# 2018 Fall Simulation Innovation Workshop (SIW)

Simulation Interoperability Standards Organization

*"Simulation Interoperability & Reuse through Standards"*

Event supported by NTSA

September 10-14, 2018, Florida Hotel & Conference Center at the Florida Mall, Orlando, FL

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SISO Simulation Interoperability Standards Organization

*"Simulation Interoperability & Reuse through Standards"*

The Simulation Interoperability Standards Organization (SISO) serves the global community of modeling and simulation (M&S) professionals, providing an open forum for the collegial exchange of ideas, the examination and advancement of M&S-related practices and technologies, and the development and management of standards and other products that enable greater M&S capability, interoperability, credibility, reuse, and cost-effectiveness. As a recognized International Standards Development Organization, SISO, through its members, transforms ideas, proven practices, and innovative technologies into products that can be used and reused by M&S professionals.

SISO provides standards, guidance, and reference products on its website for downloading at no charge. Please visit www.sisostds.org/ for more information.

NTSA A Proud Affiliate of NDIA

The National Training and Simulation Association (NTSA) is America's premier organization representing the interests of the modeling and simulation community worldwide. As such, it serves as a constant point of contact for government, academia, industry, research organizations and the military to exchange information, share knowledge, align business interests and in general stimulate growth and overall advancement of the industry. NTSA pursues these goals through a series of conference, meetings and exhibitions throughout the year. NTSA produces The Interservice/Industry Training, Simulation and Education Conference (I/ITSEC), which is the world's largest conference and exhibition dedicated to modeling and simulation. While NTSA primarily serves the North American community of practice, many of its members and participants are non-US. NTSA is a key member of the International Training and Simulation Alliance (ITSA), a worldwide group of simulation associations who promotes knowledge and information about training and simulation worldwide.

# SCHEDULE AT A GLANCE

## MONDAY 9/10

**Tutorials**
0800-1000

**Tutorials**
1030-1200

**Plenary Session**
1330-1500

**Tutorials**
1530-1700

**SISO Social**
1700-1900

## TUESDAY 9/11

**Newcomers Orientation Breakfast**
0715-0800

**Paper Tracks**
0830-1000

**Paper Tracks**
1030-1200

**General Session**
1330-1500

**Paper Sessions**
1530-1700

**Enumerations Working Group**
1900-2100

## WEDNESDAY 9/12

**Working Sessions**
0730-1000

**Paper Tracks**
0830-1000

**Working Sessions**
1030-1200

**Working Sessions**
1330-1500

**Working Sessions**
1530-1700

## THURSDAY 9/13

**Working Sessions**
0730-1000

**Working Sessions**
1030-1200

**General Session**
1330-1500

**Working Sessions**
1530-1700

## FRIDAY 9/14

**DMSCO Special Session**
0900-1500

## REGISTRATION

The Registration Desk is located in the Mezzanine Area on the 2nd floor. All registrants must check in at the registration desk to receive an identification badge and conference materials. Name badges must be worn at all Workshop functions.

**The Registration Desk will be open:**

**Sunday**
1500-1700

**Monday to Thursday**
0700 - 1700

## BREAKS

Breaks are scheduled for **1000-1030** and **1500-1530** each day. Coffee/soda and snacks will be provided.

## LUNCH

Lunch break is scheduled for **1200 – 1330** each day. Attendees are “on their own” for lunch.

## SISO SOCIAL

The SISO Social will take place in Salon 1 at 1700 on Monday, September 10

## EXHIBITS – SALON 1

**Monday 9/10**
1500-1900

**Tuesday 9/11**
0800-1330 / 1500 – 1700

**Wednesday 9/12**
0800-1200

# EVENT INFORMATION

## LOCATION

The Florida Hotel & Conference Center
500 Sand Lake Rd
Orlando, FL 32819

## BUSINESS CENTER/ INTERNET ACCESS

Complimentary wireless internet is now available in the hotel lobby and all the meeting rooms.

The Business Center is located in the lobby on the first floor and is available and open on a 24-hour basis. You will need your room key to access the business center.

Photocopies - Black and White; Complimentary (limited)

Fax Machines - Domestic Fax; Complimentary

International Fax; $5.00 per page

Boarding pass printing is complimentary

## EVENT WEBSITE

www.sisostds.org

## ATTIRE

Business Casual

## EVENT CONTACT

**Patrick Rowe**
Director, Membership and Certification
(703) 247-471
prowe@ndia.org

## PAPER PRESENTATIONS

To view a paper presentation that was uploaded to our site before the conference:
www.sisostds.org/DigitalLibrary.aspx?EntryId=47428

## SISO MEMBERSHIP INFORMATION

SISO MEMBERS, Please keep your contact information current!

Please verify/update your SISO contact information at the below URL: sisostds.org and click on the Membership menu in the top right hand side bar and select: “Update Your Membership”. Don’t forget to select “SUBMIT” to save any changes that you make to your information!

If you have any questions, please email Erica Recktenwald at recktenwald@ist.ucf.edu.

You are automatically enrolled as a SISO Member by being a registered and paid attendee of this workshop. All new SISO members will receive a SISO membership number via email approximately two weeks following this workshop. Your membership number will allow you to download papers and documents from the SISO website, participate in SISO Elections, and participate in the development of SISO Products.

To find information on the many benefits of being a SISO Member, please visit our membership page on the SISO website: sisostds.org/Membership/BenefitsofMembership.aspx

If you should have any questions concerning your membership ID number, please contact Erica Recktenwald at 407-882-1378 or email recktenwald@ist.ucf.edu

## MESSAGE CENTER

A Message Board will be located at the registration area Monday-Thursday. All incoming phone messages/faxes will be posted to this message board.

*Telephone messages:* (407) 859-1500

Request to speak with the Simulation Innovation Workshop (SIW) registration area.

*FAX messages:* (407) 855-1585

Please be sure to specify the "SIW Workshop" on the cover sheet. If you would like to send a fax, there is one available at the hotel Business Center (across from hotel registration desk).

## HOTEL RESTAURANTS

**Marcelo's Bistro**
Breakfast Buffet: 0700-1100
Lunch: 1100-1400
Dinner: 1700-2200 (TBD)

**Starbucks**
0600-2100

**Cricket's Lounge**
Monday-Friday: 1400-2400
Weekends: 1200-2400

**Grab & Go**
0830-2200

## BREAKS

BREAKS are scheduled from 1000-1030 and 1500-1530 on Monday-Thursday.

## REGISTRATION & EXHIBITS

The Registration Desk is located in the Mezzanine Area on the 2nd floor. All registrants need to check in at the registration desk to receive an identification badge and reference materials. Name badges must be worn at all Workshop functions.

Be sure to make it a part of your conference plans to visit the SISO exhibit area located in the Salon 1 on the 2nd floor. There will be several companies on-hand to show you their new and evolving technologies.

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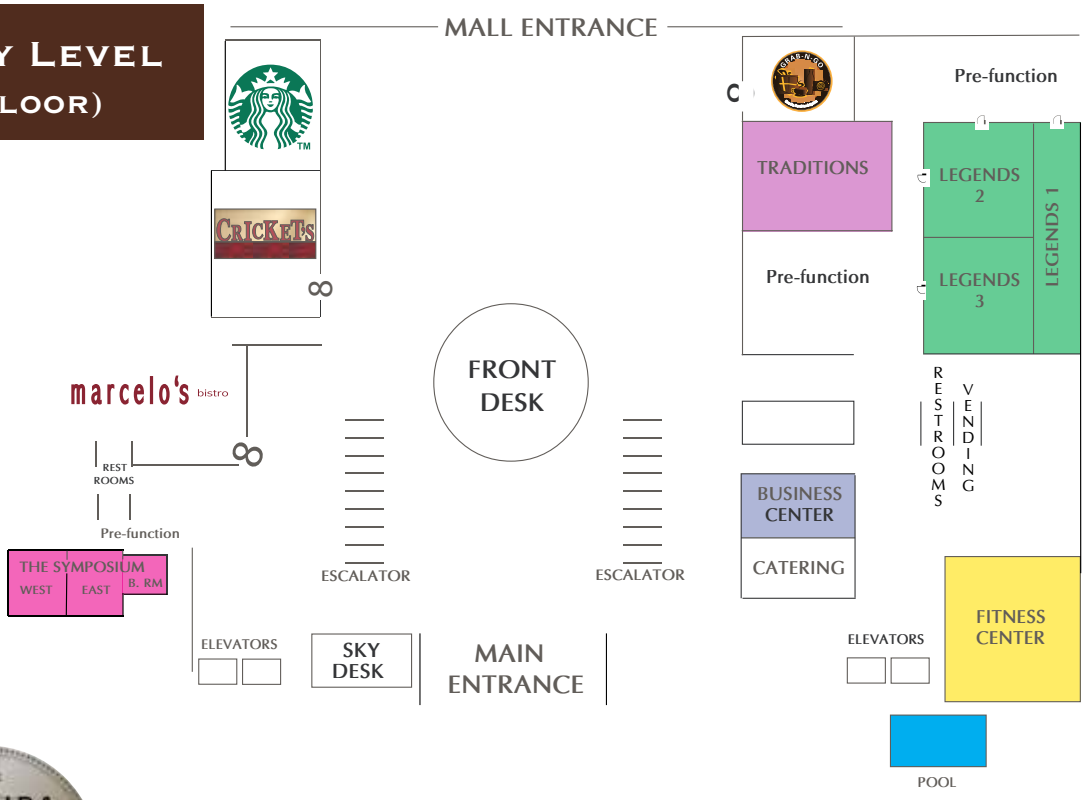
## HARASSMENT STATEMENT

NDIA is committed to providing a professional environment free from physical, psychological and verbal harassment. NDIA will not tolerate harassment of any kind, including but not limited to harassment based on ethnicity, religion, disability, physical appearance, gender, or sexual orientation. This policy applies to all participants and attendees at NDIA conferences, meetings and events. Harassment includes offensive gestures and verbal comments, deliberate intimidation, stalking, following, inappropriate photography and recording, sustained disruption of talks or other events, inappropriate physical contact, and unwelcome attention. Participants requested to cease harassing behavior are expected to comply immediately, and failure will serve as grounds for revoking access to the NDIA event.

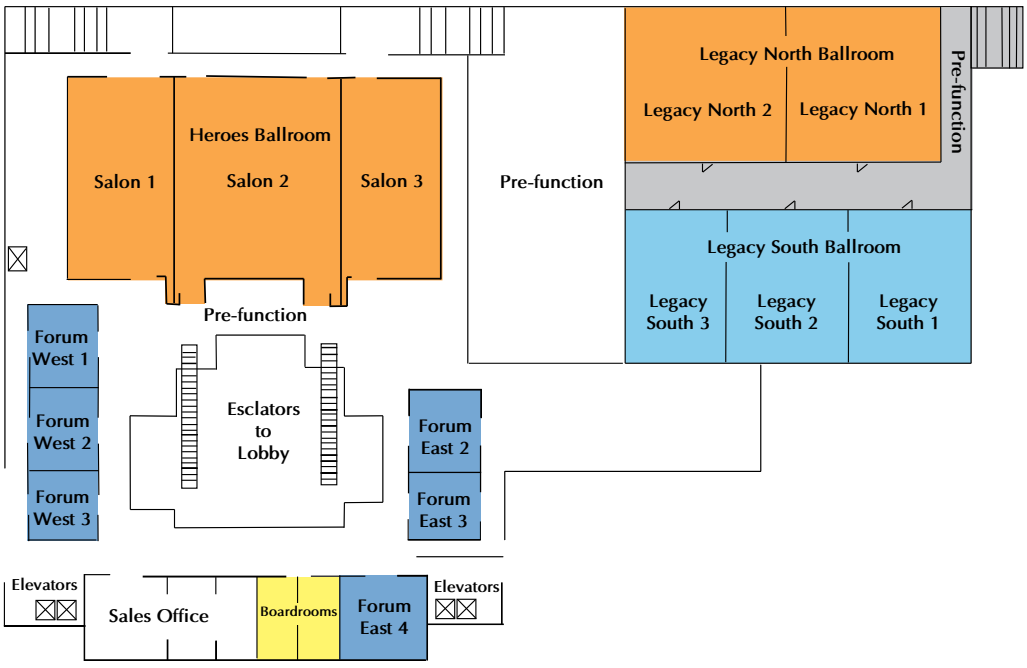
# VENUE MAP

## Lobby Level (1st Floor)




THE FLORIDA HOTEL AND CONFERENCE CENTER

## Mezzanine Level (2nd Floor)



# WELCOME LETTERS

## STANDARDS ACTIVITY COMMITTEE – DR. KATHERINE L. MORSE

On behalf of the SISO Standards Activity Committee (SAC), welcome to the 2018 Fall SIW. In my letter for the 2018 Winter SIW, I attempted to list all of SISO's standards accomplishments for the last year and everything the SAC had done to enable our volunteers. But I'm not going to do that this time, both because it's a lot of work and because I don't think it makes for interesting reading. Before all else, I want to thank the members of the SAC for their continuing commitment to maintaining the machinery of standards development. It's not glamorous work, but we know the rest of SISO's volunteers depend upon us doing it in a timely and efficient manner. We're now focused on initiatives to broaden engagement across our community including completing the XML style guide and the standards roadmap. We're also starting a new initiative called "cross-pollination." Please peruse the display on the wall of the vendor room. We hope it will help you connect with other SISO groups with interests that align with your own.

#GoStandards

P.S. If you're truly a standards wonk as I am, find me at the SIW because I have a way for you to show your true colors.

