

2017 Annual IEEE International Systems Conference (SysCon 2017)

**Montreal, Quebec, Canada
24-27 April 2017**



**IEEE Catalog Number: CFP17SYT-POD
ISBN: 978-1-5090-4624-9**

**Copyright © 2017 by the Institute of Electrical and Electronics Engineers, Inc
All Rights Reserved**

Copyright and Reprint Permissions: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

****** This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.***

IEEE Catalog Number:	CFP17SYT-POD
ISBN (Print-On-Demand):	978-1-5090-4624-9
ISBN (Online):	978-1-5090-4623-2
ISSN:	1944-7620

Additional Copies of This Publication Are Available From:

Curran Associates, Inc
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: (845) 758-0400
Fax: (845) 758-2633
E-mail: curran@proceedings.com
Web: www.proceedings.com

CURRAN ASSOCIATES INC.
proceedings
.com

TABLE OF CONTENTS

Welcome to Montreal for the 2017 IEEE International Systems Conference	xxi
2017 IEEE International Systems Conference Organizing Committee	xxii
Keynote Speaker.....	xxvi

Tuesday, April 25

13:30 - 15:00

2C1: Transportation Systems

Room: Salon Viger C

Session Chair: Aldo Fabregas (Florida Institute of Technology, USA)

Segmented Arrival Graph based Evacuation Plan Assessment Algorithm Using Linear Programming	1
<i>Manki Min (South Dakota State University, USA)</i>	
<i>Sunho Lim (Texas Tech University, USA)</i>	

A High-Speed Color-Based Object Detection Algorithm for Quayside Crane Operator Assistance System	9
<i>Xiang Gao (California State University, Long Beach, USA)</i>	
<i>Hen-Geul Yeh (California State University, Long Beach, USA)</i>	
<i>Panadda Marayong (California University, Long Beach, USA)</i>	

Application-Driven Traffic Sensor System Acceptance Tests for Intelligent Transportation Systems	15
<i>Thiago Mendonca (Florida Institute of Technology, USA)</i>	
<i>Aldo Fabregas (Florida Institute of Technology, USA)</i>	
<i>Troy Nguyen (Florida Institute of Technology, USA)</i>	

13:30 - 15:00

2C2: Space and Communicatio Systems

Room: Salon Viger B

Session Chair: Paul Hershey (Raytheon, Inc., USA)

System for Small Satellite Onboard Processing	23
<i>Paul Hershey (Raytheon, USA)</i>	
<i>William Wolpe (Raytheon, USA)</i>	
<i>Jeffery Klein (Raytheon, USA)</i>	
<i>Charlotte Dekeyrel (Raytheon, USA)</i>	

Battlespace Communications Network-of-Network Interface Modelling	29
<i>Mansoor Syed (Capability, Acquisition and Sustainment Group (CASG), Australia)</i>	
<i>Peter Pong (Jacobs Australia, Australia)</i>	
<i>Bob Hutchinson (Capability, Acquisition and Sustainment Group (CASG), Australia)</i>	

Inter-Satellite Communication MBSE Design Framework for Small Satellites	35
<i>Awele I AnyanHun (North Carolina A&T State University, USA)</i>	
<i>William W Edmonson (North Carolina A&T State University, USA)</i>	

13:30 - 15:00

2C3: Model Based Systems Engineering I

Room: Salon Terrasse

Session Chair: *Thomas A McDermott, Jr (Georgia Tech Research Institute, USA)*

Approximation Effects and User-Controllable Design Space Exploration.....42
Haifeng Zhu (United Technologies Research Center, USA)

Reuse of SysML Model to Support Innovation in Mechatronic Systems Design50
Mizuki Shinozaki (University of Electro-Communications, Japan)
Faïda Mhenni (SUPMECA, France)
Jean-Yves Choley (SUPMECA, France)
Aiguo Ming (University of Electro-Communications, Japan)

Web Notebooks as a Knowledge Management Tool for System Engineering Trade Studies.....56
Jack Zentner (Georgia Tech Research Institute (USA))
Tom McDermott, Jr (Georgia Tech Research Institute (USA))

13:30 - 15:00

2C4: Research in Systems Engineering I

Room: Salon Neufchatel

Session Chair: *Alberto Sols (HSN, Spain)*

Applications of an Emulation Model towards the Preservation of Modern Computing Systems.....61
Darin Jamraj (Florida Atlantic University, USA)
Shihong Huang (Florida Atlantic University, USA)
Perambur Neelakanta (Florida Atlantic University, USA)
Bassem Alhalabi (Florida Atlantic University, USA)

A Standard Based Adaptive Path to Teach Systems Engineering: 15288 and 29110 Standards Use Cases69
Mohammed BOUGAA (CentraleSupélec Engineering School & EISTI, France)
Stefan BORNHOFEN (EISTI Cergy, France)
Rory V O'Connor (Dublin City University & Lero, Irish Software Engineering Research Centre, Ireland)
Alain Riviere (Institut Supérieur De Mécanique, France)

Receding Capabilities in Systems of Systems.....77
Alberto Sols (HSN, Spain)

13:30 - 15:00

2C5: Modeling and Simulation I

Room: Salle de Bal Foyer

Session Chair: *Joe Cecil (Oklahoma State University & Cyber Tech, USA)*

Test-driven modeling and development of cloud-enabled cyber-physical smart systems.....83
Allan Munck (Technical University of Denmark, Denmark)
Jan Madsen (Technical University of Denmark, Denmark)

A Next Generation Collaborative System for Micro Devices Assembly91
J. Cecil (Oklahoma State University & Cyber Tech, USA)
Raviteja Gunda (Oklahoma State University, USA)
Aaron Cecil-Xavier (Soaring Eagle Program, USA)

