



**COMPLEX**  
Adaptive Systems

**Engineering Cyber  
Physical Systems:**

**Applying Theory to Practice**

**Los Angeles, California  
November 2 - 4, 2016**

**Conference Program**

## Organizing Committee

### General Conference Chair

**Cihan H. Dagli**

*Missouri University of Science & Technology, USA*

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*Missouri University of Science and Technology, USA*

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## Welcome

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, Intelligent & Adaptive Systems, Data Science & Analytics and Complex Systems. There will be a lot of discussions as to the Engineering Cyber Physical Systems and how we can apply the theory to practice. 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 15 countries presenting 64 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, government laboratories 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.

## Shared Insights

MITRE is excited to welcome you to this year's Complex Adaptive Systems (CAS) Conference. As a not-for-profit operator of multiple federally funded research and development centers, we bear witness to the many critical United States government program needs that are no longer being satisfied by traditional systems engineering methods. According to the International Council on Systems Engineering (INCOSE), the future of systems engineering will require us to embrace the complexity that is confounding these traditional methods ('A Complexity Primer for Systems Engineers,' INCOSE White Paper, November 2015).

We must take a new strategic approach in order to derive continued value from our existing highly interconnected systems, one that seeks to leverage complexity and emergence; this approach has come to be called applied complexity science. Furthermore, if we ever hope to design complex systems to productively harness the forces of emergence and push forward the nascent field of Complex Systems Engineering, multidisciplinary conferences such as CAS are going to be absolutely vital. We thank you for your participation and look forward to the shared insights to come.

*Michael D. Norman holds a Ph.D. in Complex Systems and Brain Sciences from Florida Atlantic University and a B.S. in Computer Systems Engineering from the University of Massachusetts at Amherst.*



**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  
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**Michael D. Norman, Ph.D.**

Complexity Science Area Lead  
MITRE Corporation's Systems  
Engineering Technical Center

## Conference Schedule at a Glance Full Schedule starts on pg. 5.

### Wednesday, Nov. 2, 2016

**8:00 a.m. – 5:00 p.m.**

**Registration Desk Open** (Coral Foyer)

**8:00 a.m. – 8:40 a.m.**

**Continental Breakfast** (Seascape Ballroom)

**8:40 a.m. – 9:00 a.m.**

**Welcoming Remarks** (Redondo 1 & 2)

Moving Applied Complexity  
Science Forward

*Speaker: Michael D. Norman*

**9:00 a.m. – 10:00 a.m.**

**Morning Plenary Session**

(Redondo 1 & 2)

Two Synergistic Strategies  
for Coping with Complexity  
in Engineered Systems

*Speaker: David Broniatowski*

**10:00 a.m. – 10:30 a.m.**

**Break** (Seascape Ballroom)

**10:30 a.m. – 12:00 p.m.**

**Concurrent Sessions I**

**Cyber Physical Systems: Cyber Security**

(Redondo 1 & 2)

**Intelligent & Adaptive Systems:**

**Deep Learning** (Redondo 3)

**12:00 p.m. – 1:30 p.m.**

**Luncheon & Afternoon Plenary Session**

(Seascape Ballroom)

National Security Implications  
of Virtual Currencies: The Case of  
Non-State Actor Deployment

*Speaker: Joshua Baron*

**1:30 p.m. – 3:00 p.m.**

**Concurrent Sessions II**

**Cyber Physical Systems: System  
of Systems** (Redondo 1 & 2)

**Intelligent & Adaptive Systems:**

**Applications I** (Redondo 3)

**3:00 p.m. – 3:30 p.m.**

**Break** (Seascape Ballroom)

**3:30 p.m. – 5:00 p.m.**

**Concurrent Sessions III**

**Cyber Physical Systems: Complex  
System Behavior** (Redondo 1 & 2)

**Intelligent & Adaptive Systems:**

**Applications II** (Redondo 3)

### Thursday, Nov. 3, 2016

**8:00 a.m. – 5:00 p.m.**

**Registration** (Coral Foyer)

**7:30 a.m. – 8:30 a.m.**

**Continental Breakfast** (Seascape Ballroom)

**8:30 a.m. – 9:30 a.m.**

**Announcements**

**Morning Plenary Session**

(Redondo 1 & 2)

ACP-Based Parallel Systems: Knowledge  
Automation and Smart Adaptability for  
Complex Adaptive Systems

*Speaker: Fei-Yue Wang*

**9:30 a.m. – 10:00 a.m.**

**Break** (Seascape Ballroom)

**10:00 a.m. – 11:30 a.m.**

**Concurrent Sessions I**

**Cyber Physical Systems: Architectures**

(Redondo 1 & 2)

**Intelligent & Adaptive Systems:**

**Applications III** (Redondo 3)

**11:30 a.m. – 1:00 p.m.**

**Lunch on Your Own**

**1:00 p.m. – 2:30 p.m.**

**Concurrent Sessions II**

**Data Science & Analytics: Cluster Analytics**

(Redondo 1 & 2)

**Complex Systems Modeling I** (Redondo 3)

**2:30 p.m. – 3:00 p.m.**

**Break** (Seascape Ballroom)

**3:00 p.m. – 4:30 p.m.**

**Concurrent Sessions III**

**Data Science & Analytics: Prediction**

(Redondo 1 & 2)