## SISO EXECUTIVE COMMITTEE – MICHAEL J. O'CONNOR

Welcome to the final Fall Simulation Innovation Workshop. Last year we had to cancel the Fall SIW because of Hurricane Irma. As a result of that, we rescheduled SIW in January of 2018. I want to thank everyone for working with us to make the Winter 2018 SIW a great success. The feedback we got indicated that winter was a better time for the SIWs. I know this will be a big change for many of us that have spent part of September in Orlando for the last 20 plus years. I hope you enjoy our final September Orlando visit and look forward to our 2nd Winter SIW.

We are continuing to evolve the format of the SIW and you will see a new format for some of the presentations this year. We want the Innovation in SIW to continue and we will continue to adjust the format to maximize participation. Please provide your feedback to these changes to the Conference Committee. Thanks to the CC for their work in organizing this conference.

The Standards Activity Committee continues its hard work. Standards are a team sport and everyone's input is important. I want to thank all of the SISO members that contribute to the development of our standards. SISO is always looking for the next area we need to standardize.

I want to encourage your organizations to send more people to SIW. SIW is the key venue for the development of standards and their applications. We need to maintain this critical mass of practitioners now and in the future. I am looking forward to seeing y'all at the Fall SIW.

## SISO CONFERENCE COMMITTEE – PAUL GUSTAVSON

I want to welcome you to the Simulation Innovation Workshop (SIW). We're so glad you are here! Joining you are some of the brightest minds in our community. We encourage you to connect, and we challenge you to contribute.

Our theme this fall is Leveraging the Power of Simulation. We chose this theme because we have a vision for leading innovation centered by advancing the use of simulation. We believe Modeling and Simulation (M&S) has far greater potential than the world realizes.

For us to lead, we recognize the four types of innovation: Sustaining, Evolutionary, Revolutionary and Disruptive. Sustaining Innovation is often necessary for continuity, but simply sustaining the status quo doesn't add the value that's needed. There are still gaps that need to be filled. Our roots in leading have always been in creating Evolutionary Innovation, which is about technological improvements through the standards we forge.

We have also been about Revolutionary Innovation, which is about creating something new that allows others to take simulation interoperability to the next level. Also, as a community, SIW is also about encouraging Disruptive Innovation. Disruptive Innovation is what creates a new market by introducing capabilities that never before existed. When we started, this community chose to be Disruptive---resulting in interoperability standards. It was new, it was novel, and it was disruptive. We can't imagine simulation without interoperability now.

Fast forward to today, and you will find that this community is hungry again. We are passionate about simulation, the use of models, and the application it can provide as a service. This week, I invite you to engage, share, and contribute your ideas and approaches that will allow us to fill the innovation gaps that we know still exist. Your contributions will help this community advance the use of simulation in such a way that it creates a positive Disruptive Innovation.

Join us in our discussions and our working groups through the week. And share with us your ideas in how we can all better leverage the power of simulation.

## CONFERENCE/WORKSHOP ACTIVITIES – MARK MCCALL

As always, this Workshop represents the efforts of dozens of people. Some of them wear badges with colored ribbons, showing the committees on which they serve. Others, including our support staff, work behind the scenes, producing our published documents, supporting our volunteer committees, maintaining our web site, and keeping dozens of email reflectors up to date. We ask you to talk to us, providing positive reinforcement in areas where you think things are going well, and providing suggestions for improvements in areas where we can do better. If you would like to become active on a SISO committee, Study Group, or Product Development/Support Group, introduce yourself to someone already involved in a related activity. Ask them how to get more involved. Over the history of SISO, no individual with an idea, a willingness to work, and a reasonable level of initiative has ever failed to find a spot within our flexible structure to try to turn their idea into reality!

Finally, don't forget to have some fun this week as you meet colleagues you see only once or twice a year, make new friends, and discover other people who share your enthusiasm for a particular aspect of modeling and simulation.

# BIOGRAPHIES

## DR. ELIZABETH D'ANDREA

*Senior Consultant*
SimVentions, Inc.

Dr. D'Andrea serves as a senior consultant with SimVentions in Fredericksburg, VA focusing on next-generation weapons for the Navy. She was the NAVSEA Assistant Railgun Program Manager. Railgun, an Innovative Naval Prototype (INP), is a transformational solution for volume fires, time-critical strike and missile defense. The Railgun is designed to deliver lethal, hyper-velocity projectiles at ranges more than 100 nautical miles within five minutes. Previously, she was the Program Executive for the DoD Counter-Narcoterrorism Technology (CNT) Program for the Deputy of Defense for Counternarcotics Office. As the Program Executive for CNT, she directed capabilities to support Combatant Commanders and international operations. She directed the development of technology and special systems to enhance the Counter-narcoterrorism capabilities of the military and civilian law enforcement agencies. Dr. D'Andrea served at the Joint Warfare Analysis Center for nine years as the Director of Science and Technology (S&T) and was the JWAC first chief engineer. She was responsible for the Command's S&T strategic planning, allocation execution, and evaluation; ensuring the rapid integration of mature, leading-edge technologies, and scientific methods were integrated into products that support the Combatant Commanders. She served the US Air Force's HQ Tactical Air Command for six years where she was an Operations Research Analyst in the Operations Directorate. During Desert Storm, she supported Battle Damage Assessment and authored the Desert Database for Sortie Generation. Her systems engineering approach to integrate diverse programs into a combat system has been widely used for the USN, United States Army, United States Air Force (USAF), Combatant Commands (COCOMs), and OSD. Throughout her career, she has developed threat and missile intercept models, technology to assist in closing the fire-control loop, kill chain analysis, materials assessments and thermal and aerodynamic analysis.

Dr. D'Andrea received several awards for her lead role in the Army's Force Modernization and Training. Dr. D'Andrea worked for the National Aeronautics and Space Administration (NASA) following graduation from Old Dominion University. She received a Bachelor of Science degree in Quantitative Methods and a Master's in Systems Management/ Operations Research from the Florida Institute of Technology. She completed her Doctor of Science from George Washington University in Engineering Management and Systems Engineering.

Her numerous awards include three Navy Superior Civilian Awards (1998, 2002 and 2010), the Navy Meritorious Civilian Award (1994), the Langley Air Force Base Woman of the Year Award (1987), and two Army Special Service Awards (1985, 1983). Additionally, the Republic of Colombia, South America, recognized her with the Republic of Colombia Air Force Meritorious Service Cross (2003).

## COLONEL ROBERT H. EPSTEIN, USAF

*Commander*
Air Force Agency for Modeling and Simulation (AFAMS)

Colonel Robert H. Epstein is commander of the Air Force Agency for Modeling and Simulation (AFAMS), which is the lead agent for centralized management of Air Force cross-functional and shared live, virtual and constructive operational training (LVC-OT) foundational capabilities and resources supporting the Air Force service core functions. As commander, Colonel Epstein is responsible for overseeing Air Force initiatives for enterprise solutions that will help build an efficient foundation to achieve "Readiness Thru LVC," and allow warfighters to maximize performance and decision-making.

Colonel Epstein received his commission through Air Force ROTC at the University of Cincinnati in 1995. He holds advanced academic degrees from Central Michigan University, Air Command and Staff College, Air War College and is a graduate of the Joint and Combined Warfighting School. He is a Joint Staff Officer who has held various operational, test and staff assignments and is a Navigator and Electronic Warfare Officer (EWO) who has flown operationally in support of Operations NORTHERN WATCH, SOUTHERN WATCH, JOINT GUARDIAN, JOINT ENDEAVOR, and ENDURING FREEDOM. Additionally, Colonel Epstein was the Chief of Joint Fires for the NATO mission in Afghanistan in 2009, responsible for planning, processing and prioritizing all close air support; and Chief EWO for NATOs combat mission in Libya in 2011, where he was directly responsible for all Coalition Electronic Warfare and Suppression of Enemy Air Defenses. Colonel Epstein has commanded at the squadron level and prior to his current assignment, served as the Director of the Commander's Action Group and Section Commander for the Air Force District of Washington (AFDW) and the 320th Air Expeditionary Wing, the air component of Joint Task Force – National Capital Region in direct support of the 58th Presidential Inauguration. As Section Commander, Colonel Epstein was the Uniform Code of Military Justice authority for Airmen located within the NCR, selected Field Operating Agencies, and selected Air Force elements.

## MR. LEIGH YU

*Deputy Director*
Defense Modeling and Simulation Coordination Office

Mr. Leigh Yu serves as the Deputy Director of the Defense Modeling and Simulation Coordination Office (DMSCO), in the Office of the Secretary of Defense (OSD), Under Secretary of Research and Engineering (USD(R&E)) within the Systems Engineering Department. In this role, he is responsible for Policy, Technology, Standards and Collaboration related to modeling and simulation (M&S) across the DoD, Federal Government, and International partners. He is the Chair of the M&S Technical Working Group under the Joint Enterprise Standards Committee (JESC) and Voting US Member of the NATO Modelling and Simulation Group (NMSG).

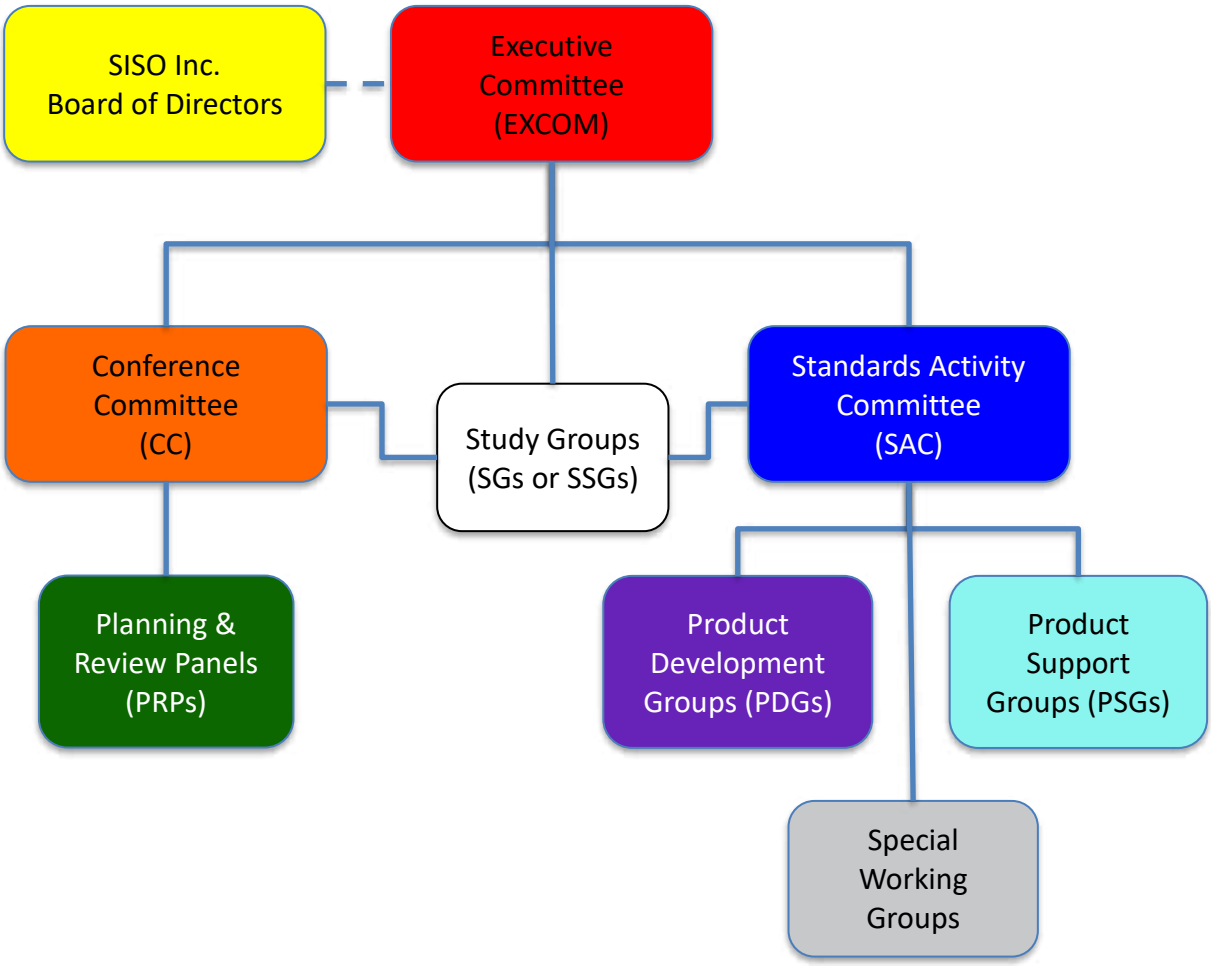
Mr. Yu graduated from Case Western Reserve University with a Bachelor of Science degree in Systems and Control Engineering, from Southern Methodist University with a Master of Science degree in Software Engineering, and from George Mason University with a Certificate in Command, Control, Communications and Intelligence Systems Engineering. He holds an Engineering Level III Certification from Defense Acquisition University.

Mr. Yu has extensive experience in applying Systems and Software Engineering, modeling and simulation, analysis, policy and standards development, and leadership within a defense context.

He has worked at DMSCO since 2011. Prior to that, he worked as a support contractor Program Manager for the Air Force Modeling and Simulation Policy Division (2004-2011), support contractor Program Manager for the Air Force Studies and Analyses Agency (1999-2004), and contractor National Security Space Architect (1997-1999).

From 1995 to 1997 he worked for Hughes Information Technology Systems as a systems and software engineer on a satellite ground station capability, and from 1989 to 1995 he worked in the avionics department of General Dynamics/Lockheed for the F-16 Fighting Falcon as Lead Systems Engineer for Software and Integration Test Stations.