Performance of Constant Envelope DCT Based OFDM System with M-ary PAM Mapper in AWGN Channel	99
<i>Rayan H. Alsisi (Western University, Canada)</i>	
<i>Raveendra K. Rao (The University of Western Ontario, Canada)</i>	

13:30 - 15:00

2C6: INCOSE

Room: Salon Viger A

Session Chair: *Claude Laporte (Ecole de Technologies Superieure, Canada)*

Learning from Research about CASs operating as Enterprises	105
<i>Vernon Ireland (The University of Adelaide, Australia)</i>	
<i>Larissa Statsenko (The University of Adelaide, Australia)</i>	
<i>Indra Gunawan (The University of Adelaide, Australia)</i>	
<i>Carmen Haule (The University of Adelaide, Australia)</i>	

Systems Engineering and Management Processes for Small Organizations with ISO/IEC 29110 An implementation in a Small Public Transportation Company	112
<i>Claude Y Laporte (Ecole de Technologie Superieure, Canada)</i>	
<i>Nicolas Tremblay (Ecole de Technologie Superieure, Canada)</i>	
<i>Jamil Menaceur (CSiT, Canada)</i>	
<i>Denis Poliquin (CSiT, Canada)</i>	
<i>Ronald Houde (Mannarino Systems & Software, Canada)</i>	

Developing a System ConOp for Complex Infrastructure Upgrade Programmes	120
<i>A.G. Hessami (Vega Systems, UK)</i>	

15:30 – 17:00

2D1: Medical Systems

Room: Salon Viger C

Session Chair: *Joe Cecil (Oklahoma State University & Cyber Tech, USA)*

Systems Thinking and Predictive Analytics to Improve Veteran Healthcare Scheduling	126
<i>N. Peter Whitehead (MITRE Corporation, USA)</i>	
<i>Stephen C. Adams (University of Virginia, USA)</i>	
<i>William T. Scherer (University of Virginia, USA)</i>	
<i>Hyojung Kang (University of Virginia, USA)</i>	
<i>Matthew Gerber (University of Virginia, USA)</i>	

A Distributed Collaborative Simulation Environment for Orthopedic Surgical Training	134
<i>J. Cecil (Oklahoma State University & Cyber Tech, USA)</i>	
<i>Avinash Gupta (Oklahoma State University, USA)</i>	
<i>P. Ramanathan. (University of Wisconsin at Madison, USA)</i>	
<i>Miguel Pirela-Cruz (Texas Tech Health Sciences Center, USA)</i>	

Network of Wireless Medical Devices to Assess the Gait of Rehabilitation in Patients for Walking and Running.....	142
<i>A. Beaulieu (Royal Military College of Canada, Canada)</i>	
<i>A. Lapointe (Royal Military College of Canada, Canada)</i>	
<i>S. Givigi (Royal Military College of Canada, Canada)</i>	
<i>K. Sillins (Canadian National Defence, Canada)</i>	
<i>A. Lavoie (Royal Military College of Canada, Canada)</i>	
<i>K. Tilley (Royal Military College of Canada, Canada)</i>	
<i>N. Le Bel (Canadian National Defence, Canada)</i>	

15:30 – 17:00

2D2: Cloud Computing

Room: Salon Viger B

Session Chair: Paul Rad (Rackspace, USA)

Transmitter Beam-forming Techniques for Indoor Millimeter wave Communication 150

Pravinkumar Shanmugam (California State University Long Beach, USA)

Hen-Geul Yeh (California State University Long Beach, USA)

Joe Lee (Spatial Digital Systems, USA)

Donald Chang (Spatial Digital Systems, USA)

Resource Usage Prediction Algorithm Using Weighted Linear Regression for Virtual Machine Live Migration in Cloud Data Centers N/A

Mohammad Ali Khoshkholghi (University Putra Malaysia, Malaysia)

Performance Evaluation of Cloud Object Storage for Big Data N/A

Swanand Mhalagi (University of Texas at San Antonio & Open Cloud Institute at UTSA, USA)

Lide Duan (University of Texas at San Antonio, USA)

Paul Rad (University of Texas at San Antonio, USA)

15:30 – 17:00

2D3: Model Based Systems Engineering II

Room: Salon Terrasse

Session Chair: Pierre de Saqui-Sannes (ISAE-SUPAERO, France)

Feasibility study of a multispectral camera with automatic processing onboard a 27U satellite using Model Based Space System Engineering..... 171

Andre Pierre Mattei (Senai Innovation Institute for Embedded Systems, Brazil)

Luis Loures (Aeronautics Institute of Technology, Brazil)

Pierre de Saqui-Sannes (ISAE-SUPAERO, France)

Benedicte Escudier (ISAE-SUPAERO, France)

Can ontologies prevent MBSE models from becoming obsolete? 179

Uri Shani (IBM Research-Haifa, Israel)

Model-Based Dynamic Reliability Engineering for Hybrid Electric Vehicle Design 187

Armin Zimmermann (Ilmenau University of Technology & Systems and Software Engineering, Germany)

Thomas Dietrich (Ilmenau University of Technology & Systems and Software Engineering, Germany)

Paulo Maciel (Federal University of Pernambuco, Brazil)

Andreas Hildebrandt (Pepperl+Fuchs GmbH, Germany)

15:30 – 17:00

2D4: Research in Systems Engineering II

Room: Salon Neufchatel

Session Chair: Martin Malchow (Hasso Plattner Institute, Germany)

Embedded Smart Home - Remote Lab Grading in a MOOC with over 6000 Participants 195

Martin Malchow (Hasso Plattner Institute, Germany)

Jan Renz (Hasso Plattner Institute, Germany)

Matthias Bauer (Hasso Plattner Institute, Germany)

Christoph Meinel (Hasso Plattner Institute, University of Potsdam, Germany)