**Complex Systems Modeling II** (Redondo 3)

**4:30 p.m. – 6:00 p.m.**

**Concurrent Sessions IV**

**Data Science & Analytics: Data Analytics**

**Frameworks** (Redondo 1 & 2)

**Complex Systems Modeling III** (Redondo 3)

**7:00 p.m. – 9:30 p.m.**

**Banquet & Awards** (Seascape Ballroom)

**Banquet Plenary**

Large-Scale Complex Systems

*Speaker: Anna-Maria Rivas McGowan*

### Friday, Nov. 4, 2016

**8:00 a.m. – 12:00 p.m.**

**Registration** (Coral Foyer)

**8:00 a.m. – 9:00 a.m.**

**Continental Breakfast** (Seascape Ballroom)

**9:00 a.m. – 10:00 a.m.**

**Announcements**

**Morning Plenary Session**

(Redondo 1 & 2)

Decision Making in Complex System  
Architecture Design: Issues and Challenges

*Speaker: Marija Jankovic*

**10:00 a.m. – 10:15 a.m.**

**Break** (Seascape Ballroom)

**10:15 a.m. – 11:45 p.m.**

**General Assembly Sessions**

(Redondo 1 & 2)

**Data Science & Analytics: Intrusion  
Detection**

**11:45 p.m. – 1:15 p.m.**

**Luncheon & Afternoon Plenary (TBA)**

(Seascape Ballroom)

**1:15 p.m. – 2:45 p.m.**

**General Assembly Sessions**

(Redondo 1 & 2)

**Complex Systems Modeling IV**

**2:45 p.m.**

**Conference Adjourns**

## Conference Morning Plenary Speaker

Wednesday, November 2, 2016 | 9:00 a.m. – 10:00 a.m. | Redondo 1 & 2

# Two Synergistic Strategies for Coping with Complexity in Engineered Systems



## David Broniatowski, Ph.D.

Assistant Professor of  
Engineering Management  
and Systems Engineering  
*George Washington University, USA*

**Abstract:** Recent advances in the field of system architecture relate to complex adaptive systems including an increasing emphasis on multi-level modeling (under the rubric of model-based systems engineering), the relationship between structure and behavior, and the role of narrative and perception in systems design. This talk will provide an overview of these advances, with a specific focus on the relationship between a system's architecture and its lifecycle properties, such as its flexibility, descriptive complexity, and potential for rework. Findings suggest that no architecture is ideal under all circumstances; rather, each has strengths and weaknesses that can be exploited in different environments. Thus, specific attention is given to tree- and layered hierarchies, which emphasize decomposition and abstraction respectively. System decomposition, emphasizes a one-to-one mapping between form and function, as in modular designs. In contrast, abstraction decouples form from function, enabling a many-to-many mapping, as in layered designs. These approaches need not be mutually exclusive; rather, they can be synergistic. These claims are examined using simulated intermodal freight shipping networks. Results show that systems relying on decomposition are especially sensitive to disruptions. In contrast, systems relying on abstraction are less sensitive to disruption as long as rates of change in the environment are low; however, they are also less able to respond to unmet demand. Given enough resources, systems using both approaches can respond both to disruptions and unmet demand. Implications for the design and modification of large-scale complex adaptive systems are discussed.

### Biography:

**David Broniatowski**, Ph.D., Director of the Decision Making and Systems Architecture Laboratory, conducts research in decision-making under risk, group decision making, system architecture, and behavioral epidemiology. This research program draws upon a wide range of techniques including formal mathematical modeling, experimental design, automated text analysis and natural language processing, social and technical network analysis, and big data. Current projects include a text network analysis of transcripts from the US Food and Drug Administration's Circulatory Systems Advisory Panel meetings, a mathematical formalization of Fuzzy Trace Theory — a leading theory of decision-making under risk, derivation of metrics for flexibility and controllability for complex engineered socio-technical systems, and using Twitter data to conduct surveillance of influenza infection and the resulting social response.

## Conference Schedule

Wednesday Morning, November 2, 2016 *Presentations are noted by corresponding page number in proceedings.*

### Registration Desk Open

8:00 a.m. – 5:00 p.m.

*Coral Foyer*

### Continental Breakfast

8:00 a.m. – 8:40 a.m.

*Seascape Ballroom*

### Welcoming Remarks

8:40 a.m. – 9:00 a.m.

*Redondo 1 & 2*

*Speaker: Michael D. Norman*

### Moving Applied Complexity Science Forward

### Morning Plenary Session

9:00 a.m. – 10:00 a.m.

*Redondo 1 & 2*

**Speaker: David Broniatowski**

### Two Synergistic Strategies for Coping with Complexity in Engineered Systems

David Broniatowski, Ph.D.  
Assistant Professor of  
Engineering Management  
and Systems Engineering,  
*George Washington University, USA*

(SPEAKER PROFILE ON PAGE 4)

### Morning Break

10:00 a.m. – 10:30 a.m.

*Seascape Ballroom*

### Concurrent Sessions I

10:30 a.m. – 12:00 p.m.

*(See schedule at right)*

### Concurrent Sessions I

10:30 a.m. – 12:00 p.m.

