Packet and Mel-Frequency Cepstral Coefficients-Based Feature Extraction Method for Speaker Identification
Claude Turner, *Norfolk State University, USA;* Anthony Joseph, *Pace University, USA*

410 - Transformation Based Score Fusion Algorithm for Multi-Modal Biometric User Authentication through Ensemble Classification
Firas S. Assaad | Gursel Serpen, *University of Toledo, USA*

Challenges for a Theory of Complex Cognitive Work Systems

Robert R. Hoffman, PhD

Senior Research Scientist
Institute for Human and Machine Cognition, USA

Abstract: This presentation will focus on the design and analysis of macrocognitive work systems. Macrocognition is the study of the functions by which human perception and reasoning adapt to complexity. Macrocognition is distinguished from microcognition. The latter focuses on such phenomena as millisecond shifts of attention, and access to individual long-term memories. Such phenomena are the traditional subject matter of academic laboratory psychology. Macrocognition focuses on processes such as sensemaking, re-planning, and collaborating. These processes span longer periods of time and entail research on the reasoning of domain experts in "real world" humans-machines work contexts (such as cyberwork). The past few decades of research in the fields of Cognitive Systems Engineering and Naturalistic Decision Making have yielded some generalizations about macrocognitive work. These can be regarded as genuine scientific laws, expressing fundamental boundary conditions. This presentation will review these laws and use them to highlight the challenges in forming a covering theory of complex cognitive systems. There are many challenges, relating to the requirement that a well-formed scientific theory have an articulated subject matter (complex systems, in general) and ontology, a metatheory, and a methodology, as well as a set of testable laws. A theory of macrocognitive work systems must deviate from the classical norms in a number of respects. For instance, the metatheory must assume that the ontology and the laws are necessarily incomplete, and the methodology must assert that the set of conceptual measurables is unbounded. The outline of such a theory is now well within our grasp.

Biography:

Robert R. Hoffman is a recognized world leader in cognitive systems engineering and Human-Centered Computing. He is a Fellow of the Association for Psychological Science, Fellow of the Human Factors and Ergonomics Society, Senior Member of the Association for the Advancement of Artificial Intelligence, and a Fulbright Scholar. His Ph.D. is in experimental psychology from the University of Cincinnati, where he received McMicken Scholar, Psi Chi, and Delta Tau Kappa Honors. Following a Postdoctoral Associateship at the Center for Research on Human Learning at the University of Minnesota, he joined the faculty of the Institute for Advanced Psychological Studies at Adelphi University. He began his career as a psycholinguist, and founded the journal, *Metaphor and Symbol*. His subsequent research leveraged the psycholinguistics background in the study of methods for eliciting the knowledge of domain experts. Hoffman has been recognized internationally in psychology, remote sensing, human factors engineering, intelligence analysis, weather forecasting, and artificial intelligence – for his research on the psychology of expertise, the methodology of cognitive task analysis, human-centering issues for intelligent systems technology, and the design of macrocognitive work systems. Hoffman is a Co-Editor for the Department on Human-Centered Computing in IEEE: Intelligent Systems. He is Editor for the book Series, "Expertise: Research and Applications." He was a co-founder of *The Journal of Cognitive Engineering and Decision Making*. His current research focuses on the psychology of intelligence analysis, methodological issues in the analysis of complex systems, and performance measurement for macrocognitive work systems. A full vita and all of his publications are available for download at: www.ihmc.us/users/rhoffman/main.

Conference Schedule

Tuesday, November 3, 2015   *Presentations are noted by corresponding page number in proceedings.*

Concurrent Session

3:30 p.m. – 5:00 p.m.
(See schedule at right)

Cash Bar

6:30 p.m. – 7:00 p.m.
Mediterranean Foyer

Banquet & Awards

Plenary Speaker:
Robert R. Hoffman, Ph.D

7:00 p.m. – 9:30 p.m.
Castillian

Challenges for a Theory of Complex Cognitive Work Systems

Robert R. Hoffman, Ph.D
Senior Research Scientist Institute for Human and Machine Cognition, USA

Concurrent Sessions   3:30 p.m. – 5:00 p.m.