A systematic and practical method for selecting systems engineering tools201
Allan Munck (Technical University of Denmark, Denmark)
Jan Madsen (Technical University of Denmark, Denmark)

Model based QFD method with the integrated sensitivity Analysis209
Seyed Sina Shabestari (Ruhr Universität Bochum, Germany)
Beate Bender (Ruhr Universität Bochum, Germany)

15:30 – 17:00

2D5: Defense Systems

Room: Salle de Bal Foyer

Session Chair: *George L Ball (Raytheon, Inc., USA)*

Research on weapon system portfolio selection based on combat network modeling215
Cheng Cheng (National University of Defense Technology, P.R. China)
Jichao Li (National University of Defense Technology, P.R. China)
Qingsong Zhao (National University of Defense Technology, P.R. China)
Jiang Jiang (NUDT, P.R. China)
Lixin Yu (Beijing Simulation Center, P.R. China)
Huilin Shang (National University of Defense Technology, P.R. China)

Research on Development Strategy of Weapon Equipment in Antagonistic Environment221
Chunqi Wan (National University of Defense Technology, P.R. China)
Weitao Xiong (National University of Defense Technology, P.R. China)
Yanqing Ye (National University of Defense Technology, P.R. China)
Qingsong Zhao (National University of Defense Technology, P.R. China)
Kewei Yang (National University of Defense Technology, P.R. China)

Simulation and Exploration of High-Density Unmanned Aerial Vehicle Systems226
Timothy B. Nysetvold (Brigham Young University, USA)
John L. Salmon (Brigham Young University, USA)

15:30 – 17:00

2D6: INCOSE

Room: Salon Viger A

Session Chair: *Inas S. Khayal (Geisel School of Medicine at Dartmouth, USA)*

The Application of Model-Based Systems Engineering to the Practice of Clinical Medicine234
Inas S. Khayal (Geisel School of Medicine at Dartmouth, USA)
Amro M. Farid (Thayer School of Engineering at Dartmouth, USA)

A Holistic Approach for Virtual Commissioning of Intelligent Systems.....239
Christian Henke (Fraunhofer-Institute for Mechatronic Systems Design, Germany)
Jan Michael (Fraunhofer Institut for Mechatronic Systems Design, Germany)
Christopher Lankeit (University of Paderborn & Heinz Nixdorf Institute, Germany)
Ansgar Trächtler (Fraunhofer-Institute for Mechatronic Systems Design, Germany)

The future of Engineering - Scenarios of the future way of working in the engineer-to-order business245
Jan Vollmar (Siemens AG, Germany)
Michael Gepp (Siemens AG, Germany)
Andreas Schertl (Siemens AG, Germany)

Wednesday, April 26

08:00-09:30

3A1: System Architecture

Room: Salon Viger C

Session Chair: Arash Khabbaz Saberi (TNO, The Netherlands)

A Centralized Enterprise Chef System and Architecture N/A

Jianwen Chen (IBM Australia, Australia)

Choong Thio (IBM Australia, Australia)

Gopal Pingali (IBM Australia, Australia)

George Africa (IBM Australia, Australia)

Chris Freeman (IBM Australia, Australia)

Analysis Sharing Method by Managing Provenance of Query 254

Hiromitsu Nakagawa (Hitachi. Ltd., Japan)

Keiro Muro (Hitachi. Ltd., Japan)

An Architecture Pattern for Safety Critical Automated Driving Applications: Design and Analysis 261

Yaping Luo (Eindhoven University of Technology, Netherlands, The Netherlands)

Arash Khabbaz Saberi (Eindhoven University of Technology, The Netherlands)

Tjerk Bijlsma (Eindhoven University of Technology, The Netherlands)

Johan J. Lukkien (Eindhoven University of Technology, The Netherlands)

Mark van den Brand (Eindhoven University of Technology, The Netherlands)

08:00-09:30

3A2: Decision Making Systems I

Room: Salon Viger B

Session Chair: Steven Hoffenson (Stevens Institute of Technology, USA)

Robust System Portfolio Selection with Multi-Function Requirements and System Instability 268

Boyuan Xia (National University of Defense Technology, China)

Yajie Dou (National University of Defense Technology, China)

Qingsong Zhao (National University of Defense Technology, China)

Bingfeng Ge (National University of Defense Technology, China)

Yang Zhang (National University of Defense Technology, China)

Goal-Seeking Framework to Empower Personal Wellness Management..... N/A

Mukesh K. Chippa (The University of Akron, USA)

Shivakumar Sastry (University of Akron, USA)

Using Agent-Based Modeling to Understand Stakeholder Interactions in the Rollout of NextGen by the Federal Aviation Administration 282

Matthew Mosca (Stevens Institute of Technology, USA)

Steven Hoffenson (Stevens Institute of Technology, USA)

08:00-09:30

3A3: Sensors Integration and Applications I

Room: Salon Terrasse

Session Chair: Alla R. Hilal (University of Waterloo, Canada)

Context-Aware Source Reliability Estimation For Multi-Sensor Management..... 290
Allaa R. Hilal (University of Waterloo, Canada)

**A Framework for Designing Active Pan-Tilt-Zoom (PTZ) Camera Networks
for Surveillance Applications.....294**

Samer Hanoun (Deakin University, Australia)
James Zhang (Deakin University, Australia)
Vu Le (Deakin University, Australia)
Burhan Khan (Deakin University, Australia)
Michael Johnstone (Deakin University, Australia)
Michael Fielding (Deakin University, Australia)
Asim Bhatti (Deakin University, Australia)
Doug Creighton (Deakin University, Australia)
Saeid Nahavandi (Deakin University, Australia)