### Cyber Physical Systems: Cyber Security

*Redondo 1 & 2*

**Session Chair: Michael D. Norman**

*The MITRE Corporation, USA*

#### 18 - Affective Computing as Complex Systems Science

*Dr. William Lee | Dr. Michael D. Norman, The MITRE Corporation, USA*

#### 10 - Cyber Collateral Damage

*Sasha Romanosky, RAND Corporation, USA; Zachary Goldman, New York University, USA*

#### 24 - A Method for Revealing and Addressing Security Vulnerabilities in Cyber-Physical Systems by Modeling Malicious Agent Interactions with Formal Verification

*Dean C. Wardell | Robert F. Mills | Gilbert L. Peterson | Mark E. Oxley, Air Force Institute of Technology, USA*

#### 32 - Topology-Based Safety Analysis for Safety Critical CPS

*Jean-Yves Choley | Faïda Mhenni | Anis Baklouti, Supméca, France; Nga Nguyen, EISTI, France*

### Intelligent & Adaptive Systems: Deep Learning

*Redondo 3*

**Session Chair: Fred Highland**

*University of Maryland, USA*

#### 159 - Implementing Multilayer Neural Network Behavior Using Polychronous Wavefront Computation

*Fred Highland, University of Maryland Baltimore County, USA; Corey Hart, Networx, LLC, USA*

#### 153 - Entity Resolution Using Convolutional Neural Network

*Ram Deepak Gottapu | Cihan Dagli | Bharami Ali, Missouri University of Science and Technology, USA*

#### 135 - Modeling of Computational Systemic Deep Mind Under Uncertainty

*Ben Khayut | Lina Fabri | Maya Avikhana, Intelligence Decisions Technologies Systems, Israel*

#### 145 - Image Data Compression and Noisy Channel Error Correction Using Deep Neural Network

*Yijing Z. Watkins | Mohammad R. Sayeh, Southern Illinois University Carbondale, USA*

## Conference Afternoon Plenary Speaker

Wednesday, November 2, 2016 | 12:00 p.m. – 1:30 p.m. | Redondo 1 & 2

# National Security Implications of Virtual Currencies: The Case of Non-State Actor Deployment



### Joshua Baron, Ph.D.

Information Scientist  
RAND Corporation, USA

**Abstract:** Unintended damage to non-military targets is typically straightforward to characterize and weigh against anticipated benefits because of well-established definitions, technical assessments, and legal conventions. In a kinetic military context, collateral damage occurs when a hostile action causes physical or property damage to a civilian target. However, collateral effects caused by cyber operations lack formal recognition when they are limited to electronic data, information technology and computing systems, whether caused by conventional military operations, or the result of law enforcement, or private sector operations. Even though there may be tangible consequences stemming from the loss or destruction of data, conventional norms are ill equipped to formally recognize them. Uniquely in the cybersecurity context, tactical operations may have broad systemic “collateral” effects on other important policy priorities that must be accounted for. In short, we lack a clear conceptual vocabulary for cyber operations for both the military operations, as well as for non-military operations, where many cyber activities occur. This research examines this discontinuity by first examining conventional military definitions of “cyber operations,” “collateral damage” and international norms governing operations conducted by lawful participants against military targets. It then introduces other contexts for considering collateral damage in the cyber realm.

### Biography:

**Joshua Baron**, Ph.D., is an information scientist at the RAND Corporation and a professor at the Pardee RAND Graduate School. His work focuses on policy implications of emerging technologies for cybersecurity, computer network operations, virtual currencies, and cryptography. Before coming to RAND, Baron researched efficient protocols for secure multi-party computation (MPC) for national security and industry applications. Baron received a Ph.D. in mathematics from UCLA in 2012 and a B.A. in mathematics from UC Berkeley in 2006.

## Conference Schedule

Wednesday Afternoon, November 2, 2016 *Presentations are noted by corresponding page number in proceedings.*

### Registration Desk Open

8:00 a.m. – 5:00 p.m.

*Coral Foyer*

### Luncheon & Afternoon

#### Plenary Session

12:00 p.m. – 1:30 p.m.

*Seascape Ballroom*

#### Speaker: Joshua Baron

#### National Security Implications of Virtual Currencies: The Case of Non-State Actor Deployment

Joshua Baron, Ph.D.  
Information Scientist  
*RAND Corporation, USA*

(SPEAKER PROFILE ON PAGE 6)

### Concurrent Sessions II

1:30 p.m. – 3:00 p.m.

*(See schedule at right)*

### Afternoon Break

3:00 p.m. – 3:30 p.m.

*Seascape Ballroom*

### Concurrent Sessions II

1:30 p.m. – 3:00 p.m.

#### Cyber Physical Systems: System of Systems

*Redondo 1 & 2*

#### Session Chair: Bonnie Johnson

*Naval Postgraduate School, USA*

#### 48 - Executable Behavioral Modeling of System and Software Architecture Specifications to Inform Resourcing Decisions

Monica Farah-Stapleton, *PEO DHMS OSD, USA*; Mikhail Auguston | Kristin Giammarco, *Naval Postgraduate School, USA*

#### 58 - Exploring Engineered Complex Adaptive Systems of Systems

Bonnie Johnson | Alejandro Hernandez, *Naval Postgraduate School, USA*

#### 40 - Applied Graph Theory to Real Smart City Logistic Problems

Jose M. Gutierrez, *Aalborg University, Denmark*; Michael Jensen, *NetPlan A/S, Denmark*; Tahir Riaz, *Radio Analyzer, Denmark*

#### 66 - Confidence Investigation of Discovering Organizational Network Structures Using Transfer Entropy

Joshua Rodewald | John Colombi | Kyle Oyama | Alan Johnson, *Air Force Institute of Technology, USA*

#### Intelligent & Adaptive Systems: Applications I

*Redondo 3*

#### Session Chair: Walker Land

*Binghamton University, USA*

#### 168 - A Machine Intelligence Designed Bayesian Network Applied to Alzheimer's Detection Using Demographics and Speech Data