# SISO ORGANIZATION




## BOARD OF DIRECTORS (BOD) – 2017–2018

**The Board of Directors (BOD) is responsible for financial oversight of SISO and for SISO's contractual relationships with other organizations.**

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**Treasurer**
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**Assistant Treasurer**
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# SISO ORGANIZATION

## SISO EXECUTIVE COMMITTEE (EXCOM) MEMBERS – 2017-2018

**The Executive Committee (EXCOM) is the policy body that provides overall governance and strategic planning to SISO.**

**Chair**
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**CC Chair**
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## NEWLY ELECTED – SISO EXECUTIVE COMMITTEE (EXCOM) MEMBERS – 2018-2019

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Siegfried, Robert (2021)
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**CC Chair**
(X)

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**NATO MSG**
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## SISO CONFERENCE COMMITTEE (CC) MEMBERS – 2017-2018

**The Conference Committee (CC) organizes the Simulation Innovation Workshops and oversees several tracks in which information and new ideas are exchanged within and across various components of the M&S Community.**

**Chair**
Gustavson, Paul (2018)
pgustavson@simventions.com

**Vice Chair**

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JeanLouis.Igarza@icloud.com



(A) = Appointed Committee member (term expires each fall) | (X) = Ex-officio member of committee (term expires each fall) | (+) = Not limited to this term

## NEWLY ELECTED – SISO CONFERENCE COMMITTEE (CC) MEMBERS – 2018–2019

**Chair**
Vacancy (2020)

**Vice Chair**
Vacancy (2020)

**Secretary**
Vacancy (2020)

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## SISO STANDARDS ACTIVITY COMMITTEE (SAC) MEMBERS – 2017–2018

**The Standards Activity Committee (SAC) provides oversight for all standards activities, including the Balloted Products Development and Support Process, and oversees the groups that are studying, developing, and supporting SISO products.**

**Chair**
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## NEWLY ELECTED SISO STANDARDS ACTIVITY COMMITTEE (SAC) MEMBERS – 2018–2019

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**Liaisons:**

**NATO MSG**
Bailey, Grant
grant.bailey.127@mod.gov.uk

(A) = Appointed Committee member (term expires each fall) | (X) = Ex-officio member of committee (term expires each fall) | (+) = Not limited to this term

# SISO ORGANIZATION

## STANDARDS ORGANIZATION LIAISONS

### Institute of Electrical and Electronics Engineers

**Katherine L. Morse (SAC)**
katherine.morse@jhuapl.edu

- Distributed Interactive Simulation (DIS)
- High Level Architecture (HLA)
- Distributed Simulation Engineering & Execution Process (DSEEP)

### International Organization for Standardization

**Katherine L. Morse (SAC)**
katherine.morse@jhuapl.edu

- Spatial Reference Model (SRM)
- Environmental Data Coding Specification (EDCS)

### North Atlantic Treaty Organization

**Wim Huiskamp (EXCOM)**
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**Grant Bailey (SAC)**
grant.bailey.127@mod.gov.uk

On 24 July 2007, NATO and the SISO signed a formal Technical Cooperation Agreement for coordination and cooperation in the development of M&S standards. The agreement, signed at the Collaboration Support Office of the Science & Technology Organization of NATO just outside Paris, officially recognized SISO as an accredited Standards Development Organization for NATO.

## STUDY GROUPS

**www.sisostds.org/StandardsActivities/StudyGroups.aspx**

- Cloud-based Modeling & Simulation (CBMS) SG
- Cyber Modeling and Simulation (CyberMS) SG

## STANDING STUDY GROUPS

- Exploration of Next Generation Technology Applications to Modeling and Simulation (ENGTAM) SSG
- Simulation Australia SSG

## PRODUCT DEVELOPMENT & SUPPORT GROUP COMBINED

**www.sisostds.org/StandardsActivities/DevelopmentGroups/C2SIMPDGPSG-CommandandControlSystems.aspx**

- Command and Control Systems - Simulation Systems Interoperation (C2SIM) PDG/PSG

## PRODUCT DEVELOPMENT GROUPS

**www.sisostds.org/StandardsActivities/DevelopmentGroups.aspx**

- Acquisition Modeling and Simulation Standards Profile (ACQMS) PDG
- Enhanced Position Location Reporting System including Situational Awareness Data Link Simulation Standard (EPLRS/SADL) PDG
- Gateway Description and Configuration Languages (GDACL) PDG
- Guideline on Scenario Development (GSD) PDG
- High Level Architecture (HLA) PDG / IEEE Working Group
- Link 11 A/B Simulation Standard Network (Link 11 A/B) PDG
- Reuse and Interoperation of Environmental Data and Processes (RIEDP) PDG
- Space Reference Federation Object Model (SRFOM) PDG
- Simulation Reference Markup Language (SRML) PDG
- Interoperability Between Web-based Federates and LVC Federations (WebLVC) PDG
- Urban Combat Advanced Training Technologies (UCATT) PDG

## PRODUCT SUPPORT GROUPS

**www.sisostds.org/StandardsActivities/SupportGroups.aspx**

- Base Object Model (BOM) PSG
- Common Image Generator Interface (CIGI) PSG
- Distributed Interactive Simulation / Real-time Platform Reference Federation Object Model (DIS / RPR FOM) PSG
- Distributed Simulation Engineering and Execution Process/Multi-Architecture Overlay (DSEEP/DMAO) PSG
- Environmental Data Representation Standards (EDRS) PSG
- Federation Engineering Agreements Template (FEAT) PSG
- High Level Architecture - Evolved (HLA-Evolved) PSG
- Tactical Digital Information Link–Technical Advice and Lexicon for Enabling Simulation (TADIL TALES) PSG
- Urban Combat Advanced Training Technologies (UCATT) PSG
- Verification, Validation & Accreditation/Acceptance Products (VV&A Products) PSG

## SPECIAL WORKING GROUPS

**www.sisostds.org/StandardsActivities/StandardsActivityCommittee.aspx**

- Reference for Enumerations for Simulation (SAC SWG Enumerations)
- Reference for Problem Report / Change Request (SAC SWG PR/CR)
- Reference for XML Schema Naming and Design Best Practices (SAC SWG XML Schema)

# SIW TRACKS

The workshop structure for 2018 has been organized into three tracks. SIW tracks provide an opportunity for members of the Modeling and Simulation (M&S) community who share common interests and/or are involved in similar activities or are members of similar organizations to network, exchange ideas and information, introduce new M&S technologies, share lessons learned, and to identify where standardization will improve simulation interoperability and the efficient and effective use of M&S resources and tools.

**At the 2018 Fall SIW, the SIW tracks comprise the following:**

## SYSTEM LIFECYCLE AND TECHNOLOGIES (SLT) TRACK

The System Lifecycle and Technologies (SLT) track encompasses information that provides guidance on the selection and use of M&S standards and practices to support the System Lifecycle and corresponding technologies. The track focuses on the promotion and use of M&S standards and practices that support the system lifecycle. We solicit papers that address the identification, application, and value-added benefits of M&S for analysis, research and development, test and evaluation, training, acquisition, asset management, and system lifecycle strategies.

## 2018- SLT PLANNING & REVIEW PANEL

**These Planning & Review Panel (PRP) members reviewed abstracts/papers designated for the SLT track.**

**Johnston, Scott**
Booz Allen Hamilton
johnston_scott@bah.com

**Halinski, Thomas**
CAE USA Inc.
thomas.halinski@caemilusa.com

**Oates, William**
AFAMS
william.oates@mail.mil

**Gravitz, Peggy**
pgravitz@gmail.com

## NEWLY ELECTED 2019 - SLT PLANNING & REVIEW PANEL MEMBERS

**The following are newly elected members of the SLT PRP.**

**Halinski, Thomas**
CAE USA Inc.
thomas.halinski@caemilusa.com

**Johnston, Scott**
Booz Allen Hamilton
johnston_scott@bah.com

**Oates, William**
AFAMS
william.oates@mail.mil

**Vacancies (4)**

## SERVICES, PROCESSES, TOOLS, AND DATA (SVCS) TRACK

The Services, Processes, Tools, and Data (SVCS) track encompasses technologies, frameworks, and methodologies to provide services that support models, simulations, and associated data. The track is interested in both processes and their implementations / tools in the areas of; distributed simulation process, verification, validation, and accreditation; communications infrastructure; and simulation and environment reuse. The SVCS track focuses on evolving a systems engineering solution to simulation problems across the spectrum from design, through implementation and deployment, to validation, use, and reuse.

## 2018- SVCS PLANNING & REVIEW PANEL

**These Planning & Review Panel (PRP) members reviewed abstracts/papers designated for the SVCS track.**

**Igarza, Jean-Louis**
Antycip Simulation
JeanLouis.Igarza@icloud.com

**Hodicky, Jan**
University of Brno
jan.hodicky@seznam.cz

**Morse, Katherine L.**
JHU/APL
katherine.morse@jhuapl.edu

**Saunders, Randy**
JHU/APL
r.saunders@ieee.org

**Siegfried, Robert**
aditerna GmbH
robert.siegfried@aditerna.de

**Voogd, Jeroen**
TNO Defence and Security
jeroen.voogd@tno.nl

## NEWLY ELECTED 2019 - SVCS TRACK PLANNING & REVIEW PANEL MEMBERS

**The following are newly elected members of the SVCS PRP.**

**Louisell, Chuck**
Cisco Systems
chulouis@cisco.com

**Morse, Katherine L.**
JHU/APL
katherine.morse@jhuapl.edu

**Saunders, Randy**
JHU/APL
r.saunders@ieee.org

**Siegfried, Robert**
aditerna GmbH
robert.siegfried@aditerna.de

Vacancies (3)

## MODELING & SIMULATION SPECIALTY TOPICS (SPEC) TRACK

The M&S Specialty Topics (SPEC) track is concerned with using simulation technologies for a specific purpose such as: LVC interoperability; augmented reality; Internet of Things (IoT) integration, system, vehicle, or weapon product development; space travel; understanding and prediction of human behavior; and design of interoperable command and control systems. Present thrust areas center on the application of M&S for Cyber Warfare, Medical, Space, and IoT, but the forum is not limited to these topics.

## 2018 – SPEC PLANNING & REVIEW PANEL MEMBERS

**These Planning & Review Panel (PRP) members reviewed abstracts/papers designated for the SPEC track.**

**van den Berg, Tom**
TNO Defence, Security, & Safety
tom.vandenberg@tno.nl

**Galvin, Kevin**
Thales Research & Technology
kevin.galvin@btinternet.com

**Lemmers, Arjan**
Netherlands National Aerospace Lab
arjan.lemmers@nlr.nl

**Meyer, Sara**
453 EWS/EWO
sara.meyer.1@us.af.mil

## NEWLY ELECTED 2018 - SPEC PLANNING & REVIEW PANEL MEMBERS

**The following are newly elected members of the SPEC PRP.**

**Galvin, Kevin**
Thales Research & Technology
kevin.galvin@btinternet.com

**Lemmers, Arjan**
Netherlands National Aerospace Lab
arjan.lemmers@nlr.nl

**Meyer, Sara**
453 EWS/EWO
sara.meyer.1@us.af.mil

Vacancies (4)

# AGENDA

## MONDAY, SEPTEMBER 10

### TUTORIALS

The SISO 101 and SISO Standards 101 tutorials (both in Forum West 1) are free of charge to all. To attend any – or all - of the other tutorials, attendees must register and pay the $75 Tutorials fee.

0800-1000 **AN INTRODUCTION TO SISO (SISO 101)**
FORUM WEST 1

**Mark McCall**
SISO Executive Director
*Instructor*

**Prerequisite:** Interest in learning more about SISO and how to become involved in SISO activities.
**Note**: The is no fee for this tutorial session

This tutorial is hosted by the SISO Executive Director who explains SISO's principles, processes and organizational makeup.

0800–1000 **INTRODUCTION TO HIGH LEVEL ARCHITECTURE (HLA 101)**
FORUM WEST 2

**Dr. Katherine L. Morse**
*Instructor*

**Prerequisite**: A general understanding of modeling and simulation.
**Note**: A one-time fee of $75.00 allows you to attend any/all tutorials that are offered at this Workshop.

The High-Level Architecture (HLA) is an international standard for simulation interoperability. It originated in the defense community, but is increasingly used in other domains. This tutorial provides an introduction to HLA and these IEEE Standards that specify HLA: IEEE Std 1516TM - 2010, IEEE Standard for Modeling and Simulation (M&S) High Level Architecture (HLA) – Framework and Rules • IEEE Std 1516.1TM - 2010, IEEE Standard for Modeling and Simulation (M&S) High Level Architecture (HLA) – Federate Interface Specification • IEEE Std 1516.3TM - 2010, IEEE Standard for Modeling and Simulation (M&S) High Level Architecture (HLA) –Object Model Template (OMT) Specification

This tutorial describes the requirements for interoperability, flexibility, composability and reuse, and how HLA meets those requirements. The principles and terminology of an HLA federation are given including some real-world examples.

**The tutorial will cover:** The HLA Rules that federates and federations follow. • The HLA Interface Specification that describes the services a simulation can use for data exchange, synchronization, and overall management. • The HLA Object Model Template that is used for describing the data exchange between simulations.

Some practical information is given about current implementations, including commercial-off-the-shelf, government-off-the-shelf, and open source implementations. The continuous development of performance, robustness of the implementations as well as available tools is also described. Finally, some advice is given on how to get started with HLA, including the use of the related process standard: IEEE Std 1730TM - 2010, IEEE Recommended Practice for Distributed Simulation Engineering and Execution Process (DSEEP)

0800-1000

## GAME ENGINES 101

FORUM WEST 3

**Tim Rodabaugh**
*Instructor*

**Prerequisite***:* A general understanding of modeling and simulation.
**Note**: A one-time fee of $75.00 allows you to attend any/all tutorials that are offered at this Workshop

The tutorial includes introductory background material describing the use of video game engines, such as Unity and Unreal, in the development of simulation capabilities for training use cases. Basic game engine mechanics will be covered, and the two foremost game engines will be compared. The tutorial will highlight data access and sharing options, including the data handling native to the engines as well as the use of the Distributed Interactive Simulation (DIS), which enable performance and physiological data and assessment within the simulations. Strategies allowing the integration of external devices and data streams will be explored. Examples will be used to highlight game engine capabilities, data handling, and integration strategies.