Low-Cost Wireless Intelligent Two Hand Gesture Recognition System..... 300

Aswin Natesh (Solarillion Foundation, India)
Gandhi Rajan Ramachandran (Solarillion Foundation, India)
Balasubramanian Thiagarajan (Sri Venkateswara College of Engineering, India)
Vineeth Vijayaraghavan (Solarillion Foundation, India)

08:00-09:30

3A4: Research in Systems Engineering II

Room: Salon Neufchatel

Session Chair: *Jean C Domercant (Georgia Tech Research Institute, USA)*

Automated Markov-chain based Analysis for Large State Spaces 306

Kaitlin N. Smith (Southern Methodist University, USA)
Michael A. Taylor (Southern Methodist University, USA)
Anna A. Carroll (Southern Methodist University, USA)
Theodore W. Manikas (Southern Methodist University, USA)
Mitchell A. Thornton (Southern Methodist University, USA)

Cloud-based Semantic Services for Pan-European Emergency Preparation and Planning 314

Christina Schäfer (University of Paderborn, Germany)
Torben Sauerland (Paderborn University, Germany)
Jens Pottebaum (Paderborn University, Germany)
Robin Marterer (Paderborn University, Germany)
Daniel Behnke (TU Dortmund University, Germany)
Christian Wietfeld (TU Dortmund University & Communication Networks Institute, Germany)
Peter Gray (CloudSigma, Germany)
Bogdan Despotov (CloudSigma, Bulgaria)

**A Functional Modularization Approach for Architecting Defense Open Systems: In Support of Strategic Open
Architecture Reuse..... 321**

Jean Charles Domercant (Georgia Tech Research Institute & Electronic Systems Laboratory, USA)

08:00-09:30

3A6: INCOSE

Room: Salon Viger A

Modbus Monitoring for Networked Control Systems of Cyber-Defensive Architecture..... 328

Charles Kim (Howard University, USA)
Dayne Robinson (Howard University, USA)

Network Intrusion Detection through Artificial Immune System..... 334
Marzie Tabatabaefar (Institut National de la Recherche Scientifique (INRS), Canada)
Maryam Miriestahbanati (Concordia University, Canada)
Jean-Charles Grégoire (Institut National de la Recherche Scientifique (INRS), Canada)

Secure Solution: One Time Mobile Originated PKI..... 340
Zia Saquib (Centre for Development of Advanced Computing, Mumbai, India)
Manish Kumar (Centre for Development of Advanced Computing, India)
Kapil kant Kamal (Centre for Development of Advanced Computing, India)
Bharat Varyani (Center for Development of Advanced Computing, India)

10:00-11:30

3B1: Robotic Systems

Room: Salon Viger C

Session Chair: *Aleksandr Sergeyev (Michigan Technological University, USA)*

Fuzzy Controlled Object Manipulation using a Three-Fingered Robotic Hand..... 346
Vinicius Prado da Fonseca (University of Ottawa, Canada)
Daniel Kucherhan (University of Ottawa, Canada)
Thiago E. Alves de Oliveira (University of Ottawa, Canada)
Da Zhi (University of Ottawa, Canada)
Emil M. Petriu (University of Ottawa, Canada)

Promoting Industrial Robotics Education by Curriculum, Robotic Simulation Software, and Advanced Robotic Workcell Development and Implementation..... 352
Aleksandr Sergeyev (Michigan Technological University, USA)
Nasser Alaraje (Michigan Technological University, USA)
Siddharth Parmar (Michigan Technological University, USA)
Scott Kuhl (Michigan Technological University, USA)
Vincent Druschke (Michigan Technological University, USA)
Joshua Hooker (Michigan Technological University, USA)

Secure communication for the Robot Operating System 360
Benjamin Breiling (Joanneum Research, Austria)
Bernhard Dieber (Joanneum Research, Austria)
Peter Schartner (Joanneum Research, Austria)

10:00-11:30

3B2: Decision Making System II

Room: Salon Viger B

Session Chair: *Jakob Axelsson (Mälardalen University & Swedish Institute of Computer Science, Sweden)*

The tradeoffs between portfolios in multi-attribute project portfolio selection..... 366
Xiaoxiong Zhang (University of Waterloo, Canada)
Yajie Dou (National University of Defense Technology P.R., China)
Qingsong Zhao (National University of Defense Technology & College of Information System and Management, P.R. China)
Kai Zhao (University of Waterloo, Canada)

Towards the Architecture of a Decision Support Ecosystem for System Component Selection..... 371
Jakob Axelsson (Mälardalen University & Swedish Institute of Computer Science, Sweden)
Ulrik Franke (Swedish Institute of Computer Science, Sweden)
Jan Carlson (Mälardalen University, Sweden)
Séverine Sentilles (Mälardalen University, Sweden)
Antonio Cicchetti (Mälardalen University, Sweden)

A Threshold Based Airspace Capacity Estimation Method for UAS Traffic Management378
Vishwanath Bulusu (University of California, Berkeley, USA)
Valentin Polishchuk (Linkoping University, Sweden)

10:00-11:30

3B3: Sensors Integration and Applications II

Room: Salon Terasse

Session Chair: *Andy Adler (Carleton University, Canada)*

Decentralized Configuration of Embedded Web Services for Smart Home Applications385

Arne Wall (University of Rostock, Germany)

Vlado Altmann (University of Rostock, Germany)

Johannes Müller (University of Rostock, Germany)

Hannes Raddatz (University of Rostock, Germany)

Dirk Timmermann (University of Rostock, Germany)

Biometric Permanence: Definition and Robust Calculation391

Henry Harvey (Carleton University, Canada)

John Campbell (Bion Biometrics, USA)

Stephen Elliott (BSPA Laboratory, Purdue University, USA)

Andy Adler (Carleton University, Canada)