Cyber Physical Systems: Systems Modeling & Design II
Riviera/Granada

Session Chair: Ronald E. Giachetti
Naval Postgraduate School, USA

274 - Towards Modelling Data Infrastructures in the Asset Management Domain
Paul Brous | Paulien Herder | Marijn Janssen,
Delft University of Technology, The Netherlands

240 - Application of System Design for Operational Effectiveness for Architectural Modeling of the SoS Relationship Between Primary and Enabling Systems
Marilyn T. Gaska | Joseph S. Bobinis | Vincent Galluzzo,
Lockheed Martin, USA

246 - An Agent Based Approach for Simulating DEMO Enterprise Models
Mamadou Seck, *Old Dominion University, USA;* Joseph Barjis,
Institute of Engineering and Management, The Netherlands

254 - Evaluation of the DoDAF Meta-Model's Support of Systems Engineering
Ronald E. Giachetti, *Naval Postgraduate School, USA*

Intelligent & Adaptive Systems: Adaptive Control
Monte Carlo

Session Chair: Nuri Yilmazer
Texas A&M University - Kingsville, USA

492 - An Improved eXtended Classifier System for the Real-time-input Real-time-output (XCSRR) Stability Control of a Biped Robot
A. Sabzehzar | W.L. Shan, *University of Nevada, Reno, USA;*
M. Shariat Panahi | O. Saremi, *University of Tehran, Iran*

500 - μAutonomy: Intelligent Command of Movable Objects
Abdoulaye Saadou-Yaye | Julio Aráuz, *Ohio University, USA*

507 - Real-Time Optimal Scheduling of a Group of Elevators in a Multi-Story Robotic Fully-Automated Parking Structure
Jayanta K. Debnath | Gursel Serpen, *University of Toledo, USA*

436 - Application of Object Detection and Tracking Techniques for Unmanned Aerial Vehicles
Shreyamsh Kamate | Nuri Yilmazer,
Texas A&M University - Kingsville, USA

Assistance Patterns: The DNA that will make Digital Assistants Helpful

Mike Calcagno

Director of Engineering, Cortana
Microsoft Corporation, USA

Abstract: It's an exciting time to be working on digital assistants, and the field has grown increasingly crowded in recent years, powered by advances in speech and language understanding, as well as real-time understanding of both user and real world information. Yet, for all the technology we can bring to bear, no digital assistant has reached the point of indispensability in our day-to-day lives. In this talk, I'll discuss our efforts to identify what we call assistance patterns, and the implications of these patterns for what the next generation of assistants will do, as well as the technology that powers them.
.

Biography:

Mike Calcagno joined Microsoft in 1999 as an NLP specialist, and has worked on problems and technology in language and document understanding for many years, eventually coming to lead the teams responsible for delivering this technology at scale across all of Microsoft's products.

In late 2012, he moved to Bing, where he played a key role in designing and building the service that powers Cortana, the world's best and most personal digital assistant, and his team currently delivers this Cortana service to millions of customers around the world, on Windows, Android and iOS.

Outside of work, he enjoys travel, photography, the winter sport of curling, and collecting vintage mechanical gadgets. He lives in Seattle.

Conference Schedule

Wednesday, November 4, 2015   *Presentations are noted by corresponding page number in proceedings.*

Registration Desk Open
8:00 a.m. – 12:00 p.m.
Mediterranean Foyer

Continental Breakfast
8:00 a.m. – 9:00 a.m.
Mediterranean Foyer

Session Convenes
9:00 a.m. – 10:00 a.m.
Riviera/Granada

Announcements

Morning Plenary

Speaker: Mike Calcagno

Assistance Patterns: The DNA that will make Digital Assistants Helpful

Mike Calcagno
*Director of Engineering,
Cortana, Microsoft
Corporation, USA*

Break
10:00 a.m. – 10:15 a.m.
Mediterranean Foyer

Concurrent Sessions
10:15 a.m. – 12:00 p.m.
(See schedule at right)

Concurrent Sessions   10:15 a.m. – 12:00 p.m.

