



IEEE CONFERENCE ON SYSTEM OF SYSTEMS ENGINEERING

From Systems Engineering to Systems of Systems Engineering Panel Session

Holiday Inn Riverwalk

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1540-1640

San Antonio, Texas, USA

Systems of Systems Engineering (SoSE) is emerging as an engineering discipline to address complex systems. SoSE is evolving from traditional systems engineering whereby traditional systems engineering deals with well defined and bounded systems. This panel will discuss the emerging state of SoSE and whether it is just traditional systems engineering, a hybrid of traditional systems engineering, or an entirely new engineering discipline.

The session will have 60 minutes. During the first 30 minutes 6 panelists will provide a brief introduction to specific issues in SoSE. The remaining 30 minutes will be dedicated to discussion of SoSE. Agenda for the discussion hour is given at the bottom of this notice.

Panelist # 1 - Michael J. DiMario, Lockheed Martin Corporation and Stevens Institute of Technology

Title: Introduction - From Systems Engineering to System of Systems Engineering



Michael DiMario is a Lockheed Martin senior program manager in Moorestown, New Jersey managing C4ISR and advanced technology programs. Prior to joining the program management organization, he served as Director of Systems and Software Quality. Prior to joining Lockheed Martin in 2001, he spent 19 years with AT&T and Lucent Bell Laboratories in managerial and director leadership roles for software development and systems engineering of switching and broadband telecommunication systems, software test and verification, and total quality management. During his tenure at Lucent Bell Labs, Michael led numerous ISO 9001 and SEI certifications, and Malcolm Baldrige applications, as well as the creation of the Total Quality Management, and systems engineering business models and corporate infrastructures. He was instrumental in the creation of five telecommunications software engineering Lucent Best Current Practices, TL9000 telecommunications standard, managed the scaling of systems engineering and software development processes for new acquisitions, and led major telecommunication outage causal teams. He is the author of numerous papers and articles on software quality and systems engineering. He is an avid amateur astronomer and works closely with University of Chicago and University of Wisconsin where he conducts research on near earth asteroids and archival astronomical data whereby a predisccovery of Pluto to 1905 is under investigation.

He holds a BS degree in Natural Science and a MS degree in computer science from the University of Wisconsin, an MBA in the management of technology from the Illinois Institute of Technology in Chicago, and is a PhD candidate in systems engineering at Stevens Institute of Technology in Hoboken, NJ. His research concerns system of systems and complex systems engineering. He is an active member in IEEE and INCOSE.

Panelist # 2 - Dr. Dan DeLaurentis, Purdue University

Title: Distinctive Challenges for Modeling and Analysis in SoSE



Dan DeLaurentis is an Assistant Professor in the School of Aeronautics and Astronautics at Purdue University in West Lafayette, Indiana. He joined the faculty in 2004 under Purdue's College of Engineering Signature Area in System-of-Systems - with specific applications of interest in the aerospace sector.

Dr. DeLaurentis' recent research has been focused upon the development of an intellectual foundation for addressing problems characterized as system-of-systems. Pursuit of this focus includes establishment of an effective frame of reference, crafting of a common lexicon, and understanding of distinguishing behaviors and dynamics. Since he approaches these problems from a *design perspective*, the foundation is

used to develop methods and tools for modeling and analysis which include especially probabilistic robust design (including uncertainty modeling/management), agent-based modeling, object oriented simulations, network topology analysis, and numerical and visual tools for capturing the interaction of system requirements, concepts, and technologies. The context for the research has been the exploration of future aerospace architectures, especially including the presence of innovative vehicles, new business models, and alternate policy constructs.

In the past two years, his research has been sponsored under grants from the NASA Langley Research Center (concerning the development of future National Transportation Architectures via a System-of-Systems approach). He was also co-organizer for a Workshop held in May, 2006 entitled "*Methods for Designing, Planning, and Operating System-of-Systems*", sponsored by the Air Force Office of Scientific Research (AFOSR).