Energy Harvesting in Wireless Sensor Network with Efficient Landmark Selection using Mobile Actuator398

Ahmad Shawahna (University of Louisiana, Lafayette, USA)

Md Enamul Haque (University of Louisiana, Lafayette, USA)

Mehmet Engin Tozal (University of Louisiana, Lafayette, USA)

10:00-11:30

3B4: Aerial Systems

Room: Salon Neufchatel

Session Chair: *Eddie E Galarza (Universidad de las Fuerzas Armadas ESPE, Ecuador)*

An Empirical Study on Generic Multicopter Energy Consumption Profiles406

Thomas Dietrich (Technische Universität Ilmenau, Germany)

Silvia Krug (Technische Universität Ilmenau, Germany)

Armin Zimmermann (Technische Universität Ilmenau, Germany)

Control Algorithm for the Inertial Stabilization of UAVs412

Eddie E. Galarza (Universidad de las Fuerzas Armadas ESPE, Ecuador)

Cesar A. Naranjo (Universidad de las Fuerzas Armadas - ESPE, Ecuador)

Octavio Guijarro (Universidad Tecnica de Ambato, Ecuador)

David Basantes (Universidad Tecnica de Ambato, Ecuador)

Victor Enriquez (CIDFAE - Centro de Investigación y Desarrollo FAE Ecuador, Ecuador)

Diego Paredes (CIDFAE - Centro de Investigación y Desarrollo FAE Ecuador, Ecuador)

Integrating UAS Swarming with Formation Drag Reduction.....418

John Colombi (Air Force Institute of Technology, USA)

David R Jacques (Air Force Institute of Technology, USA)

Jacob L Lambach (Air Force Institute of Technology, USA)

10:00-11:30

3B5: Systems Thinking

Room: Salle de Bal Foyer

Session Chair: *William S. Devereux (JHU/APL, USA)*

The Agile Manifesto, Design Thinking and Systems Engineering426

M. Ann Darrin (The Johns Hopkins University Applied Physics Laboratory, USA)

William S. Devereux (The Johns Hopkins University Applied Physics Laboratory, USA)

Software Development Using Agile and Scrum in Distributed Teams431

Youry Khmelevsky (Okanagan College, Canada)

Xitong Li (Ecole des Hautes Etudes, France)

Stuart Madnick (Massachusetts Institute of Technology, USA)

Attributable Design Trades: Reliability and Cost Implications for Unmanned Aircraft.....435

John Colombi (Air Force Institute of Technology, USA)

Bryan Bentz (Air Force Institute of Technology, USA)

Ryan Recker (Air Force Institute of Technology, USA)

Brandon Lucas (Air Force Institute of Technology, USA)

Jason Freels (Air Force Institute of Technology, USA)

10:00 - 11:30

3B6: INCOSE

Room: Salon Viger A

Session Chair: *Luc Fillion (Nuum Solutions inc, Canada)*

Fulfilling the Potential of Consumer Connected Fitness Technologies: Towards Framing Systems Engineering Involvement in User Experience Design443

Woodrow W. Winchester (Robert Morris University, USA)

Valerie Washington (Kennesaw State University, USA)

Using Atlassian Tools for Efficient Requirements Management.....446

Luc Fillion (Nuum Solutions inc, Canada)

Nicolas Daviot (Nuum Solutions inc, Canada)

Jean-Philippe Le Bel (ISC Applied Systems, Canada)

Marc Gagnon (ISC Applied Systems, Canada)

Applying Standard Independent Verification and Validation (IV&V) Techniques within an Agile Framework: Is there a Compatibility Issue?.....452

James B. Dabney (University of Houston, USA)

James D. Arthur (Virginia Polytechnic Institute and State University, USA)

13:00 – 14:30

3C1: Cyber Security Issues

Room: Salon Viger C

Session Chair: *Logan Mailloux (Air Force Institute of Technology & United States Air Force, USA)*

Conceptual Design Acceleration for Cyber-Physical Systems457

Kevin Lynch (Raytheon Corporation, USA)

Randall Ramsey (Raytheon Corporation, USA)

George Ball (Raytheon, Inc., USA)

Matthew Schmit (Georgia Institute of Technology & Aerospace Systems Design Laboratory, USA)

Kyle Collins (Georgia Institute of Technology & Aerospace Systems Design Laboratory, USA)

Game Theoretic Analysis for Resource Allocation in Dynamic Multi-hop Networks with Arbitration463

Laurent Njilla (Air Force Research Laboratory, USA)
Harold Ouate (University of Douala, Cameroon)
Niki Pissinou (Florida International University, USA)
Kia Makki (Technological University of America (TUA), USA)

System-Level Considerations for Modeling Space-Based Quantum Key Distribution Architectures471

Logan O. Mailloux (Air Force Institute of Technology, USA)
Benjamin N. Sargeant (Air Force Institute of Technology, USA)
Douglas D. Hodson (Air Force Institute of Technology, USA)
Michael R. Grimaila (Air Force Institute of Technology, USA)

13:00 – 14:30

3C2: Decision Making Systems III

Room: Salon Viger B

Session Chair: *Saeid Nahavandi (Deakin University, Australia)*

A New Decomposition-based Evolutionary Framework for Many-objective Optimization.....477

Burhan Khan (Deakin University, Australia)
Samer Hanoun (Deakin University, Australia)
Michael Johnstone (Deakin University, Australia)
Chee Peng Lim (Deakin University, Australia)
Doug Creighton (Deakin University, Australia)
Saeid Nahavandi (Deakin University, Australia)

Systems Engineering Decision-making: Optimizing and/or Satisficing?.....484

Alex Gorod (The University of Adelaide, Australia)
Tiep Nguyen (The University of Adelaide, Australia)
Leonie Hallo (The University of Adelaide, Australia)