**The tutorial will cover:** Game engine basics including: assets creation & manipulation, physics, scripting, visuals, performance, and plugins • Game engine evaluation • Data extraction (control input, world information, DIS) • Device integration (Strategies, data interleaving)

**Project examples include**: Eye tracker Unity 3D integration and data collection • Data collection using Unreal Engine • Data stream integration with Unity 3D • Virtual environment built in Unreal Engine • Multiplayer game-based training simulation using Unity 3D • DIS game integration

0800-1000

## VERIFICATION, VALIDATION & ACCREDITATION (VV&A 101)

BOARDROOM 4

**Simone Youngblood**
*Instructor*

**Prerequisite***:* A general understanding of modeling and simulation.
**Note***:* A one-time fee of $75.00 allows you to attend any/all tutorials that are offered at this Workshop.

This tutorial provides an overview of the processes of Verification, Validation, and Accreditation, which are foundational elements that underlie assessments of M&S credibility. Information derived from the VV&A processes is used to shape the understanding of how and where a model or simulation should be used and under what constraints.

While VV&A is founded on basic software engineering principles, implementation is often constrained by resources, whether these resources be time, money, personnel, or information. This tutorial will introduce M&S Users, M&S Developers, and VV&A Practitioners to the key concepts associated with VV&A planning and implementation, the impacts and the drivers, and basic documentation requirements.

0800-1000

## SIMULATION INTEROPERABILITY 101

FORUM EAST 4

**Stefan Sandberg**
**Kurt Lessmann**
*Instructor(s)*

**Prerequisite***:* A general understanding of modeling and simulation.
**Note***:* A one-time fee of $75.00 allows you to attend any/all tutorials that are offered at this Workshop.

The aim of this tutorial is to give the participants an overview of the most common simulation interoperability standards. The tutorial explains various aspects of simulation interoperability and describes how these aspects are addressed in simulation interoperability standards like DIS, HLA, RPR-FOM and TENA. The tutorial also explains some of the technologies used and the business models associated with the different standards.

1030–1200

## AN INTRODUCTION TO THE SISO STANDARDS DEVELOPMENT PROCESS (SISO STANDARDS 101)

FORUM WEST 1

**Lance Marrou**
SAC Secretary
*Instructor*

**Prerequisite**: Interest in learning more about SISO and how to become involved in SISO activities.
**Note**: The is no fee for this tutorial session

This tutorial session is hosted by leaders of the SISO Standards Activity Committee who explain how to become involved in the SISO standards development and support process.

1030-1200

## DISTRIBUTED SIMULATION ENGINEERING AND EXECUTION PROCESS (DSEEP 101)

FORUM WEST 2

**Dr. Katherine L. Morse**
**Robert Lutz**
*Instructor(s)*

**Prerequisite***:* A general understanding of modeling and simulation.
**Note***:* A one-time fee of $75.00 allows you to attend any/all tutorials that are offered at this Workshop.

**This tutorial provides an overview of:** IEEE Std 1730™ - 2010, IEEE Recommended Practice for Distributed Simulation Engineering and Execution Process (DSEEP)

DSEEP defines the processes and procedures that should be followed by users of distributed simulations to develop and execute their simulations.

The DSEEP generalizes the Federation Development and Execution Process (FEDEP, IEEE 1516.3) to all distributed simulation environments and architectures, no longer focusing solely on the High Level Architecture (HLA).

This tutorial provides the top level steps and supporting activities for the entire process. It also introduces and illustrates the inputs, recommended tasks, and outcomes of the activities.

There will be a brief overview of the architecture-specific annexes for HLA, Distributed Interactive Simulation (DIS), and the Test and Training Enabling Architecture (TENA).

**Attendees also will be introduced to:** IEEE Std 1730.1™ - 2013, IEEE Recommended Practice for Distributed Simulation Engineering and Execution Process Multi-Architecture Overlay (DMAO) • SISO-STD-012-2013, Standard for Federation Engineering Agreements Template

DMAO is the IEEE standard that extends the DSEEP to multi-architecture environments.

1030-1200

## DISTRIBUTED INTERACTIVE SIMULATION (DIS 101)

FORUM WEST 3

**Prerequisite:** A general understanding of modeling and simulation. Minimum technical background needed. Familiarity with distributed real-time simulation of vehicles and weapon system platforms is helpful.

**Note:** A one-time fee of $75.00 allows you to attend any/all tutorials that are offered at this Workshop.

**Mark McCall**
*Instructor*

**This tutorial provides an overview of:** IEEE Std 1278.1 TM - 2012, IEEE Standard for Distributed Interactive Simulation - Application Protocols.

The tutorial includes introductory background material describing what Distributed Interactive Simulation (DIS) is; explains why DIS is a viable standard for distributed simulation; and provides information for joining an active developers group. New features added in the 2012 version, including Directed Energy Weapons, Information Operations, and the general extensibility of Protocol Data Units (PDUs) will be discussed.

1030-1200

## HIGH LEVEL ARCHITECTURE EVOLVED FOM MODULES (HLA 202)

BOARDROOM 4

**Björn Möller**
*Instructor:*

**Prerequisites***:* General knowledge about the purpose and principles of HLA corresponding to HLA 101. Some experience with HLA object model development is useful, but not required.
**Note***:* A one-time payment fee of $75.00 allows you to attend any/all tutorials that are offered at this Workshop.

**This tutorial provides an overview of how to apply:** IEEE Std 1516.3TM - 2010, IEEE Standard for Modeling and Simulation (M&S) High Level Architecture (HLA) –Object Model Template (OMT) Specification • Additional features for FOM development, provided in the upcoming version of HLA, informally called “HLA 4”.

The Federation Object Model (FOM) specifies the data that is exchanged between federates in an HLA federation. This tutorial shows the principles of good FOM design. It describes how FOMs can be developed maintained and reused using the Modular FOM concept, introduced in HLA Evolved (IEEE 1516-2010).

Special attention is given to the modular version of the SISO Real-time Platform Reference Federation Object Model (RPR FOM) 2.0. Other FOMs covered are the NATO Education and Training Network FOM and the upcoming SISO Space Reference FOM.

Finally, it presents new features for developing FOMs that are proposed for the next version of HLA, in particular for extending reference FOMs.

1330-1500

## PLENARY SESSION

SALON 2

### Call to Order

**Paul Gustavson**
SISO Conference Committee Chair

### State of SISO

**Michael O’Connor**
SISO Executive Committee Chair

### Featured Speaker

**Col. Robert Epstein**
Commander, Air Force Agency for Modeling and Simulation

### Sponsor Speaker

**Mr. Leigh Yu**
Deputy Director, Defense Modeling and Simulation Coordination Office (DMSCO)

### Admin Announcements

**Mark McCall**
SISO Executive Director

## TUTORIALS

1530-1700

### BRIDGES AND GATEWAYS

FORUM WEST 1

Michael O'Connor
Kurt Lessmann
*Instructor(s)*

**Prerequisite:** A general understanding of modeling and simulation.
**Note:** A one-time fee of $75.00 allows you to attend any/all tutorials that are offered at this Workshop.

Bridges and Gateways are critical to most distributed Live, Virtual, Constructive simulation environments. The role of bridges and gateways is often misunderstood by distributed simulation planners. This tutorial provides an overview of the role of gateways in distributed simulation. A description of how gateways work is also presented. The tutorial covers the process for to select a gateway that meets the needs of the distributed simulation event. The best practices for using a gateway are also covered. This tutorial will provide the attendees with a better understanding of gateways and how to use them in a distributed LVC event.

1530-1700

### REDISCOVER THE DEFENSE M&S CATALOG

FORUM WEST 2

Rachael Orzechowski
*Instructors*

**Prerequisite:** None
**Note:** A one-time fee of $75.00 allows you to attend any/all tutorials that are offered at this Workshop.

M&S industry leaders are capitalizing on the new and improved Defense M&S Catalog. This tutorial presents the new approach to search, discover, and publish M&S assets. It focuses on the purpose of the Defense M&S Catalog and how its new concept of operations simultaneously serves the local needs of M&S practitioners and the policy objectives of the United States Department of Defense.

Live demonstrations will illustrate how to effectively access and utilize the catalog's upgraded search methods, operate its menu-driven tool for creating valid metadata records, and publish locally-developed metadata records directly to the catalog without data transformation or human intervention.

The tutorial is intended for M&S Leaders, especially those in Systems Engineering, Acquisition, and Program Management, who rely on M&S to develop new system capabilities; as well as developers, project managers, and other senior technical leaders, who are responsible for the management and sharing of M&S assets.

1530-1700

## NEW EXTENSIBILITY AND DEAD RECKONING FEATURES IN DIS VERSION 7 (DIS 201)

FORUM WEST 3

**Robert Murray**
*Instructor*

**Prerequisite:** Familiarity with basic DIS PDU usage. Knowledge of dead reckoning is helpful, but the tutorial will include an introduction to the concepts.
**Note:** A one-time fee of $75.00 allows you to attend any/all tutorials that are offered at this Workshop.

This tutorial provides an in-depth review of two features: PDU extensibility and improvements in dead reckoning.

PDU extensibility expands the ability of DIS users to add custom data to PDUs. Some PDUs allow user-defined records to be directly added. Other PDUs can be extended using the new Attribute PDU. Both methods retain compatibility with older versions of DIS. This allows customized PDUs to be added in new or upgraded simulations while maintaining interoperability to older simulations that cannot be modified.

Dead reckoning has been enhanced in DIS Version 7, mainly in the extrapolation of entity orientation. A new geometric method of determining the orientation threshold is described using either quaternions or rotation matrices. This method avoids the problems of Euler angle singularities than can cause excessively high PDU transmit rates. Other new features speed up dead reckoning calculations in receiving simulations by adding extra information in the Entity State PDU. These new features maintain full backward and forward compatibility with DIS Version 5 and 6.

1530-1700

## FEDERATION ENGINEERING AGREEMENTS TEMPLATE (FEAT 101)

BOARDROOM 4

**Dr. Katherine L. Morse**
*Instructor*

**Prerequisite:** A general understanding of distributed simulation. An understanding of the Distributed Simulation Engineering and Execution Process (DSEEP) is beneficial.
**Note:** A one-time fee of $75.00 allows you to attend any/all tutorials that are offered at this Workshop.

The FEAT [SISO-STD-012-2013] is an eXtensible Markup Language (XML) schema that provides a standardized format for recording federation agreements to increase their usability and reuse. The FEAT is designed to: Ensure federation and federate engineers accurately record all necessary agreements by providing a complete list of all potential agreements • Ensure agreements are recorded in a standardized, unambiguous manner • Enable federation participants to locate agreements rapidly or determine that a required agreement has not been recorded • Enforce internal consistency between related agreements • Enable the development of a new generation of federation engineering tools driven by the XML schema that reduce the cost, schedule, and risk of developing federations. • This tutorial leverages the FEAT User's Guide and Fuel Economy Federation FEAT example to illustrate the use of FEAT for a simple federation.

**The tutorial will cover:** FEAT structure including categories of agreements • Design patterns and reuse of existing schemas • Supporting tools and documents • Examples of applying FEAT to the Fuel Economy Federation

1530-1700

## AUGMENTED REALITY DEVELOPMENT

FORUM EAST 4

**Jerry Huggins**
*Instructor*

**Prerequisite:** A general understanding of modeling and simulation.
**Note:** A one-time fee of $75.00 allows you to attend any/all tutorials that are offered at this Workshop.

The tutorial provides an overview of development of commercially-available virtual, augmented, and mixed reality devices. Discussion will center on use case demonstrations and relevant integration considerations based on use cases developed at the Air Force Research Laboratory at Wright Patterson Air Force Base in Dayton, Ohio.

**The tutorial will cover** Overview of Past, Current, and Future AR and VR devices (Market availability and accessibility of commercial products and Integration of devices to specific applications) • Basics of developing with the Microsoft HoloLens using Unity 5.5 and visual studio. (Tools needed for development and best practices and Short tutorial on basic hologram creation) • Localization and its requirements including inside out tracking, outside in tracking, and depth sensing • Spatial registration and its requirements

**Project examples include:** AR NDE app • Inhance Digital's F-15 maintainer app • (Possible tactile manifest showcase)

1700-1900

## SISO SOCIAL

SALON 1

Please join us for this informal gathering! Food and drink will be available. Renew acquaintances, plan your week, and meet members of the Executive Committee, Standards Activity Committee, Conference Committee, and Planning & Review Panels along with our authors/presenters at the conference. Also, take a look around at the products and technology on display in the exhibitor booths.

# TUESDAY, SEPTEMBER 11

0715-0800 **NEWCOMERS' ORIENTATION BREAKFAST**
FORUM EAST 4

The Newcomers' Orientation is designed for those who have not previously participated in a Simulation Innovation Workshop (SIW). The session's goal is to help new participants gain maximum benefit from SIW and from their participation in the Simulation Interoperability Standards Organization (SISO). In this session, the SISO Leadership welcome the newcomers and answer questions relating to SISO's organization, principles, processes and SIW.

## PAPER PRESENTATIONS

### SYSTEM LIFECYCLE AND TECHNOLOGIES (SLT) TRACK
SALON 2

The System Lifecycle and Technologies (SLT) Track encompasses information that provides guidance on the selection and use of M&S standards and practices to support the System Lifecycle and corresponding technologies that address analysis, research and development, test and evaluation, training, acquisition, asset management, and system lifecycle strategies.