Panelist # 3 – Dr. Stuart Rubin, Space and Naval Warfare Systems Center

Title: SOSE and the Science of Information



Stuart H. Rubin is a senior scientist at the Space and Naval Warfare Systems Center (SSC) in San Diego, code 2734. He was previously a tenured associate professor of computer science at Central Michigan University (CMU). He has since given the keynote speech at several international conferences, founded and currently serves as general chair of the IEEE Information Reuse and Integration (IRI) conference (<http://www.sis.pitt.edu/~iri06/>), the IEEE North American Fuzzy Information Processing Society (NAFIPS) conference (<http://129.128.208.114/nafigs07/comm.htm>), mentored

several post-docs, and supervised numerous MS Theses and independent studies. His current interests include computational creativity, data fusion, and knowledge-discovery systems. Dr. Rubin was previously an ONT post-doctoral fellow at the Naval Command, Control, and Ocean Surveillance Center (NCCOSC). He received a BS from the University of Rhode Island, Magna Cum Laude in business in 1975, an MSISE in systems engineering from Ohio University in 1977, and an MS in computer science from Rutgers University in 1980. He received his Ph.D. from Lehigh University in Bethlehem, PA in 1988. Dr. Rubin's Ph.D. thesis was entitled, "On the transformative compression of coherent languages." His dissertation was selected for novel AI content by SIGART in January, 1989. Dr. Rubin received SSC-SD's Publication of the Year Award in 2007.

Dr. Rubin was an electronic engineer with the US Army Research Labs, Ft. Monmouth, NJ from 1980-83. He worked on projects involving the application of AI technology to the Very High-Speed Integrated Circuits (VHSIC) program for which he was awarded the US Government Certificate of Merit in 1987. He also received the Navy Award of Merit for Group Achievement in 2002.

Dr. Rubin chairs the IEEE SMC Committee on knowledge acquisition in intelligent systems. He also serves as an Associate Editor for the *IEEE SMC Transactions, Part C: Applications and Reviews* and is on the editorial board of the electronic *IEEE SMC Transactions, Part B: Cybernetics* as well as the *International Journal of Modeling and Simulation*, the *International*

Journal of Industrial Engineering (IJIE), and the *Journal of Systemics, Cybernetics, and Informatics*. In 2003, he was awarded the IEEE Systems, Man, and Cybernetics Society's (SMC) Outstanding Service Award and in 2006 the IEEE Most Active System, Man, and Cybernetics Technical Committee Award.

Dr. Rubin holds 3 professional U.S. patents and is the author or co-author of 166 refereed papers plus 2 pending. Moreover, he authored a 511-page textbook (i.e., with multimedia CD) on computers and society, published by Wiley in September 1997. His publications detail new results in computational creativity (e.g., SoS), computing with words, knowledge representation and mining, decision support, neural networks, and knowledge-discovery systems with applications in summarization, tracking, and fusion.

Dr. Rubin is a senior member of the IEEE, a member of the Armed Forces Communications and Electronics Association (AFCEA), the American Association for the Advancement of Science (AAAS), the New York Academy of Sciences (NYAS), and several other scientific societies. He is listed in Fuzzy Logic in the Internet (FLINT) Who's Who 2006-, the 2d-9th editions of Who's Who in Science and Engineering (1994-2007), and several others. He was elected to the IEEE SMC AdCom Committee for a three-year term, which expired in 2004, then to the IEEE Board of Governors (BoG) for a three-year term, expiring in 2007, and subsequently to the NAFIPS Board in 2006. He presently serves as the IEEE SMC industrial as well as AAAI liaison.

Panelist # 4 - Dr. Andrew Sage, George Mason University

Title: Systems Engineering Extensions for Systems of Systems Engineering



Andrew P. Sage received the BSEE degree from the Citadel, the SMEE degree from MIT and the Ph.D. from Purdue, the latter in 1960. He received honorary Doctor of Engineering degrees from the University of Waterloo in 1987 and from Dalhousie University in 1997. He has been a faculty member at several universities including holding a named professorship and being the first chair of the Systems Engineering Department at the University of Virginia. In 1984 he became First American Bank Professor of Information Technology and Engineering at George Mason University and the first Dean of the School of Information Technology and Engineering. In May 1996, he was elected as Founding Dean Emeritus of the School and also was appointed a University Professor. He is an elected Fellow of the Institute of Electrical and Electronics Engineers, the American Association for the Advancement of Science, and the International Council on Systems Engineering. He is editor of the John Wiley textbook series on Systems Engineering and Management, the INCOSE Wiley journal Systems Engineering and is coeditor of Information, Knowledge, and Systems Management. He edited the IEEE Transactions on Systems, Man, and Cybernetics from January 1972 through December 1998, and also served a two-year period as President of the IEEE SMC Society. In 2000, he received the Simon Ramo Medal from the IEEE in recognition of his contributions to systems engineering and an IEEE Third Millennium Medal. In 2002, he received an Eta Kappa Nu Eminent Membership Award and the INCOSE Pioneer Award. He was elected to the National Academy of Engineering in 2004 for contributions to the theory and practice of systems engineering and systems management. His interests include systems engineering and management efforts in a variety of

application areas including systems integration and architecting, reengineering, engineering economic systems, and sustainable development.