Intelligent & Adaptive Systems: Manufacturing Applications
Riviera/Granada

Session Chair: Mitsuo Gen
Fuzzy Logic Systems Institute, Japan

527 - A Branch-and-Price Algorithm to Solve a Quay Crane Scheduling Problem
Nabil Kenan | Ali Diabat, *Masdar Institute, UAE*

515 - A Co-cooperative Evolutionary Algorithm for Flexible Scheduling Problem Under Uncertainty
Yan Wang | Lin Lin | Lu Sun, *Dalian University of Technology, China;*
Mitsuo Gen, *Fuzzy Logic Systems Institute, Japan;*
Hiroshi Kawakami, *Kyoto University, Japan*

521 - A Bayesian Optimization-based Evolutionary Algorithm for Flexible Job Shop Scheduling
Yan Wang | Lin Lin | Lu Sun, *Dalian University of Technology, China;*
Mitsuo Gen, *Fuzzy Logic Systems Institute, Japan*
Hiroshi Kawakami, *Kyoto University, Japan*

533 - Scheduling Blocking Flow Shops Using Meta-RaPS
Mohammad Sadaqa | Reinaldo J. Moraga,
Northern Illinois University, USA

355 - Adapting NSGA-II for Hierarchical Sensor Networks in the IoT
Angela Rodriguez | Armando Ordóñez,
Foundation University of Popayan, Colombia;
Hugo Ordoñez | Rocio Segovia,
University of San Buenaventura, Colombia

Cyber Physical Systems: Complex Analytics
Monte Carlo

Session Chair: TBD
TBD

133 - Use of Bayesian Networks for Qualification Planning: A Predictive Analysis Framework for a Technically Complex Systems Engineering Problem
Davinia B. Rizzo, *Sandia National Laboratories, USA;*
Mark R. Blackburn, *Stevens Institute of Technology, USA*

301 - A Smart Adaptable Architecture Based on Contexts for Cyber Physical Systems
Francesco Rago, *Megatris Comp. LLC, USA*

141 - Using Semantic Web Technologies for Integrating Domain Specific Modeling and Analytical Tools
Mark R. Blackburn, *Stevens Institute of Technology, USA;*
Peter O. Denno, *National Institute of Standards & Technology, USA*

147 - Using Information-Theoretic Principles to Analyze and Evaluate Complex Adaptive Supply Network Architectures
Joshua Rodewald | John Colombi | Kyle Oyama | Alan Johnson,
Air Force Institute of Technology, USA

341 - Student Yield Maximization Using Genetic Algorithm on a Predictive Enrollment Neural Network Model
Z. Sarafraz | H. Sarafraz | M. Sayeh | J. Nicklow,
Southern Illinois University Carbondale, USA

COMPLEX
Adaptive Systems

Conference Afternoon Plenary Speaker
Wednesday, November 4, 2015 | 12:00 p.m. – 1:15 p.m. | Castillian

Antoine Rauzy, PhD

Professor, Production and
Quality Engineering Deparment
*Norwegian University of Science
and Technology, Norway*

Models are Complex Too

Abstract: To handle complex systems, engineers and scientists design models of these systems. A model aims at capturing a particular aspect of the system at hand. It is useful because (and only because) it abstracts away irrelevant aspects. In a word, it simplifies the problem. Yet, the question is how far can go this simplification? Can we get rid of complexity thanks to models?

In this talk, we shall discuss this question with the point of view of (probabilistic) safety analyses of complex systems. We shall argue that the engineering of models of complex systems is a complex process as well, notably because calculations of reliability and safety indicators are provably hard.