Walker H. Land | J. David Schaffer, *Binghamton University, USA*

#### 175 - Unsupervised Learning of Patterns Using Multilayer Reverberating Configurations of Polychronous Wavefront Computation

Fred Highland, *University of Maryland Baltimore County, USA*; Corey Hart, *Network, LLC, USA*

#### 185 - Identifying High Velocity Objects in Complex Natural Environments Using Neural Networks

Kyle Buller, *Missouri University of Science and Technology, USA*

#### 193 - Detection of Fault Data Injection Attack on UAV Using Adaptive Neural Network

Alireza Abbaspour | Kang K. Yen, *Florida International University, USA*; Shirin Noei, *University of Florida, USA*; Arman Sargolzaei, *Florida Polytechnic University, Lakeland, Florida, USA*

## Conference Schedule

Wednesday Afternoon, November 2, 2016 *Presentations are noted by corresponding page number in proceedings.*

### Registration Desk Open

8:00 a.m. – 5:00 p.m.

*Coral Foyer*

### Afternoon Break

3:00 p.m. – 3:30 p.m.

*Seascape Ballroom*

### Concurrent Sessions III

3:30 p.m. – 5:00 p.m.

*(See schedule at right)*

### Dinner on Your Own

### Concurrent Sessions III

3:30 p.m. – 5:00 p.m.

#### Cyber Physical Systems: Complex System Behavior

*Redondo 1 & 2*

**Session Chair: Andrew Renault**

*Missouri University of Science and Technology, USA*

#### 73 - Complex Adaptive Behavior: Pragmatic Idealism

*Mustafa Canan | Andres Sousa-Poza, Old Dominion University, USA*

#### 80 - Development of an Instrument to Assess Capacity for Systems Thinking

*Kaitlynn M. Castelle, Old Dominion University, USA; Raed M. Jaradat, Mississippi State University, USA*

#### 87 - SoS Meta-Architecture Assessment by Dual Application of Rule Based Fuzzy Inference Systems

*Andrew Renault, Missouri University of Science and Technology, USA*

#### 95 - Genetic Algorithm Optimization of SoS Meta-Architecture Attributes for Fuzzy Rule Based Assessments

*Andrew Renault | Cihan Dagli, Missouri University of Science and Technology, USA*

#### Intelligent & Adaptive Systems: Applications II

*Redondo 3*

**Session Chair: Zeyi Sun**

*Missouri University of Science and Technology, USA*

#### 201 - MMO Smart Servers Using Neural Networks for Intelligent, Client-Handling Decisions and Interactions

*Ben Smith, Missouri University of Science and Technology, and Jack Henry and Associates, USA*

#### 209 - Application of Neural Network in Shop Floor Quality Control in a Make to Order Business

*Rajkamal Kesharwani | Cihan Dagli | Zeyi Sun, Missouri University of Science and Technology, USA*

#### 217 - Determining the Economical Wind Power Sites for the Needed Power Loads Accounting for Geographical Terrains

*Wen-Li Wang, Penn State Erie, The Behrend College, USA; Mei-Huei Tang, Gannon University, USA*

#### 223 - Importance of Model Resolution on Discriminating Rapidly and Non-Rapidly Intensifying Atlantic Basin Tropical Cyclones

*Andrew Mercer | Alexandria Grime, Mississippi State University; Northern Gulf Institute, USA*

#### 507 - Permanent Magnet Synchronous Generator Stability Analysis and Control

*Marwa A. Abd El Hamied, Arab Academy, Egypt; Noha H.El.Amary, Sapienza University, Italy*



## Conference Schedule

Thursday Morning, November 3, 2016 *Presentations are noted by corresponding page number in proceedings.*

### Registration Desk Open

8:00 a.m. – 5:00 p.m.

*Coral Foyer*

### Continental Breakfast

7:30 a.m. – 8:30 a.m.

*Seascape Ballroom*

### Announcements & Morning Plenary Session

8:30 a.m. – 9:30 a.m.

*Redondo 1 & 2*

### Speaker: Fei-Yue Wang

**ACP-Based Parallel Systems: Knowledge Automation and Smart Adaptability for Complex Adaptive Systems**

Fei-Yue Wang, Ph.D.  
Research Scientist and Director  
*Chinese Academy of Sciences, China*

(SPEAKER PROFILE ON PAGE 10)

### Morning Break

9:30 a.m. – 10:00 a.m.

*Seascape Ballroom*

### Concurrent Sessions I

10:00 a.m. – 11:30 a.m.

*(See schedule at right)*

### Lunch on Your Own

11:30 a.m. – 1:00 p.m.

### Concurrent Sessions I

10:00 a.m. – 11:30 a.m.