Panelist # 5 – Dr. Brian Sauser, Stevens Institute of Technology

Title: Systems of Systems – A New Beginning and a New End



“We shall not cease from exploration and the end of all our exploring will be to arrive where we started and know the place for the first time.”T.S. Eliot

Brian Sauser is an Assistant Professor in the School of Systems and Enterprises at Stevens Institute of Technology. Before joining Stevens in 2005, he spent more than 12 years working in government, industry, and academia both a researcher/engineer and director of programs. He holds a B.S. from Texas A&M University in Agricultural Development with an emphasis in Horticulture Technology, a M.S. from Rutgers University in Bioresource Engineering, and a Ph.D. from Stevens Institute of

Technology in Technology Management.

He has managed an applied research and development laboratory in life sciences and engineering at NASA Johnson Space Center, was Program Director of the New Jersey – NASA Specialized Center of Research and Training, where he managed a multi-institutional, multi-disciplinary science and engineering research center working to generate new knowledge and technology for life support systems, and was a Project Specialist with ASRC Aerospace responsible for managing technology utilization and assessment, and commercial partnership development at NASA Kennedy Space Center. In his current position at Stevens in the School of Systems and Enterprises he is the Director of Research Administration and the Director of Systems Engineering Management.

His research interests are in theories, tools, and methods for bridging the gap between systems engineering and project management for complex systems and system maturity assessment. He has recently published articles entitled: “An Application of Prim’s Algorithm in Defining a SoS Operational Boundary;” “From Prescience to Emergence: Taking Hold of System of Systems Management;” and “System of Systems – The Meaning of Of.” He was also part of the Stevens lead team to develop the System of Systems Engineering Guide for the Office of the Secretary of Defense.

Panelist # 6 - Dr. Bernard Zeigler, University of Arizona

Title: Composability and Interoperability in Systems of Systems - A Modeling and Simulation Perspective



Bernard P. Zeigler is Professor of Electrical and Computer Engineering at the University of Arizona, Tucson and co-Director of the [Arizona Center for Integrative Modeling and Simulation](#). He is internationally known for his 1976 foundational text [Theory of Modeling and Simulation](#), recently revised for a [second edition](#) (Academic Press, 2000). He has published numerous [books](#) and [research publications](#) on the Discrete Event System Specification (DEVS) formalism. He is a Fellow of the IEEE and of the Society for Computer Simulation and received the [McLeod Founder's Award](#) by the Society for Computer Simulation, its highest recognition, for his contributions to discrete event simulation. In June 2002, he was elected [President](#) of the Society (recently, renamed [The Society for Modeling and Simulation, International](#).) Zeigler served on two National Research Council committees to recommend directions for information technology and [simulation modeling in the 21st Century](#) and a third NRC committee that developed a book of recommendations on simulation enhancements to [systems acquisition and manufacturing](#). He has given numerous keynote talks, tutorials and short courses, and organized symposia and conferences that were the first to promote modeling and simulation fundamentals and theory. Zeigler is currently heading a project for the Joint Interoperability Test Command ([JITC](#)) where he is leading the design of the future architecture for large distributed simulation events for the Joint Distributed Engineering Plant ([JDEP](#)). He is also developing [DEVS-methodology approaches](#) for testing mission thread end-to-end interoperability and combat effectiveness of Defense Department acquisitions and transitions to the Global Information Grid with its Service Oriented Architecture (GIG/SOA). He received the JITC Golden Eagle Award for research and development of the Automated Test Case Generator, 2005 and the Award for Best [M&S Development in the Cross-functional Area](#), 2004/2005, by the National Training Simulation Association, May 2, 2006. He is preparing a [book](#) on the methodology of M&S-based dynamic data engineering to be published by Academic Press (2007).

AGENDA - Discussion Hour (1540-1640)

- Introduction - From Systems Engineering to System of Systems Engineering
- Distinctive Challenges for Modeling and Analysis in SoSE
- SOSE and the Science of Information
- Systems Engineering Extensions for Systems of Systems Engineering
- Systems of Systems - A New Beginning and a New End
- Composability and Interoperability in Systems of Systems - A Modeling and Simulation Perspective
- Discussion and Debate