Executive Overview

Dr. Dinesh Verma
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SERC Network of Over 20 Collaborators

SERC leverages expertise of over 450 researchers across the United States

University or Research Organization

1. Stevens Institute of Technology
2. University of Southern California
3. Air Force Institute of Technology
4. Auburn University
5. Carnegie Mellon University
6. Georgetown University
7. Georgia Institute of Technology
8. Massachusetts Institute of Technology
9. Missouri University of Science and Technology
10. Naval Postgraduate School
11. North Carolina Agricultural & Technical State University
12. Pennsylvania State University
13. Purdue University
14. Southern Methodist University
15. Texas A&M University
16. Texas Tech University
17. University of Alabama in Huntsville
18. University of California - San Diego
19. University of Maryland
20. University of Massachusetts Amherst
21. University of Virginia
22. Wayne State University
SERC Research Thematic Areas

Enterprises and SoS
- Enterprise Analysis
- System of Systems Modeling and Analysis

Trusted Systems
- Systemic Security
- Systemic Assurance

Human Capital Development
- Evolving Body of Knowledge
- Experience Acceleration
- SE and Technical Leadership Education

SE & Systems Mgmt Transformation
- Affordability and Value in Systems
- Quantitative Risk
- Interactive Model-Centric Systems Engineering
- Agile Systems Engineering
Research Council Members

• Enterprise Systems and Systems of Systems
  — Dan DeLaurentis, Purdue
  — Jo Ann Lane, USC
  — Bill Rouse, Stevens (NAE)

• Human Capital Development
  — Tom McDermott, GA Tech
  — Jon Wade, Stevens

• Trusted Systems
  — Barry Horowitz, UVA (NAE)
  — Bill Scherlis, CMU
  — Kevin Sullivan, UVA

• Systems Engineering and Systems Management Transformation
  — Mark Blackburn, Stevens
  — Barry Boehm, USC (NAE)
  — Paul Collopy, UAH
Key Transition Activities

- **SoS Analytic Workbench** – APL for DoD; MITRE for multiple
  - Purdue University

- **Modeling Framework for SoS and Enterprise Systems** – MITRE for the Veterans Administration, and others
  - Stevens Institute of Technology

- **TRLs to SRLs** – DoD
  - Stevens Institute of Technology

- **Multiple HCD Projects with significant impact within the DoD to the DAU and the Systems Community in general**
  - Georgia Tech; USC; Purdue University; Stevens Institute of Technology, NPS

- **System Aware Security** – ARDEC, potentially others
  - University of Virginia
Transition of the SERC Analytic Workbench Technology into Government Service by JHUAPL

14 November 2016

The Johns Hopkins University Applied Physics Laboratory (JHUAPL) is a University-Affiliated Research Center (UARC) and a non-profit organization with a long tradition of serving the US Government as a trusted agent. This role has enabled JHUAPL to develop extensive knowledge and relationships in multiple operational and security domains. JHUAPL is working with a government sponsor in one such domain to identify technology transition opportunities from research projects being conducted by the Systems Engineering Research Center (SERC). The SERC is also a UARC, consisting of a network of academic researchers across many US universities who primarily perform unclassified fundamental research on systems engineering methods, processes, and tools (MPTs). As mature SERC technology and appropriate government programs are identified, JHUAPL will work as a trusted technology transfer agent of the government, incorporating the technology and ensuring its benefits are realized in areas where the SERC has limited access to government programs and information.

Figure 1 represents an overview of the process by which JHUAPL will transfer technologies being developed by the SERC into use by government programs. Beginning on the left side of the figure, the process starts with the SERC producing MPTs across a spectrum of research interests. JHUAPL performs initial assessments of these MPTs to identify potential candidates, favoring more mature tools in a Technology Readiness Level (TRL) 4-5 range, as guided by government sponsorship. The process of identifying technology transfer candidate tools includes the identification of an APL technology transfer champion, a government project champion, a receptive government project, and a governance model to ensure attention to such things as intellectual property rights and security issues.
Research Workshops in 2016
May 26, 2016
WASHINGTON, DC

Creating a New Culture and Ecosystem for Coordination and Collaboration with Model-Centric Design and Acquisition

INTRODUCTION, BACKGROUND, AND CONTEXT:

Model-centric engineering can be characterized as an overarching digital and visual approach to engineering. It involves integrating different model types with simulations, surrogates, systems, and components at different levels of abstraction and fidelity across disciplines throughout the system or solution lifecycle. The use of such digital engineering technologies and model-centric engineering practices are advancing, and adoption is accelerating. While this is happening, a number of technical and business/acquisition model challenges remain. The current business models may not be appropriately aligned for acquisition in such a model-centric ecosystem. As a community must discuss approaches to allow better collaboration, while nurturing competition with appropriate approaches to address Intellectual Property Protection, Government Data Rights, and a Collaborative Environment.

These digital technologies are changing how organizations are conceptualizing, architecting, designing, developing, producing, and sustaining. Some use model-centric environments for customer engagements, as well as design engineering analyses and review sessions. Some are integrating mission and system-level modeling and simulations originally created for design and development and expanding them into new cloud-like services enabled by the Industrial Internet. Most organizations today have a unique capability realized by integrating commercial technologies and tools with their own innovations.

We need insights from key stakeholders in the “user community” on how to transform our engineering and acquisition culture in light of these advancements, how to align engineering and business/acquisition models. We want to explore ideas and concepts to improve the efficiencies and speed development, deployment, and sustainment of needed capabilities to the warfighter.