#### Cyber Physical Systems: Architectures

*Redondo 1 & 2*

**Session Chair: Huy T. Tran**

*The MITRE Corporation, USA*

#### 126 - A Network-Based Cost Comparison of Resilient and Robust System-of-Systems

Huy T. Tran, *The MITRE Corporation, USA*; Jean Charles Domerçant | Dimitri N. Mavris, *Georgia Institute of Technology, USA*

#### 103 - Combining Max-Min and Max-Max Approaches for Robust SoS Architecting

Hadi Farhangi | Dincer Konur | Cihan H Dagli, *Missouri University of Science and Technology, USA*

#### 111 - Modeling Resilience in System of Systems Architecture

Paulette Acheson | Cihan H Dagli, *Missouri University of Science and Technology, USA*

#### 119 - Multiobjective System of Systems Architecting with Performance Improvement Funds

Hadi Farhangi | Dincer Konur | Cihan H. Dagli, *Missouri University of Science and Technology, USA*

#### Intelligent & Adaptive Systems: Applications III

*Redondo 3*

**Session Chair: Michael B. Richman**

*School of Meteorology, University of Oklahoma, USA*

#### 237 - A New Multilevel Input Layer Artificial Neural Network for Predicting Flight Delays at JFK Airport

Sina Khanmohammadi, | Salih Tutun, *Binghamton University, USA*;  
Yunus Kucuk, *Turkish Military Academy, Turkey*

#### 229 - Classifying Drought in Ethiopia Using Machine Learning

Michael B. Richman | Lance M. Leslie | Zewdu T. Segele, *School of Meteorology, University of Oklahoma, USA*

#### 392 - Automatic Classification of Breast Tumors Using Features Extracted from Magnetic Resonance Images

Ahmed M. Sayed, *Helwan University, Egypt*; Eman Zaghoul, *Applied Medical Sciences, Egypt*;  
Tamer M. Nassef, *Misr University for Science and Technology, Egypt* and *El-Gazeera Higher Institute for Engineering and Technology, Egypt*

#### 245 - Voice Identity Finder Using the Back Propagation Algorithm of an Artificial Neural Network

Roger Achkar | Mustafa El-Halabi | Elie Bassil | Rayan Fakhro | Marny Khalil, *American University of Science and Technology, Lebanon*

## Conference Morning Plenary Speaker

Thursday November 3, 2016 | 8:30 a.m. – 9:30 a.m. | Redondo 1 & 2

# ACP-Based Parallel Systems: Knowledge Automation and Smart Adaptability for Complex Adaptive Systems



### Fei-Yue Wang, Ph.D.

Research Scientist and Director  
Chinese Academy of Sciences  
China

**Abstract:** This presentation will review the research and development of ACP-Based Parallel Systems for intelligent control and smart management of complex systems over the last decade, from theoretical framework to real-world applications. The ACP approach mainly consists of three steps, i.e., artificial societies and software-defined systems for modeling and representation, computational experiments for analysis and evaluation, and parallel execution through virtual-actual interaction for feedback-based operation and monitoring. It provides a mechanism for achieving knowledge automation and smart adaptability and making complex systems agile, focusing, and convergence in dealing with uncertainty, diversity, and complexity. Applications of ACP-Based Parallel systems for transportation, management, intelligence, command and control, and agricultural and medical problems will be illustrated and discussed.

### Biography:

**Fei-Yue Wang, Ph.D.**, has been a researcher, educator, and practitioner of intelligent and complex systems for more than 30 years. He joined the University of Arizona in 1990 and became a Professor and Director of the Robotics and Automation Lab (RAL) and Program in Advanced Research for Complex Systems (PARCS). In 1999, he founded the Intelligent Control and Systems Engineering Center at the Institute of Automation, Chinese Academy of Sciences (CAS), Beijing, China, under the support of the Outstanding Oversea Chinese Talents Program from the State Planning Council and “100 Talent Program” from CAS, and in 2002, was appointed as the Director of the Key Lab of Complex Systems and Intelligence Science, CAS. From 2006 to 2010, he was Vice President for research, education, and academic exchanges at the Institute of Automation, CAS. Since 2005, he has been the Dean of the School of Software Engineering at Xi’an Jiaotong University. In 2011, he became the State Specially Appointed Expert and the Director of the State Key Laboratory of Management and Control for Complex Systems. Dr. Wang has published extensively in modeling, analysis, control and management of complex systems. His current research is focused on methods and applications for parallel systems, social computing, and knowledge automation. He was the Founding Editor-in-Chief of the *International Journal of Intelligent Control and Systems* from 1995 to 2000, the Series on Intelligent Control and Intelligent Automation from 1996 to 2004, and IEEE Intelligent Transportation Systems from 2006 to 2008, and the EiC of IEEE Intelligent Systems from 2009 to 2012. Currently, he is the EiC of IEEE Transactions on ITS. Since 1997, he has served as General or Program Chair of more than 20 IEEE, INFORMS, ACM, ASME conferences. He was the President of IEEE ITS Society from 2005 to 2007, Chinese Association for Science and Technology (CAST, USA) in 2005, and the American Zhu Kezhen Education Foundation from 2007-2008. Since 2008, he has been the Vice President and Secretary General of Chinese Association of Automation. Dr. Wang is member of Sigma Xi and an elected Fellow of IEEE, INCOSE, IFAC, ASME, and AAAS. In 2007, he received the 2nd Class National Prize in Natural Sciences of China and awarded the Outstanding Scientist by ACM for his work in intelligent control and social computing. He received IEEE ITS Outstanding Application and Research Awards in 2009 and 2011, respectively. In 2014, Dr. Wang received the IEEE SMC Society Norbert Wiener Award. Dr. Wang received his Ph.D. in Computer and Systems Engineering from Rensselaer Polytechnic Institute, Troy, New York in 1990.

## Conference Schedule

Thursday Afternoon, November 3, 2016 *Presentations are noted by corresponding page number in proceedings.*

### Registration Desk Open

8:00 a.m. – 5:00 p.m.

*Coral Foyer*

### Concurrent Sessions II

1:00 p.m. – 2:30 p.m.