Biography:

Antoine Rauzy is currently with the department of Production and Quality Engineering at Norwegian University of Science and Technology (Trondheim, Norway). He has a background in theoretical computer science (PhD in 1989, tenure in 1996) and works on reliability engineering and system safety for more than 20 years. He has both a strong industrial and academic experience. He has published over 100 articles in international journals and conferences. He designed computer tools that are daily used in the industry (nuclear, avionic...)

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Conference Schedule

Presentations are noted by corresponding page number in proceedings.

Luncheon & Afternoon Plenary

12:00 p.m. – 1:15 p.m.
Castillian

Speaker: Antoine Rauzy, PhD

Models are Complex Too

Antoine Rauzy, PhD
Professor, Production and Quality Engineering Department; Norwegian University of Science and Technology, Norway

Concurrent Sessions

1:15 p.m. – 3:00 p.m.
(See schedule at right)

Break

3:00 p.m. – 3:15 p.m.
Mediterranean Foyer

Concurrent Sessions   1:15 p.m. – 3:00 p.m.

Intelligent & Adaptive Systems:
Engineering Applications of Machine Learning
Riviera/Granada

Session Chair: S.H. Anderson
University of Missouri, USA

478 - The Optimisation of Bayesian Classifier in Predictive Spatial Modelling for Secondary Mineral Deposits
Adamu M. Ibrahim | Brandon Bennett,
University of Leeds, United Kingdom;
Fatima Isiaka, *Sheffield Hallam University, United Kingdom*

460 - Assessment of Selected Methods for Estimating Chemical Transport Parameters from Computed Tomographic Imaging
S.H. Anderson | R.L. Peyton, *University of Missouri, USA;*
D.J. Heinze, *Environ, USA*

486 - Modeling of a Neuro Fuzzy System to Develop an Efficient Method to Get a Specific Color Paint from the Color Model Cyan, Magenta and Yellow (CMY) Under Terms of Open Source
Victor Pulla | Xavier Serrano,
Universidad Politécnica Salesiana, Ecuador

466 - Tomography-Measured Spatial Distributions of Non-Aqueous Phase Liquids in Porous Media
S.H. Anderson | R.L. Peyton, *University of Missouri, USA;*
J.L. Holmes, *Allstate Consultants LLC, USA*

448 - Gender Effects in Surface Electromyographic Activity of the Biceps Brachii Muscle During Prolonged Isometric Contraction
Nizam Uddin Ahamed | Zulkifli bin md Yusof,
University Malaysia Pahang, Malaysia;
Mahdi Alqahtani | Omar Altwijri, *King Saud University, Saudi Arabia;*
Matiur Rahman, *Najran University, Saudi Arabia;*
Kenneth Sundaraj, *University Teknikal Malaysia Melaka, Malaysia*

Cyber Phyical Systems: Interacting Systems & Collective Dynamics
Monte Carlo

Session Chair: Syed Rizvi
Penn State University, USA

191 - Utilizing Third Party Auditing to Manage Trust in the Cloud
Syed Rizvi | Kelsey Karpinski | Brennen Kelly | Taryn Walker,
Penn State University, USA

198 - Elastic Scaling of Cloud Application Performance Based on Western Electric Rules by Injection of Aspect-Oriented Code
Konstantin Benz | Thomas M. Bohnert,
Zurich University of Applied Sciences, Switzerland

206 - Analyzing the Integration of Cognitive Radio and Cloud Computing for Secure Networking
Syed Rizvi | Nathan Showan | John Mitchell,
Penn State University, USA

213 - Cloud Services Architectures
Mehmet Toy, *Comcast Cable Communications Management, LLC, USA*

472 - A Computerized Tomographic Data Analysis System to Evaluate the Dental Implant Surface Roughness
Rania M. Moussa, *Pharos University, Egypt;*
Magdy A. Awadalla | Mona K. Marei, *Alexandria University, Egypt;*
Tamer M. Nassef, *Misr University for Science and Technology, Egypt*

Conference Schedule

Wednesday, November 4, 2015   *Presentations are noted by corresponding page number in proceedings.*

Concurrent Sessions

3:15 p.m. – 5:00 p.m.
(See schedule at right)

Conference Adjourns

5:00 p.m.