0830-0850 18F-SIW-008
**Perfect Circle Position and Orientation Analysis in Adaptive Threshold**
Jonica Tramposch

0850-0910 18F-SIW-046
**Lessons Learnt from Distributing Video Over an HLA Backbone**
Stefan Sandberg

0910-0930 18F-SIW-007
**Interoperability Testing Tools and Techniques**
Tom van Den Berg

0930-1000 **Discussion**
Peggy Gravitz

1000-1030 **Break**

1030-1050 18F-SIW-040
**CSEEP: The Consortium for the Study And Exploitation of Emergent Phenomena**
O. Thomas Holland

1050-1110 18F-SIW-025
**Exploration of Next Generation Technology Application to Modeling and Simulation (ENGTAM); An Update on Our Progress**
Chris McGroarty

1110-1130 18F-SIW-047
**Air Force Research Laboratory Modeling, Simulation and Analysis Support to the Air Force Strategic Development Planning & Experimentation (SDPE) Office**
Bret Givens

1130-1200 **Discussion**
Peggy Gravitz

1200 **Wrap-up & Adjourn**
Peggy Gravitz

## M&S SPECIALTY TOPICS (SPEC) TRACK

LEGACY NORTH 2

The M&S Specialty Topics (SPEC) Track is concerned with simulation technologies applied for a specific purpose such as augmented reality, medical, cyber security, space, human behavior, system/vehicle or weapon product development, Internet of Things (IoT), LVC interoperability, and command and control systems.

**0830-0850** 18F-SIW-004
**Tactical Data Links in a C2SIM Environment**
Lionel Khimeche

**0850-0910** 18F-SIW-023
**Healthcare Data and Models Need Standards**
Jacob Barhak

**0910-0930** 18F-SIW-012
**Integrated, Virtualized Training Using Game Engines, the Web, Learning Management Systems, and Predictive Performance**
Timothy Rodabaugh

**0930-1000** **Discussion**
Kevin Galvin

**1000-1030** **Break**

**1030-1050** 18F-SIW-035
**Quantum Annealing and Deep Learning: Advances for Virtual Humans**
Dan M. Davis

**1050-1110** 18F-SIW-030
**Ready Player Next – Paving the Path Toward Experiential Interoperability**
Paul Gustavson

**1110-1200** **Discussion**
Kevin Galvin

**1200** **Wrap-up & Adjourn**
Kevin Galvin

## SERVICES, PROCESSES, TOOLS AND DATA (SVCS) TRACK

SALON 3

The Services, Processes, Tools, and Data (SVCS) Track encompasses Technologies, frameworks, and methodologies that provide service or support for M&S in areas of: distributed simulation process; verification, validation, and accreditation; communication infrastructure; and simulation and environment reuse.

**0830-0850** 18F-SIW-022
**MSaaS Standards – Finding our Assets**
Simon Skinner

**0850-0910** 18F-SIW-016
**Models, Simulators and Data Considerations for Cloud Based Modeling and Simulation Infrastructures**
Saurabh Mittal

0910-0930 18F-SIW-001

**Towards a "Modelling and Simulation as a Service" capability in French Army: The SIAPI system for distributed education in regiments**

Jose Ruiz

0930-1000 **Discussion**

Randy Saunders

1000-1030 **Break**

1030-1050 18F-SIW-009

**Proposal of usage of Kubernetes to manage HLA federations**

Laurent Prignac

1050-1110 18F-SIW-006

**Using JavaBeans conventions in HLA-FOM data marshalling**

Tom van Den Berg

1110-1130 18F-SIW-038

**Extending Portico HLA to Federations of Federations with transport layer security**

Thomas Roth

1130-1200 **Discussion**

Randy Saunders

1200 **Wrap-up & Adjourn**

Randy Saunders

1330-1500 **GENERAL SESSION**

SALON 2

**Call to Order**

Paul Gustavson

SISO Conference Committee Chair

**Award Presentations**

Mark McCall

SISO Executive Director

**Keynote Speaker**

Dr. Elizabeth D'Andrea

Senior Consultant, SimVentions

**Grand Challenges Discussion**

Paul Gustavson

SISO Conference Committee Chair

## PAPER PRESENTATIONS

### SYSTEM LIFECYCLE AND TECHNOLOGIES (SLT) TRACK

SALON 2

The System Lifecycle and Technologies (SLT) Track encompasses information that provides guidance on the selection and use of M&S standards and practices to support the System Lifecycle and corresponding technologies that address analysis, research and development, test and evaluation, training, acquisition, asset management, and system lifecycle strategies.

**1530-1550** 18F-SIW-003
**Leveraging Modeling and Simulation to Generate Aircraft Performance Data for Intelligent Agent Development**
Jeremy May

**1550-1610** 18F-SIW-029
**Training in a Cyber-active Environment Using C2-Simulation Interoperation**
Mark Pullen

**1600-1700** **Discussion**
Peggy Gravitz

**1700** **Wrap-up & Adjourn**
Peggy Gravitz

### M&S SPECIALTY TOPICS (SPEC) TRACK

LEGACY NORTH 2

The M&S Specialty Topics (SPEC) Track is concerned with simulation technologies applied for a specific purpose such as augmented reality, medical, cyber security, space, human behavior, system/vehicle or weapon product development, Internet of Things (IoT), LVC interoperability, and command and control systems.

**1530-1550** 18F-SIW-026
**Modeling the Effects of a Cyber-Attack on the Tactical Edge**
Vikram Mittal

**1550-1610** 18F-SIW-041
**Cyber-Physical Security for a 5th Gen Training and Simulation Environment**
Chuck Louisell

**1610-1630** 18F-SIW-034
**Unifying Cyber M&S through Collaboration in SISO**
Katherine L. Morse

**1630-1700** **Discussion**
Kevin Galvin

**1700** **Wrap-up & Adjourn**
Kevin Galvin

## SERVICES, PROCESSES, TOOLS AND DATA (SVCS) TRACK

SALON 3

The Services, Processes, Tools, and Data (SVCS) Track encompasses Technologies, frameworks, and methodologies that provide service or support for M&S in areas of: distributed simulation process; verification, validation, and accreditation; communication infrastructure; and simulation and environment reuse.

**1530-1550** 18F-SIW-011

### Performance of Dead Reckoning Algorithms Across Technology Eras

David Ronnfeldt

**1550-1610** 18F-SIW-027

### DIS Version 8 Development Update

Bob Murray

**1610-1630** 18F-SIW-031

### Analysis and Optimization of Time-Management Services in CERTI 4.0

Martin Adelantado

**1630-1700**

### Discussion

Randy Saunders

**1700**

### Wrap-up & Adjourn

Randy Saunders

**1900-2100**

## ENUMERATIONS SPECIAL WORKING GROUP

FORUM WEST 1

The SAC Special Working Group Reference for Enumerations for Simulation publishes, maintains, and updates SISO-REF-010: Enumerations for Simulation Interoperability. SISO-REF-010 is an important resource for the entire simulation community, and we welcome all SISO members interested in enumerations usage for any standard or guidance products.

Lance Marrou
*Chair*

# WEDNESDAY, SEPTEMBER 12

## PAPER PRESENTATIONS

### SYSTEM LIFECYCLE AND TECHNOLOGIES (SLT) TRACK

SALON 2

The System Lifecycle and Technologies (SLT) Track encompasses information that provides guidance on the selection and use of M&S standards and practices to support the System Lifecycle and corresponding technologies that address analysis, research and development, test and evaluation, training, acquisition, asset management, and system lifecycle strategies.

**0830-0850** 18F-SIW-010
**Dynamic Representation for Evaluating the Effect of Moderators and Stress on Performance (DREEMS)**
Victor Middleton

**0850-0910** 18F-SIW-0036
**Innovative Education Technologies: Optimizing Future Information Comprehension Capabilities**
Dan M. Davis

**0910-0930** 18F-SIW-37
**Enhancing Education Menteeship: Improving On-Line Career Selection for STEM Personnel**
Dan M. Davis

**0930-1000** **Discussion**
Peggy Gravitz

**1000** **Wrap-up and Adjourn**
Peggy Gravitz

### M&S SPECIALTY TOPICS (SPEC) TRACK

LEGACY NORTH 2

The M&S Specialty Topics (SPEC) Track is concerned with simulation technologies applied for a specific purpose such as augmented reality, medical, cyber security, space, human behavior, system/vehicle or weapon product development, Internet of Things (IoT), LVC interoperability, and command and control systems.

**0830-0850** 18F-SIW-017
**One World Terrain using Unity Game Engine**
Jordan Dauble

**0850-0910** 18F-SIW-048
**The UFOS Framework Enabling Formalized Execution of Physics-integrated Descriptive Architecture Languages**
Gregory Haun

**0910-1000** **Discussion**
Kevin Galvin

**1000** **Wrap-up and Adjourn**
Kevin Galvin

## SERVICES, PROCESSES, TOOLS AND DATA (SVCS) TRACK

SALON 3

The Services, Processes, Tools, and Data (SVCS) Track encompasses technologies, frameworks, and methodologies that provide service or support for M&S in areas of: distributed simulation process; verification, validation, and accreditation; communication infrastructure; and simulation and environment reuse.

**0830-0850** 18F-SIW-021

### The M&S Standards Landscape

**Wim Huiskamp**

**0850-0910** 18F-SIW-018

### Update on Establishing a Standard for Sensor Materials

**Phuong Nguyen**

**0910-1000**

### Discussion

**Randy Saunders**

**1000**

### Wrap-up and Adjourn

**Randy Saunders**

# WORKING SESSIONS

## COMMON IMAGE GENERATOR INTERFACE (CIGI) PSG

SYMPOSIUM WEST

The PSG provides support for this SISO Standards Product: SISO-STD-013-2014, Standard for Common Image Generator Interface (CIGI), Version 4.0.

**0730-1000** **Simon Skinner**
**1030-1200** *Chair*

## HIGH LEVEL ARCHITECTURE (HLA) PDG

SYMPOSIUM EAST

**High Level Architecture (HLA) PDG -** On 5 February 2016, the IEEE Standards Association Standards Board approved three Project Authorization Requests for the revision of these IEEE 1516™ Standards:

- IEEE Std 1516™-2010, IEEE Standard for Modeling and Simulation High Level Architecture — Framework and Rules

- IEEE Std 1516.1™-2010, IEEE Standard for Modeling and Simulation High Level Architecture — Federate Interface Specification

- IEEE Std 1516.2™-2010, IEEE Standard for Modeling and Simulation High Level Architecture — Object Model Template Specification

**0730-1000** **Randy Saunders**
**1030-1200** *Chair*

## GUIDELINE FOR SCENARIO DEVELOPMENT (GSD) PDG

FORUM WEST 1

The PDG has developed a SISO Guidance Product for “Guideline on Scenario Development for Distributed Simulation Environments” and will be discussing transition to a Product Support Group.

**1030-1200** **Simon Vrieler**
*Chair*

## BASE OBJECT MODEL PSG
BOARDROOM 4

The BOM Product Support Group (PSG) supports the approved SISO-STD-003-2006 BOM Template Specification standard and the SISO-STD-003.1-2006 Guide for BOM Use and Implementation. The BOM PSG will serve as a central point for interpretations of product language, providing help desk support to the SISO community, and accepting, developing, and maintaining problem/change reports to support future product revision

1030-1200 **Paul Gustavson**
*Chair.*

## REUSE AND INTEROPERATION OF ENVIRONMENTAL DATA & PROCESSES (RIEDP) PDG
FORUM WEST 1

The PDG is developing products to harmonize environmental data representations and generation processes at a level after the source data stage, but before the run-time/proprietary stage, recognizing that there is a broad range within this band. This will be achieved by retaining the data form (or format) as close to the source data as possible in order to benefit from GIS tools; while at the same time keeping the internal data consistency (intrinsic correlation factor); and not introducing specific target application constraints at this level that should be addressed separately by each target application during run-time.

1330-1500 **Jean-Louis Gougeat**
1530-1700 *Chair*

## HUMAN PERFORMANCE MARKUP LANGUAGE (HPML) PDG
SYMPOSIUM EAST

The PDG is developing a SISO Standards Product for Human Performance Modeling Language. HPML is an XML schema-based language intended to cover all meaningful aspects of human performance measurement in various training and operational environments. The PDG is also developing the supplementary SISO Product Data Files.

1330-1500 **Courtney Dean**
*Chair*

## SPACE FEDERATION OBJECT MODEL PDG
BOARDROOM 4

The PDG is developing (1) a natural language, human readable overview, description and specification of the Space Reference FOM Federation Agreement; and (2) a set of computer-interpretable HLA 2010 FOM modules (XML) intended for consumption by HLA run-time infrastructure and other software tools.

1330-1500 **Björn Möller**
1530-1700 *Chair*

## LINK 11 A/B NETWORK SIMULATION STANDARD PDG
SYMPOSIUM BOARDROOM

The PDG is developing a standard for existing military simulations to exchange Link-11 A / B data using a single interoperable standard.

This will be a shared session with the EPLRS/SADL PDG.

## EPLRS/SADL PDG
SYMPOSIUM BOARDROOM

The PDG is developing a standard that defines the methods to simulate an EPLRS/SADL Network within a Distributed Interactive Simulation (DIS) or High Level Architecture (HLA) framework.

1330-1500 **Joe Sorroche**
*Chair*

## CLOUD-BASED MODELING & SIMULATION (CBMS) SG

LEGACY NORTH 2

Over the past few years, a significant number of SISO members have been engaged in M&S activities in the cloud. These and other early practitioners have produced practices and hard-learned lessons that would be valuable to others. The purpose of this study group is to identify and document the existing M&S in the cloud activities, document best practices, highlight lessons learned and identify where potential standards in order to facilitate adoption by other practitioners. The study group is organized into 3 different teams looking at cloud capabilities, models, and architecture. Specific study group tasks include:

- Catalog, describe, and analyze current efforts using M&S in the cloud, identifying the advantages and disadvantages of each approach.
- Conduct a literature review of SISO papers and other literature on M&S in the cloud.
- Provide emerging guidance, resources and support to emerging practitioners.
- Investigate the potential for standards to support cloud-based M&S.
- Demonstrate cloud-based M&S capabilities.