*(See schedule at right)*

### Afternoon Break

2:30 p.m. – 3:00 p.m.

*Seascape Ballroom*

### Concurrent Sessions II

1:00 p.m. – 2:30 p.m.

#### Data Science & Analytics: Cluster Analytics

*Redondo 1 & 2*

**Session Chair:** **Mika Sato-Ilic**

*University of Tsukuba, Japan*

#### 254 - Individual Compositional Cluster Analysis

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

#### 264 - Evaluating Forecasting Methods by Considering Different Accuracy Measures

*Nijat Mehdiyev | Peter Fettke | Peter Loos, Institute for Information Systems, Germany; David Enke, Missouri University of Science and Technology, USA*

#### 272 - Comparative Analyses of Stock Returns Properties and Predictability

*Anthony Joseph, Pace University, USA; Claude Turner, Norfolk State University, USA; Rolston Jeremiah, Independent Consultant, USA*

#### 281 - Using Neural Networks to Forecast Volatility for an Asset Allocation Strategy Based on the Target Volatility

*Youngmin Kim | David Enke, Missouri University of Science and Technology, USA*

#### Complex Systems Modeling I

*Redondo 3*

**Session Chair:** **Davinia Rizzo**

*Sandia National Laboratories, USA*

#### 408 - Use of Bayesian Networks for Qualification Planning: Early Results of Factor Analysis

*Davinia B. Rizzo, Sandia National Laboratories, USA; Mark R. Blackburn, Stevens Institute of Technology, USA*

#### 400 - Modeling Social, Economic, Technical & Environmental Components in an Energy System

*Ange-Lionel Toba | Mamadou Seck, Old Dominion University, USA*

#### 418 - Exploration of Simulated Creatures Learning to Cross a Highway Using Frequency Histograms

*Leslie Ly | Anna T. Lawniczak | Fei Yu, University of Guelph, Canada*

#### 428 - Epidemiology-Based Task Assignment Algorithm for Distributed Systems

*Parth Brahmhatt | Sergio G. Camorlinga, University of Winnipeg, Canada*

## Conference Schedule

Thursday Afternoon, November 3, 2016 *Presentations are noted by corresponding page number in proceedings.*

### Registration Desk Open

8:00 a.m. – 5:00 p.m.

*Coral Foyer*

### Afternoon Break

2:30 p.m. – 3:00 p.m.

*Seascape Ballroom*

### Concurrent Sessions III

3:30 p.m. – 4:30 p.m.

*(See schedule at right)*

### Concurrent Sessions IV

4:30 p.m. – 6:00 p.m.

*(See schedule on next page)*

### Banquet and

### Awards Dinner

7:00 p.m. - 9:30 p.m.

*Seascape Ballroom*

### Banquet Plenary

### Speaker: Anna McGowan

#### Large-Scale Complex Systems

Anna McGowan, Ph.D.  
Agency Senior Engineer  
for Complex Systems Design  
NASA, USA

(SPEAKER PROFILE ON PAGE 14)

### Concurrent Sessions III

3:30 p.m. – 4:30 p.m.

#### Data Science & Analytics: Prediction

*Redondo 1 & 2*

#### Session Chair: David Enke

*Missouri University of Science and Technology, USA*

#### 287 - An Efficient Hybrid Intelligent Method for Electricity Price Forecasting

Hiroyuki Mori | Kaoru Nakano, *Meiji University, Japan*

#### 297 - Time-Frequency Spatial Wavelet Phase Coherence Analysis of EEG in EC and EO During Resting State

Lal Hussain, *University of Azad Jammu and Kashmir, Pakistan*;  
Wajid Aziz, *University of Jeddah, Saudi Arabia*

#### 311 - Integration of System Modeling and Design Processes, Data and Technology for Streamlining Enterprise Integration

Craig Estridge | Timothy Eveleigh | Berek Tanju, *The George Washington University, USA*

#### 303 - Governing Asset Management Data Infrastructures

Paul Brous | Paulien Herder | Marijn Janssen, *Delft University of Technology, The Netherlands*

### Complex Systems Modeling II

*Redondo 3*

#### Session Chair: Gene Lesinski

*United States Military Academy, USA*

#### 436 - Integrating External Simulations Within the Model-Based Systems Engineering Approach Using Statistical Metamodels

Alex MacCalman | Gene Lesinski, *United States Military Academy, USA*;  
Simon Goerger, *Engineer Research and Development Center, USA*

#### 375 - Application of an Artificial Neural Network to Predict Graduation Success at the United States Military Academy

Gene Lesinski, *United States Military Academy, USA*; Steven Corns | Cihan Dagli, *Missouri University of Science and Technology, USA*

#### 442 - Analysis of CT-Measured Pore Characteristics of Porous Media Relative to Physical Properties

P. Adhikari, *Texas A&M AgriLife Research Center, USA*; S. H. Anderson | R. P. Udawatta, *University of Missouri, Columbia, USA*; S. Kumar, *South Dakota State University, USA*

#### 450 - Sparse Causal Temporal Modeling to Inform Power System Defense

Michail Misyrlis | Rajgopal Kannan | Charalampos Chelmiss | Viktor K. Prasanna, *University of Southern California, USA*

## Concurrent Sessions IV

4:30 p.m. – 6:00 p.m.