Questions? Contact Us

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Concurrent Sessions   3:15 p.m. – 5:00 p.m.

Cyber Physical Systems: Complex Systems Architecture Assessment
Riviera/Granada

Session Chair: Gene Lesinski
United States MIlitary Academy, USA

153 - A Pragmatic Method for Assessing Systems Architectures During the Architecture Generation Process with a Focus on Repurposing Business Software to Systems Engineering
Kyle Buller, *Missouri S&T, USA*

160 - A Model for Assessing UAV System Architectures
Andrew Renault, *Missouri S&T, USA*

176 - Selecting Attributes, Rules, and Membership Functions for Fuzzy SoS Architecture Evaluation
Louis Pape | Siddhartha Agarwal | Cihan Dagli, *Missouri S&T, USA*

168 - Application of Value Focused Thinking and Fuzzy Systems to Assess System Architecture
Gene Lesinski, *United States Military Academy, USA*

428 - Uniqueness and Causes of the California Drought
Michael B. Richman | Lance M. Leslie; *University of Oklahoma, USA*

Cyber Physical Systems: Service & Distributed Systems
Monte Carlo

Session Chair: Chandru Mirchandani
George Washington University, USA

113 - Real-Time Complex Event Processing and Analytics for Smart Grid
Guangyi Liu, Wendong Zhu, Chris Saunders, Feng Gao, *SGRI North America, USA;*
Yang Yu, *Stanford University, USA*

120 - Smart Waste Collection System Based on Location Intelligence
Jose M. Gutierrez, Morten Henius, *Aalborg University, Denmark;*
Michael Jensen, *NetPlan A/S, Denmark;*
Tahir Riaz, *Radio Analyzer, Denmark*

128 - An Information-centric Approach to Engineering and Manufacturing Cyber Physical Systems in the Defense Industry
George L. Ball | Christopher (Kit) Runge | Leslie Peoble, *Raytheon Company, USA*

183 - Cloud-Based Ground System for Telemetry Processing
Chandru Mirchandani, *George Washington University, USA*

307 - Understanding Space Launch Vehicle Complexity: A Case Study in Combustion Instabilities
Ronald H. Freeman, *Northcentral University, USA*