The purpose of this workshop is for key stakeholders in industry, government, and academia to converge and identify high-value “air gaps” that remain as hurdles in model-centric engineering, and that can be addressed through focused research and policy.
# AGENDA - SERC INDUSTRY & GOVERNMENT FORUM ON MODEL CENTRIC ENGINEERING

**THURSDAY, MAY 26, 2016**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>8:00</td>
<td>Registration - Continental Breakfast</td>
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<tr>
<td>8:30</td>
<td>Welcome &amp; Announcements</td>
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<tr>
<td>9:00</td>
<td>Forum Shaping Remarks (Ms. Kristen Baldwin)</td>
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<td>9:45</td>
<td>The Need for a Transformation - A Government Perspective (Mr. Dave Cohen)</td>
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<tr>
<td>10:15</td>
<td>Break</td>
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<tr>
<td>10:30</td>
<td>The Need for a Transformation - An Industry Perspective (Dr. Nicholas G. Paraskevopoulos)</td>
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<td>11:15</td>
<td>Panel: How Government Can Work Differently</td>
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<td>12:00</td>
<td>Lunch</td>
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<tr>
<td>1:00</td>
<td><strong>Breakout Session 1:</strong> A Collaboration Operational Model between Industry and Government (Moderated by Dr. Donna Rhodes, MIT)</td>
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<td>1:00</td>
<td><strong>Breakout Session 2:</strong> Roadmap of Technologies to Support a New Operational Paradigm in Model Centric Engineering (Moderated by Dr. Jon Wade, Stevens)</td>
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<td>2:45</td>
<td>Break</td>
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<td>3:00</td>
<td>Current State of Research and Development in Support of Engineered Resilient Systems (ERS) (Dr. Jeff Holland, Chief Scientist, ERDC)</td>
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<td>3:45</td>
<td>Break</td>
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<td>4:00</td>
<td>Tools and Infrastructure in support of Model Centric Engineering - a Tool Vendor Perspective (Moderated by Mr. David Long, CEO, ViTech and Former President, INCOSE)</td>
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<td>5:00</td>
<td>Open Microphone and Additional Actions</td>
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<td>5:30</td>
<td>Social and Networking Session</td>
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September 26, 2016; Invitation only attendance, limited to 35

ABSTRACT

The looming integration of data-driven, artificially intelligent, semi-autonomous cyber-physical systems with people and social phenomena at scale presents new challenges and opportunities in systems engineering. The overall opportunity is to transform societal systems into cyber-social learning systems (CSLS): systems that integrate machine, human, and institutional perception, learning, reasoning, and acting to produce major improvements in socio-technical system function, performance, and fitness in complex, evolving, competitive, and hostile environments. Progress in CSLS science, engineering, and design will drive advances in all sectors, from defense to healthcare, education, and beyond. At the same time, CSLS present significant unresolved challenges in systems engineering. This workshop will focus on CSLS, in general, and on the need for advances to underpin the trustworthiness of mission- and safety-critical CSLS, in particular. Issues include but are not limited to allocation of responsibilities across human/social-machine boundaries; test and evaluation; accountable AI; system monitoring and control; systems safety for AI-infused cyber-social learning systems; and use of CSLS concepts, methods, and tools to improve the safety and trustworthiness of existing systems.
October 5, 2016; Invitation only attendance, limited to 35
Potential Research Workshop Topics - 2017

Model Based Testing
Security at Design Time
Program and Acquisition Risk
Future Areas of SERC Research - DRAFT
SERC Research Future Impact Areas

• SE and SE Management Transformation
  — Model Centric Engineering
  — Flexible and Adaptive Systems
  — Architecting and Verification of Cyber-Human Learning Systems
  — Team Effectiveness

• Trusted Systems
  Hard: Flexible Systems Architectures and Designs
  Wicked: Cyber Resilient Weapon Systems
  Scary: Autonomous Systems with varying levels of Cognition
  — Leveraging MOSA to enhance the innovation ecosystem supporting the DoD; Modeling the Defense Innovation System
  — Understand enterprises and SoS to improve uptake of digital engineering/MCE and awareness of individual system developments

• Human Capital Development
  — Competency Identification
    o Mission Engineering Competencies
    o Competencies to support evolution of CPS and Autonomous Systems and MCE/Digital Engineering
SERC Doctoral Fellows Program
Human Capital Development: SERC Doctoral Fellows Program

- Started in 2012 as an evolution of SERC’s unique research collaboration model

- Allows Ph.D. students at participating organizations to access our Collaborator Universities’ leading systems thinkers as research advisors

- A key component of the SERC’s human capital development mission in training the next-generation of our government and industry systems engineering thought leaders

- Current participants
  - First Commercial Organization: Boeing
  - First FFRDC: MITRE
  - First Warfare Center: ARDEC-Picatinny Arsenal
SERC Talks features researchers from our Systems Engineering community sharing their insights on various questions relevant to Systems Engineering and its evolution. This series, stemming from the technical presentations which took place periodically during our SERC Collaborator WebEx meetings, will continue to grow and touch on other subjects and aspires to create an ongoing and more collaborative dialogue between academia, government and industry sectors. As always, SERC strives to grow Systems Engineering research into areas which can transition into impact.

**What Lives at the Intersection of MOSA and Set-Based Design?**
Gary Witus, Wayne State
*October 5 | 1:00 pm ET*

**Why is Human-Model Interactivity Important to the Future of Model-Centric Systems Engineering?**
Donna Rhodes & Adam Ross, MIT
*December 7 | 1:00 pm ET*
UPCOMING TOPICS:

2017

What is the Self?
Grady Booch, IBM Research
February 1 | 1:00 pm ET

Can Graphical Models Provide a Sufficient Basis for General Intelligence?
Paul S. Rosenbloom,
University of Southern California
April 5 | 1:00 pm ET

What Are Cyber-Social Learning Systems And How Will We Form Them?
Kevin Sullivan, University of Virginia
June 7 | 1:00 pm ET
Thanks!