13:00 – 14:30

3C3: Sensors Integration and Applications III

Room: Salon Terasse

Session Chair: *Gholamhossein Ekbatanifard (Lahijan Branch, Islamic Azad University, Iran)*

An Energy Aware Dynamic Cluster Head Selection Mechanism for Wireless Sensor Networks490

Maryam Kalantari (Islamic Azad University, Iran)
Gholamhossein Ekbatanifard (Islamic Azad University, Iran)

Efficient Harvester with Active Load Modulation and Wide Dynamic Input Power Range for Wireless Power Transfer Applications498

A.M. Almohaimeed (University of Ottawa, Canada)
M.C.E. Yagoub (University of Ottawa, Canada)
R.E. Amaya (Carleton University, Canada)

Requirements engineering of a micro-UAV defense system502

Markus Diehl (Technical University Munich, Germany)
Mirko Hornung (Technical University of Munich, Germany)

13:00 – 14:30

3C5: Gaming, Entertainment and Sensor Systems

Room: Salle de Bal Foyer

Session Chair: Gaetan J. D. R. Hains (Huawei Technologies Co. Ltd., France)

Game Private Networks Performance: From Geolocation to Latency to User Experience 510

Gaétan Hains (Huawei Technologies Co. Ltd., France))

Youry Khmelevsky (Okanagan College, Canada)

Rob Bartlett (W. T. Fast Inc., France)

Alex Needham (W. T. Fast Inc., Canada)

Tyler Sutherland (WTFast, Canada)

Gaming Network Delays Investigation and Collection of Very Large-Scale Data Sets 516

Ben Ward (Okanagan College, Canada)

Youry Khmelevsky (Okanagan College, Canada)

Gaétan Hains (Huawei Technologies Co. Ltd., France)

Rob Bartlett (W. T. Fast Inc., France)

Alex Needham (W. T. Fast Inc., Canada)

Tyler Sutherland (WTFast Inc., Canada)

13:00 – 14:30

3C6: INCOSE

Room: Salon Viger A

Session Chair: James J Mulcahy (Florida Atlantic University & MEDNAX, USA)

Reengineering Autonomic Components in Legacy Software Systems: A Case Study 523

James J. Mulcahy (Florida Atlantic University & MEDNAX, USA)

Shihong Huang (Florida Atlantic University, USA)

Bridging the Gap Across Program Management, Systems Engineering, And Plant Modeling 530

RaymondK. Jonkers (Merlantec Management and Engineering, Canada)

15:00 – 16:30

3D1: Autonomous Systems II

Room: Salon Viger C

Session Chair: Saeid Nahavandi (Deakin University, Australia)

Towards Trusted Autonomous Vehicles from Vulnerable Road Users Perspective 537

Khaled Saleh (Institute for Intelligent Systems Research and Innovation (IISRI))

Mohammed Hossny (Institute for Intelligent Systems Research and Innovation (IISRI), Australia)

Saeid Nahavandi (Institute for Intelligent Systems Research and Innovation (IISRI), Australia)

Analyzing Hazards in System-of-Systems: Described in a Quarry Site Automation Context 544

Stephan Baumgart (Volvo Construction Equipment, Sweden)

Joakim Fröberg (SICS & Swedish Institute of Computer Science, Sweden)

Sasikumar Punnekkat (Mälardalen University, Sweden)

An Energy-Based Flight Planning System for Unmanned Traffic Management 552

Zhilong Liu (University of California, Berkeley, USA)

Raja Sengupta (University of California, Berkeley)

15:00 – 16:30

3D2: Systems Verification and Validation

Room: Salon Viger B

Session Chair: Sofiene Tahar (Concordia University, Canada)

Formalization of Birth-Death and IID Processes in Higher-order Logic 559

Liya Liu (Concordia University, Canada)

Osman Hasan (Concordia University)

Sofiene Tahar (Concordia University, Canada)

Systems Integration and Verification in an Advanced Smart Factory 566

George Ball (Raytheon Co., USA)

Christopher Runge (Raytheon Co., USA)

Randy Ramsey (Raytheon Co., USA)

Nicholas Barrett (Raytheon Co., USA)

Improving Adaptive Network Fuzzy Inference System with Levenberg-Marquardt Algorithm 571

Ana Farhat (Oakland University, USA)

Ka C Cheok (Oakland University, USA)

15:00 – 16:30

3D3: Modeling and Simulation II

Room: Salon Terrasse

Session Chair: John Salmon (Brigham Young University)

An Agent-Based Decision Tool to Explore Urban Climate & Smart City Possibilities 577

Nasrin Khansari (University of Pennsylvania, USA)

Barry G. Silverman (University of Pennsylvania, USA)

Qing Du (University of Pennsylvania, USA)

John B. Waldt (University of Pennsylvania, USA)

William W. Braham (University of Pennsylvania, USA)

Jae Min Lee (University of Pennsylvania, USA)

Optimization of a Modular Drone Delivery System 583

Jaihyun Lee (University of Michigan, USA)

15:00 – 16:30

3D4: Energy Management and Sustainability II

Room: Salon Neufchatel

Session Chair: Leila Ismail (UAE University, United Arab Emirates)

Towards an Energy-Aware Task Scheduling (EATS) Framework for Divisible-Load Applications in Cloud Computing Infrastructure 591

Leila Ismail (United Arab Emirates University, United Arab Emirates (UAE))

Abbas A. Fardoun (United Arab Emirates University, United Arab Emirates (UAE))

Energy Management System for Automated Driving 597

Kirill Gorelik (Robert Bosch GmbH, Germany)

Ahmet Kilic (Robert Bosch GmbH, Germany)

Roman Obermaisser (University of Siegen, Germany)