**1330-1500** **COL Robert Kewley or Dr Chuck Sanders**
**1530-1700** *Lead*

## DSEEP/DMAO PSG

SYMPOSIUM WEST

The PSG supports these SISO-sponsored IEEE Standards:

- IEEE Std 1730™-2010, IEEE Recommended Practice for Distributed Simulation Engineering and Execution Process (DSEEP) (Revision of IEEE Std 1516.3™-2003)
- IEEE Std 1730.1™-2013, IEEE Recommended Practice for Distributed Simulation Engineering and Execution Process Multi-Architecture Overlay (DMAO)

**1330-1500** **Bob Lutz**
*Chair*

## TACTICAL DIGITAL INFORMATION LINK – TECHNICAL ADVICE AND LEXICON FOR ENABLING SIMULATION (TADIL TALES) PSG

## LINK 16 PDG KICK-OFF MEETING

SYMPOSIUM BOARDROOM

The PSG supports this SISO Standards Product:

- SISO-STD-002-2006, Standard for Link 16 Simulations

**1530-1700** **Joe Sorroche**
**1900-2100** *Chair*

## INTEROPERABILITY BETWEEN WEB-BASED FEDERATES AND LVC FEDERATIONS (WEB LVC) PDG

SYMPOSIUM EAST

This PDG is developing a standard for a WebLVC protocol. The WebLVC protocol defines a standard way of passing simulation data between a web-based client application and a WebLVC server, which can participate in a federation on behalf of one or more web-based federates. WebLVC messages are encoded as JSON (JavaScript Object Notation) objects, passed via WebSockets. WebLVC is flexible enough to support representation of arbitrary types of objects and interactions (i.e. arbitrary Object Models). However, WebLVC does include a "Standard Object Model" definition based on the semantics of the DIS protocol, HLA's RPR FOM, and SISO Enumerations.

**1530-1700** **Len Granowetter**
*Chair*

## FEDERATION ENGINEERING AGREEMENTS TEMPLATE (FEAT) PSG

SYMPOSIUM WEST

The Federation Engineering Agreements Template (FEAT) benefits all developers, managers, and users of distributed simulations by providing an unambiguous format for recording agreements about the design and use of the distributed simulation. The FEAT also benefits this community by enabling the development of federation engineering tools that can read the XML schema and perform federation engineering tasks automatically.

The FEAT Product Support Group (PSG) supports the FEAT schema and associated reference products such as examples of application of the schema. The FEAT PSG supports the distributed simulation community by acting as a forum and library for FEAT-related information; providing technical support to users and developers by answering questions; and providing contact information for experts in different areas.

**1530-1700** **Katherine L. Morse**
*Chair*

# THURSDAY, SEPTEMBER 13

## WORKING SESSIONS

### EXPLORATION OF NEXT GENERATION TECHNOLOGY APPLICATIONS TO MODELING AND SIMULATION (ENGTAM) SSG

SALON 1

This group is executing these group-specific tasks:

- Capture and decompose common M&S program goals including accounting for non-functional requirements such as security, performance, risk, cost, and long-term sustainability.
- Explore the latest industry technology trends and available solutions, specifically focused on their applicability to the M&S domain. Examples include wearable technology, streaming, advanced hardware, cloud services, and data sharing applications.
- Account for security requirements and what the application each technology will need to consider.
- Consider other architecture quality requirements and management requirements such as risk, cost, and long-term sustainability, among others.
- Assist the M&S domain in staying informed of recent technology advancements and to understand their impacts to our current and future implementations.

0830-1000 **Chris McGroarty**
1030-1200 *Lead*

### HIGH LEVEL ARCHITECTURE (HLA) PDG

SALON 3

**High Level Architecture (HLA) PDG -** On 5 February 2016, the IEEE Standards Association Standards Board approved three Project Authorization Requests for the revision of these IEEE 1516TM Standards:

- IEEE Std 1516™-2010, IEEE Standard for Modeling and Simulation High Level Architecture — Framework and Rules
- IEEE Std 1516.1™-2010, IEEE Standard for Modeling and Simulation High Level Architecture — Federate Interface Specification
- IEEE Std 1516.2™-2010, IEEE Standard for Modeling and Simulation High Level Architecture — Object Model Template Specification

0730-1000 **Randy Saunders**
1030-1200 *Chair*

## DISTRIBUTED INTERACTIVE SIMULATION / REAL TIME PLATFORM REFERENCE FOM (DIS / RPR FOM) PSG

### RPR FOM PDG KICK-OFF MEETING

LEGACY NORTH 1

**Distributed Interactive Simulation (DIS) / Real Time Platform Reference FOM (RPR FOM) PSG** - in 2012, the DIS PDG published:

- IEEE Std 1278.1™-2012, IEEE Standard for Distributed Interactive Simulation - Application Protocols (a revision of IEEE Std 1278.1™-1995 and IEEE Std 1278.1a™-1998)

In 2015, the RPR FOM 2 PDG published:

- SISO-STD-001-2015, Standard for Guidance, Rationale, and Interoperability Models (GRIM) for the Real-time Platform Reference Federation Object Model (RPR FOM) Version 2.0
- SISO-STD-001.1-2015, Standard for Real-time Platform Reference Federation Object Model (RPR FOM) Version 2.0

On 14 Dec 2015, the EXCOM approved the formation of a new PSG from the DIS PSG that would incorporate responsibilities both DIS and RPR FOM products.

Working groups of the PSG meet regularly by teleconference for technical discussions and the PSG meets by teleconference to conduct business as needed.

A Product Nomination has been approved to form a RPR FOM PDG for the purpose of developing RPR FOM 3, a new standard based on the concepts embodied in IEEE Std 1278.1-2012, also known as DIS Version 7. This meeting will be the RPR FOM PDG Kick-off meeting.

The primary purpose of the DIS portion this meeting is to continue activities toward the development of Gen3 of the DIS Standard (Version 8) by reviewing the current status and approving such PCRs or concepts that are ready for PSG approval. Additional PCRs will be discussed during the meeting.

0800-1000 **RPR FOM PDG Kick-off**
Lance Marrou

1030-1200 **DIS Discussions (with break)**
Mark McCall
*Chair*

1530-1900 **DIS Discussions (with dinner break)**

## A STANDARDS PROFILE FOR M&S ACTIVITIES IN SUPPORT OF ACQUISITION ACTIVITIES (ACQM&S) PDG

LEGACY NORTH 2

Starting 9 Dec 2015, the PDG initiated a 270-day trial use period for two draft products. Users were asked to use the products and to share comments and suggestions about the products. To contribute, visit the PDG webpage, scroll to the bottom, and use the Comment Tracking System to provide inputs on these two draft SISO Products:

- SISO-GUIDE-005-DRAFT, Trial Use Guide for A Standards Profile for the Use of M&S in Support of Acquisition Activities, Volume 1
- SISO-REF-066-DRAFT, Trial Use Reference for A Standards Profile for the Use of M&S in Support of Acquisition Activities, Volume 2

0830-1000 Kenneth (Crash) Konwin
1030-1200 *Chair*

## COMMAND AND CONTROL SYSTEMS – SIMULATION SYSTEMS INTEROPERATION PDG/PSG

SYMPOSIUM EAST

The Command and Control Systems - Simulation Systems Interoperation (C2SIM) PDG and Product Support Group (PSG) together form one lifecycle product group empowered over the product lifecycle to develop and support products. The functions of the PDG and PSG are distinct, but memberships are common, and administrative reporting will be as one group to consolidate administrative overhead. In addition to new products under development, the PSG supports these two SISO Standards Products:

- SISO-STD-007-2008, Standard for Military Scenario Definition Language
- SISO-STD-011-2014, Standard for Coalition Battle Management Language (C-BML) Phase 1

**0830-1000** **J. Mark Pullen**
**1030-1200** *Co-Chair*

## HUMAN PERFORMANCE MARKUP LANGUAGE (HPML) PDG

SYMPOSIUM WEST

The PDG is developing a SISO Standards Product for Human Performance Modeling Language. HPML is an XML schema-based language intended to cover all meaningful aspects of human performance measurement in various training and operational environments. The PDG is also developing the supplementary SISO Product Data Files.

**1030-1200** **Courtney Dean**
*Chair*

## VERIFICATION, VALIDATION & ACCREDITATION/ACCEPTANCE PRODUCTS (VV&A PRODUCTS) PSG

BOARDROOM 4

The PSG supports these products:

- IEEE Std 1516.4™-2007, IEEE Recommended Practice for VV&A of a Federation — An Overlay to the High Level Architecture Federation Development and Execution Process
- SISO-GUIDE-001.1-2012, Guide for Generic Methodology for Verification and Validation (GM-VV) to Support Acceptance of Models, Simulations, and Data, GM-VV Volume 1: Introduction and Overview
- SISO-GUIDE-001.2-2013, Guide for Generic Methodology for Verification and Validation (GM-VV) to Support Acceptance of Models, Simulations, and Data, GM-VV Volume 2: Implementation Guide
- SISO-REF-2013, Reference for Generic Methodology for Verification and Validation (GM-VV) to Support Acceptance of Models, Simulations, and Data, GM-VV Vol. 3: Reference Manual

**0830-1000** **Simone Youngblood**
**1030-1200** *Chair*

1330-1500

## GENERAL SESSION
## LEVERAGING THE POWER OF SIMULATION: TAKEAWAYS

SALON 2

### Call to Order

Paul Gustavson
SISO Conference Committee Chair

### Track Discussions and Best Presentations

Peggy Gravitz
System Lifecycle & Technologies

Kevin Galvin
Modeling & Simulation Specialty Topics

Randy Sanders
Services, Processes, Tools, and Data

## WORKING SESSIONS

## CYBER MODELING AND SIMULATION SG

SYMPOSIUM WEST

The purpose of this study group is to identify key cyber M&S activities, document best practices, highlight lessons learned, and identify areas for potential standardization in order to facilitate adoption by the cyber M&S community.

1530-1700 Katherine Morse
*Lead*

# FRIDAY, SEPTEMBER 14

SPECIAL SESSION

## M&S ENTERPRISE SERVICES

LEGACY NORTH 2

0900-1500 **Gabe Diaz**
DMSCO
*Coordinator*

**Overview:** The U.S. DoD's Defense Modeling and Simulation Coordination Office (DMSCO) and the Simulation Interoperability Standards Organization (SISO) are hosting a joint working group on M&S Architectures and M&S Enterprise Services. For the purposes of this meeting, we are defining Enterprise Services as any function, tool or capability that is made broadly available to support simulations or simulation exercises during simulation setup, execution or after-action. This may include, but is not limited to, data preparation, data delivery, computationally-intensive calculation, simulation management, registries and repositories.

The focus of the group will be on identifying M&S Enterprise capabilities Services available within DoD for inclusion in a modular architecture and for integration with LVC capabilities.

**Objectives:**

- Identify existing or planned Enterprise Services
- Discuss the risks to providing and using Enterprise Services
- Share challenges, best practices and lessons learned from developing and using Enterprise Services.

**Who Should Attend:**

- Defense program managers, simulation engineers, and Enterprise Services managers
- Industry chief technology officers, commercial engineers and project managers

# SISO SPONSORS

## STRATEGIC ORGANIZATIONAL MEMBER

The Department of Defense (DoD) Modeling and Simulation Coordination Office (DMSCO) is the focal point for coordinating all matters regarding modeling and simulation across the DoD for the Undersecretary of Defense (Acquisition, Technology and Logistics) (USD(AT&L)). Modeling and simulation (M&S) is an enabler of warfighting capabilities. It helps to save lives, to save taxpayer dollars, and to improve operational readiness. DMSCO assists the DoD to use M&S in a cost-effective manner through tools, policies, standards, guidance, and collaborative forums.

The use of simulations and simulators to provide training procedures improves individual and collective capabilities. Military forces train with a wide range of simulated weapons, ships, aircraft, and other vehicles in conjunction with live training on actual equipment. Within the military, and in other professions, M&S helps provide a safer and lower resource-intensive rehearsal capability for a wide variety of training.

Training is one of the most employed of the M&S applications, but there are many other ways that M&S enables Department's functions. In particular, M&S is used to analyze and inform the Department decisions in acquiring new capabilities, adopting new tactics, processing intelligence, and testing systems before they are put into the hands of our fighting forces.

Established in 2006, with a heritage back to 1991, DMSCO fosters M&S interoperability and reuse to improve value and mission effectiveness for the Department's M&S Enterprise. The Department's M&S Enterprise consists of the military services (the Army, Marines, Navy, and Air Force); the Joint Staff; and seven communities (Acquisition, Analysis, Intelligence, Experimentation, Planning, Test/Evaluation, and Training). All parts of the whole help ensure DoD's readiness to provide for national security. The M&S Enterprise also includes other US Government agencies and international military partners. As a pivotal organization, DMSCO recommends policies, plans, and programs to the USD(AT&L) that supports the M&S Strategic Vision and DoD priorities. DMSCO can be viewed as having three distinct arenas: Operations, Governance and Technology.

Operations: DMSCO manages the sustainment and operation of enterprise level M&S capabilities - tools, data, and services - in support of USD(AT&L). DMSCO also serves as the Department's lead for M&S standards and is the point of contact for International M&S activities.

Governance: DMSCO develops strategic policy, guidance, standards, and practices, with the advice and assistance of the M&S Steering Committee (M&S SC). DMSCO also provides the Secretariat (administrative) functions for the M&S SC. As a result, the policies and standards help educate the Department's workforce, promote interoperability and reuse, and enable the DoD M&S Enterprise.

Technology: DMSCO provides technical expertise to the USD(AT&L) and provides technical coordination to M&S Enterprise and the M&S SC on DoD M&S architectures, software, computing, data, and other related enabling technologies.