Hotel Floor Plan
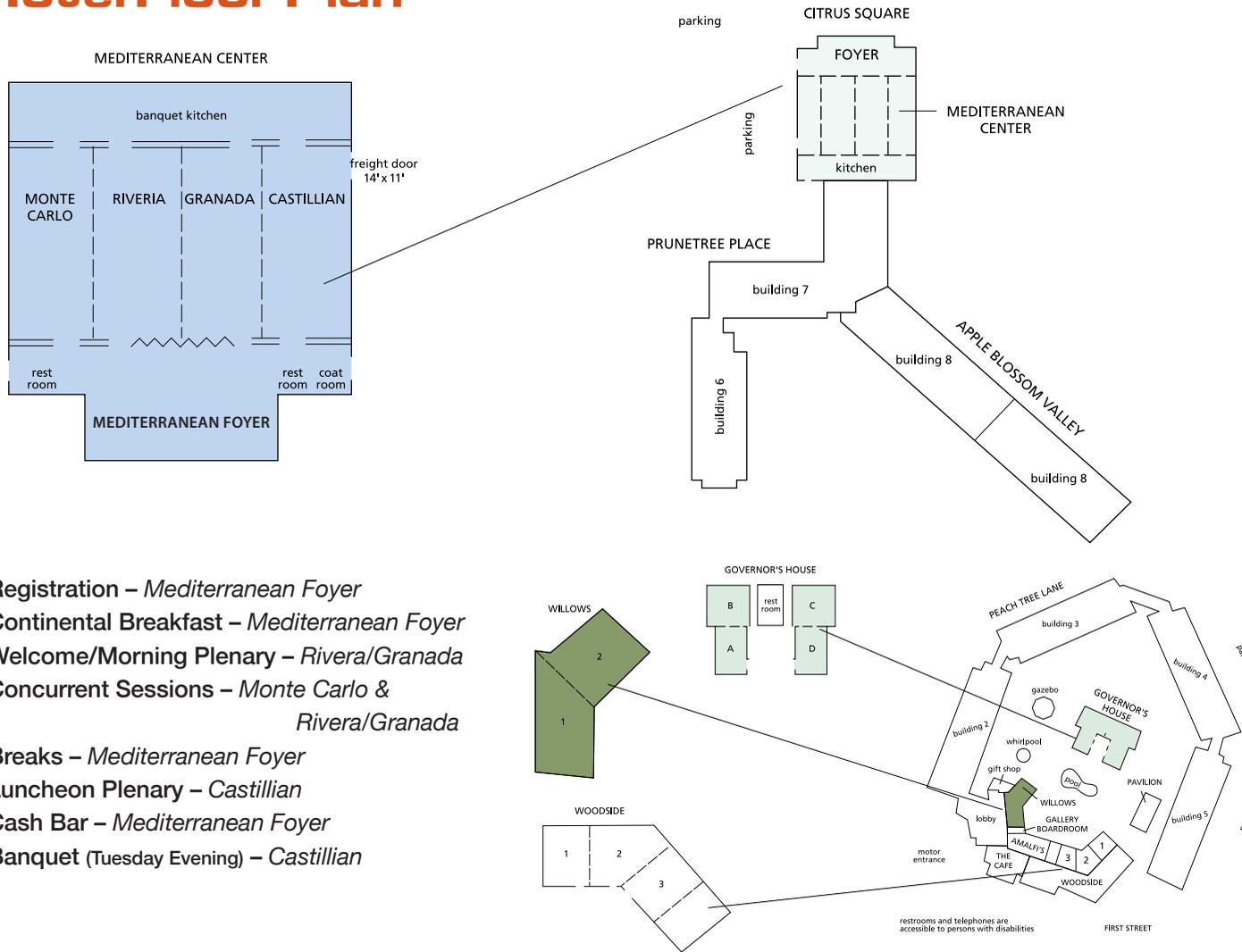

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CITRUS SQUARE

FOYER

parking

MEDITERRANEAN CENTER

kitchen

PRUNETREE PLACE

building 7

building 6

building 8

APPLE BLOSSOM VALLEY

building 8

GOVERNOR'S HOUSE

WILLOWS

2

1

B | rest room | C

A | D

PEACH TREE LANE

building 3

building 4

parking

gazebo

GOVERNOR'S HOUSE

whirlpool

gift shop

pool

PAVILION

building 2

WILLOWS

lobby

GALLERY BOARDROOM

AMALFI'S

WOODSIDE

building 5

parking

1 | 2

3

motor entrance

THE CAFE

3 | 2 | 1

WOODSIDE

restrooms and telephones are accessible to persons with disabilities

FIRST STREET

Registration – *Mediterranean Foyer*
Continental Breakfast – *Mediterranean Foyer*
Welcome/Morning Plenary – *Rivera/Granada*
Concurrent Sessions – *Monte Carlo &*
Rivera/Granada
Breaks – *Mediterranean Foyer*
Luncheon Plenary – *Castillian*
Cash Bar – *Mediterranean Foyer*
Banquet (Tuesday Evening) **–** *Castillian*

Proceedings
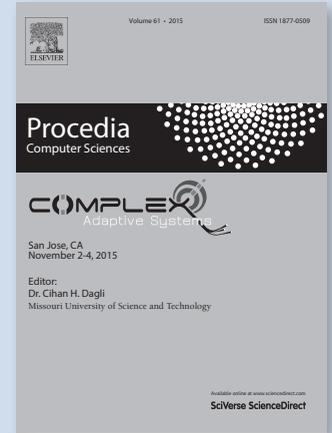
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Notes

Notes

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