### Data Science & Analytics: Data Analytics Frameworks

Redondo 1 & 2

**Session Chair:** Joseph Kroclick

*Winifred Associates, USA*

#### 319 - A Knowledge and Analytics-Based Framework and Model for Forecasting Program Schedule Performance

Kevin T. Knudsen | Mark Blackburn, *Stevens Institute of Technology, USA*

#### 327 - Vector Representation for Sub-graph Encoding to Resolve Entities

Jinhong K. Guo | David Van Brackle | Nicholas Lofaso | Martin O. Hofmann,  
*Lockheed Martin Advanced Technology Laboratories, USA*

#### 345 - Towards Assuring Correct Coordination of Multilayer Recovery Using Integrated Ontologies

Joseph Kroclick, *Winifred Associates, USA*

### Complex Systems Modeling III

Redondo 3

**Session Chair:** Ahmet Murat Ozbayoglu

*Missouri University of Science and Technology, USA*

#### 457 - Shape Analysis of Traffic Flow Curves Using a Hybrid Computational Analysis

W. Kayani | S.P. Acharya | I.G. Guardiola | D.C. Wunsch | B. Schumacher | Isaac Wagner-Muns,  
*Missouri University of Science and Technology, USA*

#### 467 - Design of a Customer's Type Based Algorithm for Partner Selection Problem of Virtual Enterprise

Shahzad Nikghadam, *Middle East Technical University, Turkey*; Ahmet Murat Ozbayoglu | Hakki Ozgur Unver,  
*TOBB University of Economics and Technology, Turkey*; Sadik Engin Kilic, *Atilim University, Turkey*

#### 475 - An Efficient Solution to the Mixed Shop Scheduling Problem Using a Modified Genetic Algorithm

V. Nguyen | H. P. Bao, *Old Dominion University, USA*

#### 483 - Optimal Policy for Sequential Stochastic Resource Allocation

K. Krishnamoorthy, *InfoSciTex Corporation, USA*; M. Pachter, *Air Force Institute of Technology, USA*;  
D. Casbeer, *Air Force Research Laboratory, USA*

## Conference Banquet Plenary Speaker

Thursday November 3, 2016 | 7:00 p.m. | Seascape Ballroom

### Large-Scale Complex Systems



#### Anna McGowan, Ph.D.

Agency Senior Engineer for  
Complex Systems Design  
NASA, USA

**Abstract:** Large-Scale Complex Engineered Systems (LaCES) include aerospace; large maritime; nuclear; and major civil infrastructure systems (e.g., water supply systems, electric power grids, healthcare systems, and air and ground transportation systems). LaCES present several unique challenges including extraordinary costs and risks, the inability to fully test and evaluate the complete system until it is nearly operational, and a significant magnitude of inherent couplings between engineering and non-engineering disciplines and components. The considerations beyond engineering are extensive: economics, policy, urban planning, education, culture, and many others. Challenges and complexities exist in creating the engineered system as well as in working with the large, geographically dispersed organizational system required to complete the system design and development. Indeed, a complex (human, organizational, political, etc.) system is often required in order to design and produce a complex engineered system. Perhaps one of the greatest challenges of and opportunities for advancing the design and development of LaCES is in theoretically-rigorously integrating the contributions of a diverse number of disciplines from the natural and social sciences. Though designing at large-scale is met with great challenge, it also presents a great opportunity to have lasting and highly positive societal impact. Innovative complex system design in large-scale can have transformative impacts as we better harness the collective wisdom of the complex and diversely trained human system the design relies upon and as we thoughtfully consider the complex and diverse needs of the human system that the design serves.

#### Biography:

**Dr. Anna-Maria McGowan** is a NASA Technical Fellow serving as the Agency Senior Engineer for Complex Systems Design. Dr. McGowan's research and agency leadership focus on interdisciplinary methodologies for designing and engineering systems with multi-faceted complexities. Dr. McGowan has over 24 years experience in aerospace research and leadership, conducting research and managing several large projects in diverse areas including design science, adaptive structures and materials, flow control, aeroservoelasticity, and organization science. Dr. McGowan has served as a NASA senior project manager, DARPA Agent, NSF visiting scientist, NATO consultant, short course instructor, flight test leader, wind-tunnel test engineer, senior researcher, and NASA spokesperson. Her career has focused on advancing innovation across disciplines including the social sciences and has incorporated both military and commercial aerospace vehicles. Dr. McGowan has a B.S. in Aeronautical and Astronautical Engineering from Purdue University, an M.S. in Aerospace Engineering from Old Dominion University, and a Ph.D. in Design Science in Engineering from the University of Michigan.

## Conference Schedule

Friday, November 4, 2016 *Presentations are noted by corresponding page number in proceedings.*

### Registration Desk Open

8:00 a.m. – 12:00 p.m.

*Coral Foyer*

### Continental Breakfast

8:00 a.m. – 9:00 a.m.

*Seascape Ballroom*

### Opening Session

9:00 a.m. – 10:00 a.m.

*Redondo 1 & 2*

### Plenary Speaker: Marija Jankovic

Decision Making in Complex System Architecture Design: Issues and Challenges

Marija Jankovic, Ph.D.  
Associate Professor  
*CentraleSupélec, France*

(SPEAKER PROFILE ON PAGE 16)

### Morning Break

10:00 a.m. – 10:15 a.m.

*Seascape Ballroom*

### General Assembly Sessions

10:15 a.m. – 11:45 a.m.

*(See schedule at right)*

### Luncheon and Afternoon

### Plenary Speaker: TBA

11:45 a.m. – 1:15 p.m.