An Agent Based Model for the Evidence-Based Long Term Planning of Power and Water Critical Infrastructure.....	605
<i>James R. Thompson (The MITRE Corporation, USA)</i>	
<i>Damon Frezza (The MITRE Corporation, USA)</i>	
<i>Burhan Necioglu (MITRE Corporation, USA)</i>	
<i>Michael Cohen (The MITRE Corporation, USA)</i>	
<i>Kenneth Hoffman (The MITRE Corporation, USA)</i>	
<i>Kristine Rosfjord (The MITRE Corporation, USA)</i>	
15:00 – 16:30	
3D5: Model-Based Systems Engineering III	
Room: Salle de Bal Foyer	
Session Chair: <i>Robert Hilbrich (German Aerospace Center (DLR), Germany)</i>	
Free and Open Source Fault Tree Analysis Tools Survey	612
<i>Anis Baklouti (Supméca & ENISo, France)</i>	
<i>Nga Nguyen (EISTI, France)</i>	
<i>Jean-Yves Choley (SUPMECA, France)</i>	
<i>Faïda Mhenni (SUPMECA, France)</i>	
<i>Abdelfattah Mlika (ENISo, Tunisia)</i>	
Experiences Gained From Modeling and Solving Large Mapping Problems During System Design.....	620
<i>Robert Hilbrich (German Aerospace Center (DLR), Germany)</i>	
<i>Michael Behrisch (DLR, Germany)</i>	
Experimentable Digital Twins for Model-Based Systems Engineering and Simulation-Based Deveopment	628
<i>Michael Schluse (Technical University of Aachen, Germany)</i>	
<i>Linus Atorf (Institute for Man-Machine Interaction, RWTH Aachen University, Germany)</i>	
<i>Juergen Rossmann (Technical University of Aachen, Germany)</i>	
15:00 – 16:30	
3D6: THEFOSE	
Room: Salon Viger A	
Session Chair: <i>William Edmonson (North Carolina A&T State University, USA); Claus Nielsen (Cranfield University, United Kingdom)</i>	
Fuzzy Classification Context for the Responsive and Formal Design Process.....	636
<i>Solomon Gebreyohannes (NC A&T State University, USA)</i>	
<i>William Edmonson (NC A&T State University, USA)</i>	
<i>Albert Esterline (NC A&T State University, USA)</i>	
<i>Abdollah Homaifar (NC A&T State University, USA)</i>	
<i>Nadew Kibret (NC A&T State University, USA)</i>	
Applying the VDM Formalism Across Systems Engineering Lifecycles	644
<i>Claus Ballegaard Nielsen (Cranfield University, United Kingdom)</i>	
Systems Theory and a Drive Towards Model-based Safety Analysis.....	651
<i>Cody H. Fleming (University of Virginia, USA)</i>	

Thursday, April 27

08:00 – 09:30

4A1: Autonomous Systems II

Room: Salon Viger C

Session Chair: *Peter Travis Jardine (Royal Military College of Canada, Canada)*

Design of Model Predictive Control via Learning Automata for a Single UAV Load Transportation.....656

Kleber Cabral (Instituto Tecnológico de Aeronáutica, Brazil)

Sergio R. Barros dos Santos (Instituto Tecnológico de Aeronáutica, Brazil)

Sidney N. Givigi (Royal Military College of Canada, Canada)

Cairo L. Nascimento, Jr. (Instituto Tecnológico de Aeronáutica, Brazil)

Experimental Results for Autonomous Model-Predictive Trajectory Planning Tuned with Machine Learning.....663

Peter T. Jardine (Royal Military College of Canada, Canada)

Sidney N. Givigi (Royal Military College of Canada, Canada)

Shahram Yousefi (Queen's University, Canada)

08:00 – 09:30

4A2: Complex Systems Issues I

Room: Salon Viger B

Session Chair: *Jawad Ahmad (Glasgow Caledonian University, United Kingdom)*

A Systematic Approach to Model and Simulate Controlling Industrial Processes with Uncertainties670

Ashraf A. Zaher (American University of Kuwait, Kuwait)

Mounib Khanafer (American University of Kuwait, Kuwait)

Energy Demand Prediction Through Novel Random Neural Network Predictor for Large Non-Domestic Buildings.....676

Jawad Ahmad (Glasgow Caledonian University, United Kingdom)

Hadi Larjani (Glasgow Caledonian University, United Kingdom)

Rohinton Emmanuel (Glasgow Caledonian University, United Kingdom)

Mike Mannion (Glasgow Caledonian University, United Kingdom)

Abbas Javed (Glasgow Caledonian University, United Kingdom)

Mark Phillipson (Glasgow Caledonian University, United Kingdom)

08:00 – 09:30

4A3: Energy Systems-of-Systems I

Room: Salle de Bal Foyer

Session Chair: *Kewei Yang (National University of Defense Technology, China)*

A Requirement-Driven Description Methodology for Technology System of SystemsN/A

Hanlin You (National University of National Defense, China)

Mengjun Li (National University of Defense Technology, China)

Jiang Jiang (National University of Defense Technology, China)

Bingfeng Ge (National University of Defense Technology, China)

Kewei Yang (National University of Defense Technology, China)

Ming Qiao (National University of Defense Technology, P.R. China)

Modeling and Analysis of Health-Information System of Systems for Managing Transitional Complexity Using Engineering Systems Multiple-Domain Matrix 688

Suguru Okami (Keio University, Japan)
Naohiko Kohtake (Keio University, Japan)

Systems of Systems Engineering for Particle Accelerator based Research Facilities..... 696

Thilo Friedrich (European Spallation Source ERIC & Royal Institute of Technology, Stockholm (KTH), Sweden)
Christian Hilbes (ZHAW School of Engineering, Switzerland)
Annika Nordt (European Spallation Source ERIC, Sweden)