NATO Modelling and Simulation Group (NMSG) is part of the NATO Science and Technology Organization (STO). The mission of the NMSG is to promote co-operation among Alliance bodies, NATO member nations and partner nations to maximise the effective utilisation of M&S.

The NMSG has been designated by the North Atlantic Council (NAC) to supervise the implementation of the NATO Modelling and Simulation Master Plan (NMSMP) and also to propose regular updates to the NMSMP. The NMSG is the delegated tasking authority on M&S interoperability standards within NATO. The NMSG M&S Standards Subgroup (MS3), consisting of NATO and national M&S experts, created and maintains the M&S Standards Profile document (published under the NATO reference AMSP-01). The second release, AMSP-01(B), was promulgated in Jan 2012 and includes more than 40 M&S related standards. The identified standards/products were included in AMSP-01 following a formal selection and classification process by the MS3 experts and is therefore considered as relevant for the NATO M&S domain. The standards and products included in AMSP-01 are formally mandated by NATO when supported by a specific STANAG. The NMSG and SISO have signed a formal technical cooperation agreement in 2007 which underpins the importance of M&S standards to the NMSG. For more information visit us at www.sto.nato.int

AEgis TECHNOLOGIES

### SUPPORTING ORGANIZATIONAL MEMBER

AEgis Technologies creates innovative solutions to challenges requiring specialized modeling and simulation knowledge; expertise in simulation and software development, integration, and analysis; training simulator development; HLA/DIS technologies; C4I-to-Simulation interoperability; object-oriented analysis/design; and VV&A programs for software/simulations. AEgis provides specialized Photonics/MEMS, electro-optic, infrared/LADAR services/products. Commercial software offerings include HLA LabWorksÔ dramatically reduces HLA simulation/ federation development costs, acslXtremeÔ provides outstanding capabilities to model real world systems using continuous simulation, and BattleStormâ provides a low-cost, flexible simulation framework on which multiple simulators are built. AEgis has offices in Huntsville, Orlando, Albuquerque, Rhode Island, Washington D.C., Canada and Europe. Visit their web site at www.aegistg.com.

APTIMA®
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Aptima's mission is to engineer tools and systems that increase human capabilities. Our scientists study how humans think and learn in today's technology-rich networked environments, and we use that knowledge to solve problems and provide solutions in defense, homeland security, healthcare, aviation and cyber security. Aptima's solutions span the human continuum from the micro to the macro – from the neural and individual level, to teams and large groups, and even to complete societies. To learn more, visit www.aptima.com.

APL
The Johns Hopkins University
APPLIED PHYSICS LABORATORY

### SUPPORTING ORGANIZATIONAL MEMBER

A not-for-profit division of The Johns Hopkins University, the Applied Physics Laboratory (APL) is a research and development organization dedicated to solving critical problems of national security. APL's 4,500+ employees work on over 400 programs serving the U.S. Navy, U.S. Air Force, U.S. Army, the Office of the Secretary of Defense, the National Aeronautics and Space Administration, and numerous other government agencies. As a University Affiliated Research Center, APL often serves as a liaison between government and industry. Key areas of research for scientists and engineers at APL include sensors, information processing, command and control systems, navigation, guidance, propulsion, aerodynamics, oceanography, space physics, sonar, software development, signal processing, materials, biomedicine, and modeling and simulation (M&S). In M&S, APL is a leader in simulation interoperability standards and techniques, and in verification, validation, and accreditation (VV&A). For more information on APL, see the APL web site at www.jhuapl.edu.


### SUPPORTING ORGANIZATIONAL MEMBER

CAE is a global leader in the provision of simulation and control technologies and training solutions for aerospace, defense and marine markets. CAE employs more than 6,000 people around the world and generates revenues in excess of C$1 billion. CAE offers HLA compliant simulation development, control, and visualization tools under the STRIVE(tm) product line; a simulation-based eLearning/ADL (seLearning) development and deployment environment under the Simfinity(tm) product line; plus modeling & simulation training, support and professional services. Visit their web site at www.cae.com.


Pitch Technologies is a leading provider of innovative state-of-the-art interoperability products, services and solutions for development of distributed systems. Our products and solutions are being used by some of the largest and most complex simulation programs in government and industry around the world.

Our experts provide the management, guidance and technical support you need to successfully integrate distributed simulation systems into an interoperable solution that meets your needs and reduces cost, risk and time-to-market.

Pitch Technologies expanding product family consists of infrastructure products, development tools and runtime tools allowing the design, integration and execution of the most complex LVC environments and supports the latest IEEE 1516 HLA Evolved standard. Pitch products have been designed to meet our customer's highest demands in terms of performance, robustness and ease-of-use.

Pitch Technologies also offers a complete range of HLA training courses targeted at general management, technical executives, project managers, developers and system integrators. Visit www.pitch.se for more information.

PRESAGIS

### SUPPORTING ORGANIZATIONAL MEMBER

Presagis is a global leader providing commercial-off-the-shelf (COTS) modeling, simulation and embedded graphics solutions to the aerospace and defense markets and is the only developer to deliver a unified COTS software portfolio based on open-standards. Presagis combines cutting-edge technology with innovative services to help customers streamline workflow, reduce project risks, create detailed models and complex simulations, in addition to developing DO-178B certifiable applications. The company services more than 1,000 active customers worldwide, including many of the world's most respected organizations such as Boeing, Lockheed Martin, Airbus, BAE Systems and CAE. For more information, visit www.presagis.com.

SimPhonics

### SUPPORTING ORGANIZATIONAL MEMBER

SimPhonics is a leader in high fidelity simulation audio and networked radio systems. Well ahead of it's time, V+, a fifth generation visual programming system, forms the heart of SimPhonics software products providing extensible standards based solutions. From FAA Level D audio simulation to realistic radio modeling for DIS/HLA, SimPhonics is committed to evolving technology in order to bring unmatched quality to our customers around the world. For nearly two decades, SimPhonics has fielded thousands of systems and has made significant contributions to establishing standards to improve interoperability. Visit www.simphonics.com for COTS pricing and technical data.

SimVentions

Imagine. Create. Explore. Discover.

SimVentions is a privately held business, incorporated in the state of Virginia in 2000. Our corporate headquarters is located in Fredericksburg, Virginia with additional offices in Virginia Beach, Quantico, Dahlgren, and Washington D.C. At SimVentions, expressing what we do is quite simple: We develop innovative solutions that strengthen and sustain U.S. Military personnel and technology. This is true whether it be for modeling and simulation, software engineering, systems engineering, or cybersecurity. A few of our key solutions include InformeDB Enterprise, which is a digital engineering tool, EMBR Portal, which is a tool for cataloging digital artifacts within the system engineering and simulation community, numerous tactical software components for the Navy and Marine Corps, object-oriented components for software applications, interactive courseware modules for training, and program management and process tools in support of the rapid insertion of technology and components to warfighters.

Specific to M&S, SimVentions' expertise lies in the development and use of DIS, HLA and other distributed technologies such as web services, service-oriented architectures (SOA), and, within the tactical community, Object Management Group's (OMG) Data Distribution Service (DDS), and The Open Group's Future Airborne Capability Environment (FACE). SimVentions has been an integral part in the research, standardization and development of various processes and concepts including Base Object Models (BOMs), Simulation Reference Markup Language (SRML), HLA Evolved, Federation Development and Execution Process (FEDEP),Coalition Battle Management Language (C-BML), Military Scenario Definition Language (MSDL), use and application of Metadata within the M&S community, and all with an eye for supporting composability and reuse within the greater SISO and M&S community. Additional experience includes the development of a suite of tools to facilitate the development of HLA federations and analysis of DIS simulations. SimVentions also has significant experience and background supporting various DoD related activities including the surface Navy in Dahlgren, VA.  SimVention's most recent achievement was as lead developer of the Tactical Simulator (TACSIM) supporting the Navy's Surface Electronic Warfare Improvement Program (SEWIP). TACSIM incorporates the SLQ-32's tactical code and interfaces to emulate a real shipboard environment for system and subsystem test and validation.  TACSIM is also deployed at Navy training commands to assist instructors in training students with scenario driven exercises.  By design, development of TACSIM has removed the requirement for availability and expensive procurement of target hardware, resulting in significant cost and schedule savings.


## SUPPORTING ORGANIZATIONAL MEMBER

Thales is a global technology leader for the Defence & Security and the Aerospace & Transport markets. In 2010, the company generated revenues of €13.1 billion with 68,000 employees in 50 countries. With its 22,500 engineers and researchers, Thales has a unique capability to design, develop and deploy equipment, systems and services that meet the most complex security requirements. Thales has an exceptional international footprint, with operations around the world working with customers as local partners.

Thales recognizes the importance of modelling and simulation in support of the systems engineering lifecycle, from concept development and experimentation through to testing and evaluation. Thales is also a world-leader in providing simulation-based training systems. SISO is considered an important forum within which to share advanced methods and technologies and to draw upon complementary capabilities to meet the specific requirements of our customers.


Trideum Corporation is a privately owned and operated small business, founded in 2005, headquartered in Huntsville, Alabama. Trideum specializes in providing solutions and services in the area of Modeling & Simulation (M&S), Test & Evaluation (T&E), Capabilities Analysis and Management, and Training/Training Development.

In addition to our Huntsville headquarters, Trideum operates a Program Office in Leavenworth, Kansas, as well as Field Offices in the Northern and Tidewater regions of Virginia; Orlando, Florida; Washington; Arizona; Ohio; and Texas.

Trideum has a broad range of expertise gained through hands-on program execution. Our offering ranges from strategic to operational, technical, and analytical requirements planning to engineering analysis, design, development and integration. We are involved in the development, design, building and operation of synthetic environments for testing, training and experimentation.

Our Quality Management System (QMS) is certified in accordance with ISO 9001:2008. Trideum was named to INC5000 in 2015, as one of America's fastest growing companies.


MÄK Technologies develops software to link, simulate and visualize the virtual world. We create tools and toolkits for distributed simulations, develop PC-based military tactical trainers, craft custom solutions, and research and develop the latest simulation technologies. We build commercial off the shelf simulation tools that are flexible, portable and supported. Whether you choose our best-selling networking toolkit VR-Link or the high performance MÄK RTI, you have purchased a product backed by the industry's leading distributed simulation experts. Please visit www.mak.com for more information.

# ABSTRACTS

18F-SIW-001

## Towards a "Modelling and Simulation as a Service" capability in French Army: The SIAPI system for distributed education in regiments

Tuesday, Salon 3, 0910-0930, SVCS Track
Jose Ruiz | ruiz__jose@hotmail.com

In the French Army, education in regiments is performed by using simulation. This activity needs simulation experts and time to prepare and manage efficient synthetic environments in all regiment locations. In 2010s, the French Army Staff decided to solve this problem by mutualizing resources (tools and staff). The first decision was to select a unique simulation framework (currently Virtual Battlespace Simulation). The second decision was to share data associated to this common framework (terrain data, 3D models of simulated entities…). The third decision was to connect all simulation platforms in military schools and regiments to the national Defense wide-area network in aim to support the deployment of simulation resources. This new organization of distributed education turns out to be a specified implementation of the new concept of "Modelling and Simulation as a Service" defined by the NATO Modelling & Simulation Group. The aim of this paper is to describe and provide feedback of the French SIAPI system, which supports the preparation of mutualized resources, their deployment in regiments and their remote control and log during education sessions.

18F-SIW-003

## Leveraging Modeling and Simulation to Generate Aircraft Performance Data for Intelligent Agent Development

Tuesday, Salon 2, 1530-1550, SLT Track
Eric Watz | ewatz@aptima.com

Developing and evaluating intelligent agent models for tactical training requires a simulation testbed that can satisfy the unusual requirements and a diversity of data and model assumptions. Both developers and evaluators must assess the robustness of agents to a wide range of tactical conditions. Thus, they require the ability to generate simulation runs that sample the potentially massive space of plausible alternative scenarios and courses of action and they require automated measures of agent performance and mission outcomes to evaluate those runs. Developers may also need simulation execution data and measurements to machine-learn mission states and tactical actions.

This paper will describe our testbed which was developed specifically to support development and evaluation of advanced tactical air agents. The testbed provides batch control for users to systematically control fuel and weapons loads in tactical scenarios, along with a highly responsive enemy agent in response to the intelligent maneuvers of agents. These provide the variability that developers and evaluators need to generate massive numbers of runs. Tactical subject matter experts and modeling researchers have vetted the measurement infrastructure and have provided access to dozens of process and outcome measures of these runs. Design elements, architecture implications and lessons learned will be showcased and discussed.

18F-SIW-004

## Tactical Data Links in a C2SIM Environment

Tuesday, North 2, 0830-0850, SPEC Track
Lionel Khimeche | lionel.khimeche@intradef.gouv.fr

Tactical Data Link (TDL) are a set of standards for Command and Control (C2) Systems to continuously exchange operational situations, orders and reports with other C2 or TDL enabled platforms such as fighters or ships.

This paper focus on proposing a solution for efficiently stimulating one or many C2 systems with a simulated complex tactical environment using the TDL interfaces of the C2 System. It relies on the ongoing work made by the C2SIM Product Development Group (PDG) of the Simulation Interoperability Standards Organization (SISO). C2SIM standard which is under development aims to ease C2 and Simulation interoperability improving both the previous SISO-STD-007-2008 Standard for Military Standard Definition Language (MSDL) and the SISO-STD-011-2015 Standard for Coalition Battle Management Language (C-BML). It is proposed to develop a C2SIM TDL extension to define a standard and straightforward way of exchanging TDL messages between simulation / simulators and C2 systems.