*Seascape Ballroom*

### General Assembly Sessions

1:15 p.m. – 2:45 p.m.

*(See schedule at right)*

## General Assembly Sessions

### Data Science & Analytics: Intrusion Detection

10:15 a.m. – 11:45 a.m.

*Redondo 1 & 2*

**Session Chair:** Anthony Joseph  
*Pace University, USA*

#### 361 - A Rule Status Monitoring Algorithm for Rule-Based Intrusion Detection and Prevention Systems

Claude Turner, *Norfolk State University, USA*; Rolston Jeremiah, *Independent Consultant, USA*; Dwight Richards, *College of Staten Island, USA*; Anthony Joseph, *Pace University, USA*

#### 369 - Advocating for Hybrid Intrusion Detection Prevention System and Framework Improvement

Syed Rizvi | Gabriel Labrador | Matt Guyan | Jeremy Savan, *Pennsylvania State University, USA*

#### 383 - Utilizing Relevant Academic and Personality Features from Big Unstructured Data to Identify Good and Bad Fit Students

Muhammad Fahim Uddin | Jeongkyu Lee, *University of Bridgeport, USA*

#### 353 - Comparing Drools and Ontology Reasoning Approaches for Automated Monitoring of Telecommunication Processes

Armando Ordóñez | Luis Eraso, *University Foundation of Popayán, Colombia*; Hugo Ordóñez | Luis Merchan, *University of San Buenaventura, Colombia*

### Complex Systems Modeling IV

1:15 p.m. – 2:45 p.m.

*Redondo 1 & 2*

**Session Chair:** Daniel Bouskela  
*EDF, France*

#### 516 - Multi-mode Physical Modelling of a Drum Boiler

Daniel Bouskela, *EDF, France*

#### 489 - A Decision Support System for Improving Resiliency of Cooperative Adaptive Cruise Control Systems

Shirin Noei, *University of Florida, USA*; Arman Sargolzaei, *Florida Polytechnic University, Florida, USA*; Alireza Abbaspour | Kang Yen *Florida International University, USA*

#### 497 - Robust Adaptive Control of a Weakly Minimum Phase General Aviation Aircrafts

Alfonso Noriega | Mark J. Balas | Richard P. Anderson, *Embry-Riddle Aeronautical University, USA*

#### 335 - We Are What We Generate - Understanding Ourselves Through Our Data

Muhammad Fahim Uddin | Jeongkyu Lee, *University of Bridgeport, USA*

## Conference Morning Plenary Speaker

Friday, November 4, 2016 | 9:00 a.m. – 10:00 a.m. | Redondo 1 & 2

# Decision Making in Complex System Architecture Design: Issues and Challenges



### Marija Jankovic, Ph.D.

Associate Professor,  
CentraleSupélec, France

**Abstract:** In complex system design, system architecture design process is a critical process determining overall system costs as well as deployment. Many of the decisions in early stages are part of the system architecture design. Even though there are standards addressing the scope of this process, this process is not well understood by the academic literature nor supported by adapted methods and tools. The focus will be on different types of system architectures and its impact on related decision making processes as well as several industry grounded studies highlighting specificities of this process with regard to different contexts. Discussions will also underline current difficulties and potential future academic and industrial needs.

### Biography:

**Marija Jankovic** Ph.D. is an Associate Professor at CentraleSupélec. Her main domain of interest concerns developing a decision support framework for early design stages in complex system design. She has particularly developed approaches for system architecture design. She is a regular reviewer for several major journals such as *Journal of Mechanical Design*, *Journal of Engineering Design*, *Artificial Intelligence in Engineering Design*, *Concurrent Engineering*, *Research in Engineering Design*, etc. She has authored more than 60 peer-review papers. She has coordinated several research projects in collaboration with major French and international companies: Snecma, Thales, EADS, PSA Peugeot Citroen, Schlumberger, etc. She is also Co-pilot of Research and Innovation Technical Committee of INCOSE French Chapter and member of Scientific Committee of IRT SystemX (French National Institute of System Sciences).





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\* **Conference Locations**

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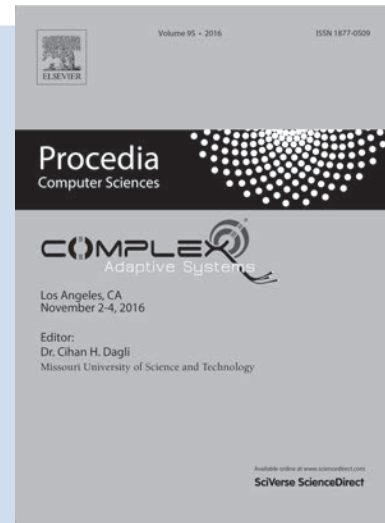


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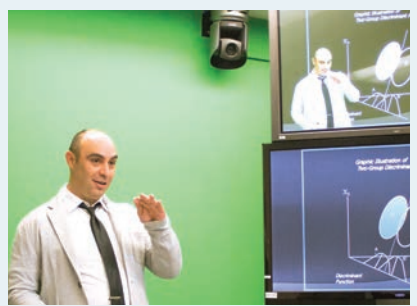
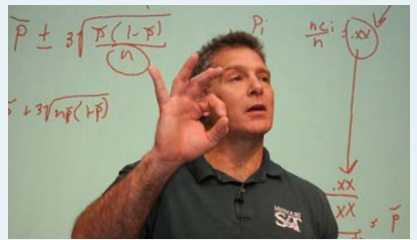




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