08:00 – 09:30

4A4: THEFOSE

Room: Salon Viger A

Session Chair: *Rick Dove (Stevens Institute of Technology, USA); William Edmonson (North Carolina A&T State University, USA)*

Case Study: Agile Hardware/Firmware/Software Product Line Engineering at Rockwell Collins 704

Rick Dove (Paradigm Shift International, USA)
William Schindel (ICTT System Sciences, USA)
Robert (Will) Hartney, III (Rockwell Collins, USA)

A Language Proposition for System Requirements 712

Benoit Lebeaupin (Universite Paris-Saclay, France)
Antoine Rauzy (NTNU, Norway)
Jean-Marc Roussel (ENS, France)

10:00 – 11:30

4B1: Large – Scale Systems Intergration

Room: Salon Viger C

Session Chair: *Eric Guetre (TRIUMF, Canada)*

System engineering for the ARIEL-II project 720

Eric Guetre (TRIUMF, Canada)

Ontology Mediation to Rule them All: Managing the plurality in Product Service Systems 725

Uri Shani (IBM, Israel)
Marco Franke (BIBA - Bremer Institut für Produktion und Logistik GmbH, Germany)
Karl A. Hribernik (BIBA - Bremer Institut für Produktion und Logistik GmbH, Germany)
Klaus-Dieter Thoben (BIBA - Bremer Institut für Produktion und Logistik GmbH, Germany)

Nesting in the Evaluation of System Readiness for Complex Systems of Emerging Technologies..... 732

Michael Knaggs (US DoE, USA)
Dennis Harkreader (KeyLogic Systems, Inc., USA)
Alfred Unione (KeyLogic Systems, Inc., USA)
John Oelfke (KeyLogic Systems, Inc., USA)
John Ramsey (KeyLogic Systems, Inc., USA)
Dale Kearns (Deloitte, Inc., USA)
Brian Sauser (University of North Texas, USA)
Brad Atwater (Lockheed Martin Rotary & Mission Systems, USA)

10:00 – 11:30

4B2: Complex Systems Issues II

Room: Salon Viger B

Session Chair: *Huy T Tran (University of Illinois at Urbana-Champaign, USA)*

A Hierarchical Framework for Complex Networks Robustness Analysis to Errors 737

Michel Bessani (University of São Paulo, Brazil)
Júlio A. D. Massignan (University of São Paulo, Brazil)
João B. A. London Jr. (University of São Paulo, Brazil)
Carlos D. Maciel (USP, Brazil)
Rodrigo Zempulski Fanucchi (Copel Distribution S/A, Brazil)
Marcos H. M. Camillo (Copel Distribution S/A, Brazil)

Designing Resilient System-of-Systems Networks 745

Huy T. Tran (Georgia Institute of Technology)
Jean Charles Domercant (Georgia Tech Research Institute & Electronic Systems Laboratory, USA)
Dimitri N. Mavris (Georgia Institute of Technology, USA)

Autonomous System Ranking by Topological Characteristics: A Comparative Study 751

Mehmet Engin Tozal (University of Louisiana, Lafayette, USA)

10:00 – 11:30

4B3: Engineering Systems-of Systems II

Room: Salle de Bal Foyer

Session Chair: *Allison Doren (MITRE Corporation, USA)*

On the Resilience of Systems of Systems N/A

Matthew P. Summers (Cranfield University, UK)
Stephen G. Barker (Cranfield University, UK)

SysML Executable Systems of System Architecture Definition: A Working Example 766

Judith Dahmann (MITRE Corporation, USA)
Aleksandra Markina-Khusid (MITRE Corporation, USA)
Allison Doren (MITRE Corporation, USA)
Thomas Wheeler (MITRE Corporation, USA)
Matthew Cotter (MITRE Corporation, USA)
Mike Kelley (MITRE Corporation, USA)

On Defense Strategies for System of Systems Using Aggregated Correlations 772

Nageswara S. V. Rao (Oak Ridge National Laboratory, USA)
Neena Imam (Oak Ridge National Laboratory, USA)
Chris Y. T. Ma (Hang Seng Management College, Hong Kong)
Kjell Hausken (University of Stavanger, Norway)
Fei He (Texas A&M University-Kingsville, USA)
Jun Zhuang (State University of New York at Buffalo, USA)

10:00 – 11:30

4B4: INCOSE

Room: Salon Viger A

Session Chair: *Thomas A. McDermott, Jr (Georgia Tech Research Institute, USA)*

Application of Model-Based Systems Engineering Methods and Tools to Improve Emergency Care Delivery N/A

Mohamed Elshal (Indiana University Purdue University Indianapolis, USA)

Hazim El-Mounayri (Indiana University Purdue University Indianapolis, USA)

Rapeepan Promyoo (Indiana University Purdue University Indianapolis, USA)

Ajay Thukral (Indiana University Purdue University Indianapolis, USA)

Vijay Thukral (Indiana University Purdue University Indianapolis, USA) Alice Mitchell (Indiana University School of Medicine, USA)

ATRIUM - Architecting Under Uncertainty: For ISO 26262 compliance.....786

Naveen Mohan (KTH Royal Institute of Technology, Sweden)

Per Roos (Scania CV AB, Sweden)

Johan Svahn (Scania CV AB, Sweden)

Martin Torngren (KTH Royal Institute of Technology, Sweden)

Sagar Behere (KTH Royal Institute of Technology, Sweden)

INCOSE Academic Research Forum - Future Systems Engineering Research Directions 794

Jon Wade (Stevens Institute of Technology, USA)

Rick Adcock (Cranfield University, UK)

Tom McDermott (Georgia Institute of Technology, USA)

Larry Strawser (Johns Hopkins University, USA)

AUTHOR INDEX 800