Such extension is intending to focus on TDL functions and not to detail technical mechanisms of real TDL implementations. The purpose is to make it accessible without a significant technical TDL knowledge. The approach relies on the definition of a data model, called LinkX, which defines the set of common services, messages, types and dictionaries reflecting the main concepts of the different TDL implementations (Link 11, Link 16, Link 22, VMF, etc). This data model is proposed to be implemented as a C2SIM extension.

This paper first describes the background information about the use of TDL in simulations which illustrates the needs for the proposed approach. The LinkX data model is then presented with the methodology used to design it. The paper provides early feedbacks about the preliminary implementation work of this data model as a C2SIM extension based on preliminary versions of the standard, and presents the experimental frame that will be developed to assess the extension.

18F-SIW-006

## Using JavaBeans conventions in HLA-FOM data marshalling

Tuesday, Salon 3, 1050-1110, SVCS Track
Tom van den Berg | tom.vandenberg@tno.nl

Data marshalling is one of the more laborious and error-prone tasks of using an HLA-RTI. It involves developing encoding and decoding functions for FOM class attributes and parameters to transform their value in a format that can be transmitted over the network. At run-time data marshalling probably takes the most CPU cycles, after the execution of the simulation model itself. HLA-RTI implementations offer basic encoder helpers to support the developer in data marshalling. However, this still involves considerable engineering work. Consequently tool-vendors fill in the gap by providing tools to generate Java or C++ middleware code that take care of data marshalling and that go well beyond to what the basic encoder helpers provide. E.g. a feature-rich object-oriented interface on top of the HLA-RTI interface, following the HLA-FOM class structure for the Java or C++ class hierarchy.

This paper takes another, more minimalistic approach to data marshalling, yet addressing the engineering challenges in data marshalling. It investigates the use of the JavaBeans conventions to create a simple and straight forward Java class structure that mimics the FOM class structure, without any dependency on an HLA-RTI. The data structure consists solely of Plain Old Java Objects (POJOs). The Java reflection API is used to introspect this data structure at run-time and automatically serialize/deserialize the data according to the HLA-OMT encoding rules. Because the data structure consists solely of POJOs, it is easy to reuse the data structure between modeling frameworks. By following the JavaBeans conventions it also becomes straight forward to serialize the data structure to file for persistent storage using standard Java object serialization or using open source JSON libraries such as Jackson. Lastly, this paper will briefly discuss performance.

18F-SIW-007

## Interoperability testing tools and techniques

Tuesday, Salon 2, 0910-0930, SLT Track

Tom van den Berg | tom.vandenberg@tno.nl

The integration of distributed simulation components is a complex and time-consuming task requiring extensive testing of components and interfaces. Testing involves amongst others the design and development of test cases based on the simulation conceptual model and scenario, the execution of test cases against the simulation components, and the analysis and evaluation of test results. Integration and testing is a well known challenge in distributed simulation environment engineering, but nevertheless the effort is often under-estimated, resulting in project delays and cost-overruns.

At the same time testing is not unique to the simulation domain. For example, testing in the software domain has a long standing history in which various standards, techniques and (open source) software frameworks related to testing have been developed and matured over time. Well known are the xUnit test frameworks and associated tooling for build and test automation. Given this rich and long standing history it makes sense to look at the software domain and see what tools and techniques can be applied to the simulation domain to help reduce the test effort and improve the quality of testing. One of the promising techniques in the software domain is called model based testing.

This paper provides an interim status update of an ongoing R&D project at TNO related to testing tools and techniques for simulation components. In particular this paper provides an overview of model based testing and how this technique can be applied to simulation interoperability testing.

18F-SIW-008

## Perfect Circle Position and Orientation Analysis in Adaptive Threshold

Tuesday, Salon 2, 0830-0850, SLT Track

Jonica Tramposch | jonica.tramposch@ngc.com

The well-known challenge of Virtual Air Refueling (VAR) is that a great degree of accuracy and precision must be achieved in time and space by distributed devices interoperating over wide area networks. This challenge is met by IEEE-1278.1 Standards. A less appreciated challenge is the rigorous quantitative testing of these standards. In order to test IEEE 1278.1 position and orientation threshold compliance, Mobility Air Force (MAF) VAR aircraft entities have been asked to fly in a circle while Entity State PDUs are recorded. Analysis of this data then reveals temporal, computational, and conceptual errors in the implementation. In order to identify the best case scenario for Entity State PDU issuance and threshold adherence a simulator can achieve by following IEEE 1278.1 guidelines, data for a perfect circle was created and subjected to the same analysis as the simulator data. This paper presents position and orientation analysis for perfect circle data in adaptive threshold at 30 Hz and 60 Hz frame rates, which provides an analysis reference that guides assessment and troubleshooting of operational simulators in their efforts to achieve IEEE 1278.1 compliance.

18F-SIW-009

## Proposal of usage of Kubernetes to manage HLA federations

Tuesday, Salon 3, 1030-1050, SVCS Track

Laurent Prignac | laurent.prignac@mbda-systems.com

MBDA has developed and uses HLA based simulations to assess system performances. This kind of simulation is a federation composed of various federates which are managed by a dedicated federate the simulation manager. The simulation manager is in charge of the management of federates of the federation and MBDA has developed its own one to manage the federation in performances simulation.

This presentation presents simulation manager and proposes to use Kubernetes to offers PaaS (Platform As A Service). Federates could be declares and store in a registry and Kubernetes manage federations on the infrastructure.

18F-SIW-010

## Dynamic Representation for Evaluating the Effect of Moderators and Stress on Performance (DREEMS)

Wednesday, Salon 2, 0830-0850, SLT Track

Victor Middleton | middletv@woh.rr.com

Fatigue and other stress factors (stressors) affect Ground Soldier and Small Unit (SSU) operational effectiveness. Analysts require an understanding of the causes and effects of fatigue and supporting data (i.e., to characterize fatigue) and need a way to represent and assess the cognitive effects of fatigue on decision making and physical activities. This paper is about a Dynamic Representation for Evaluating the Effect of Moderators and Stress on Performance (DREEMS). DREEMS is a research program to characterize fatigue and other stressors, define the elements of operation effectiveness in terms of critical tasks and processes, and develop a methodology for finding, analyzing, and using data to characterize the effects of fatigue on operational effectiveness. DREEMS provides the knowledge and data to support modeling the degradation in performance of physical and decision-making tasks in a constructive simulation.

18F-SIW-011

## Performance of Dead Reckoning Algorithms Across Technology Eras

Tuesday, Salon 3, 1530-1550, SVCS Track

**Primary Author:** Peter Ryan | peter.ryan@dst.defence.gov.au
**Presenter:** David Ronnfeldt

Dead reckoning (DR) is employed in Advanced Distributed Simulation to reduce the need to continually update a simulated entity's state information. The IEEE 1278.1 Distributed Interactive Simulation (DIS) protocol provides a standard set of 9 algorithms for entity position and orientation dead reckoning. Early work on the performance of these algorithms was reported by Hines and Towers sponsored by the then Advanced Research Projects Agency to assess the functionality of a distributed warfighting environment with real and simulated entities. These authors also fortunately included C source code and sample results that were used to regenerate the 1994 model. This code and these results can be used as benchmarks for assessing DR algorithm performance from 1994 to the present era where CPU speed is far greater. Results show that DR performance in even a simple modern processor such as a Raspberry Pi is far superior to the most advanced systems of 1994. Relative performance of the standard algorithms also shows similar trends across technology eras with the algorithms that use entity orientation always running far slower. Estimates of processor time can also be determined theoretically from counting the number of floating point operations that each algorithm processes. These results are relevant to the approach that will be adopted for the next generation of DIS and other simulation protocols such as the Real Time Platform Reference Object Model.

18F-SIW-012

## Integrated, Virtualized Training Using Game Engines, the Web, Learning Management Systems, and Predictive Performance

Tuesday, North 2, 0910-0930, SPEC Track

Timothy Rodabaugh | trodabau@ball.com

Virtualized training systems are being widely adopted by the military and industry alike as a cost effective supplement or replacement for traditional training methods. In conjunction with the United States School of Aerospace Medicine (USAFSAM) and the Air Force Research Laboratory's Cognitive Models and Agents Branch (RHAC), the Gaming Research Integration for Learning Laboratory (GRILL) developed a prototype virtualized medical device simulation. A detailed 3D model of an intravenous (IV) pump was developed and the model imported into Unreal Engine. Device functionality was scripted so that the virtual device behaves as the real device. Publishing to HTML5 allows the simulation to run in the browser. Seamless integration with the Blackboard Learning Management System (LMS) was accomplished by adding OAUTH and REST web service functionality to Unreal Engine. Finally, the Air Force Research

Laboratory's patented Predictive Performance Optimization (PPO) cognitive tool examines score history to determine a personalized training schedule. Integration of a game engine, HTML 5, LMS, and predictive performance make this a novel project for the Air Force that has the potential to serve as a model for future virtualized training.

18F-SIW-016

## Models, Simulators and Data Considerations for Cloud Based Modeling and Simulation Infrastructures

Tuesday, Salon 3, 0850-0910, SVCS Track

Saurabh Mittal | smittal@duniptech.com

The Cloud Based Modeling and Simulation (CBMS) Study Group intends to provide an overview of existing Cloud-Based M&S activities and various considerations that would aid the adoption of cloud-based M&S infrastructures. The Models, Simulators and Data subgroup within the CBMS Study group intends to analyze these efforts from interoperability perspective for the models, simulators, data and metadata aspects. The modeling aspect will elaborate on the semantic model interoperability and various modeling workbench architectures and their usage that employ cloud-based infrastructure. The simulator aspect will elaborate on various types of simulator architectures and their usage, for example, master-slave, parallel, distributed, etc., and how time management is implemented in these various simulation architectures. The paper will also elaborate on the protocols between the modeling and simulation aspects. These protocols ensure the correct execution of the model with the underlying simulation platform. Some of these protocols include, Distributed Interactive Simulation (DIS), High Level Architecture (HLA), and the formal Discrete Event Systems (DEVS) specifications. The presentation will then elaborate on the integration of these two aspects in cloud environments. The data aspect will elaborate on the data-ready simulation and simulation-ready data considerations. The metadata aspect will elaborate on existing applicable standards and various metadata considerations. The paper will close with guidance and recommendations for the models, simulators, data and metadata aspects.

18F-SIW-017

## One World Terrain using Unity Game Engine

Wednesday, North 2, 0830-0850, SPEC Track

Jordan Dauble | Jordan.Dauble@simblocks.io

SimBlocks.io has developed an innovative software tool that enables the popular Unity engine to stream whole-earth global terrain information for multi-domain Live-Virtual-Constructive & Gaming (LVC&G) simulation. Our software plugin for Unity has been developed as part of a Synthetic Training Environment prototype for the U.S. Army Soldier Lethality modernization initiative to more realistically train soldiers for upcoming missions at any location in the world. Our solution is able to stream multiple levels of detail for terrain imagery, elevation data, and high-detailed defense-specific content at a global scale. SimBlocks.io's modular software middleware also supports portable OpenFlight, SE CORE, and NPSI terrain databases as well as simulation interoperability standards such as Data Distribution Service (DDS), DIS (Distributed Interactive Simulation), CIGI (Common Image Generator Interface), and WebLVC (Web Live Virtual Constructive).

Using commercial game engines is desirable in the defense community because game engines enable rapid development of serious simulations using advanced capabilities such as high-fidelity graphics, dynamic physical environments, reactive AI-driven characters, and support the latest virtual reality and augmented reality devices out of the box.

This presentation will discuss our approach to overcome several technical challenges to visualize the globe on demand and meet high level Army objectives for the Synthetic Training Environment using the Unity game engine.

SimBlocks.io is a small business specializing in connecting commercial gaming technology with military simulation training systems through our support of industry standards for 3D models, geospatial terrain, and communication interoperability.

18F-SIW-018

## Update on Establishing a Standard for Sensor Materials

Wednesday, Salon 3, 0850-0910, SVCS Track

Phuong Nguyen | phuong.t.nguyen@leidos.com

This presentation reports on the SE Core efforts to establishment an industry standard sensor material specification for modeling, simulation and training geospatial terrain database production. In 2016, SE Core presented their work on creating standard sensor material specification to the Simulation Interoperability Standards Organization (SISO) Simulation Innovation Workshop. In the paper and presentation SE Core solicited input from the modeling, simulation and training community. At the end of the presentation it was suggested that when SE Core had complete this work, to develop mature material specification, a paper/presentation update would be desired. This proposed presentation is that update.

It is clear that SE Core does not control the design of the runtime sensor rendering engines, and clearly cannot dictate the sensor material list for the runtime sensor models. But to produce databases for the U.S. Army SE Core must establish a sensor material representation that can support multiple disparate runtime sensor rendering engines. In summary, SE Core has developed a production process, using our sensor material specification, to produce material maps (like texture maps) for all vehicle models, 3D feature models and terrain surface coverages. We have created a method to store these materials in a data representation to support conversion to each runtime specific material maps. We capture the materials in independent named-layers, providing the ability to represent the materials in a general way, supporting the easy addition of new material without reprocessing or reformatting, and enabling direct output to the target material maps or multilayer material systems.

18F-SIW-021

## The M&S Standards Landscape

Wednesday, Salon 3, 0830-0850, SVCS Track

Wim Huiskamp | wim.huiskamp@tno.nl

The primary mission of the NATO Modelling and Simulation (M&S) Group (NMSG) is to promote co-operation among its members to maximise the effective utilisation of M&S. One of the main NMSG objectives is to promote M&S standardisation. The NMSG works closely with SISO to develop new or improved interoperability standards. The challenge is to identify where M&S interoperability gaps exist and how to address these gaps. The NMSG approach is to categorise the existing and recommended standards (e.g. HLA) according to the DSEEP steps. The resulting mapping is nicknamed the ''M&S Landscape". This presentation will discuss the current M&S Landscape and the identified gaps from the NMSG perspective. The authors don't plan on preparing a full paper, but see their presentation as a starting point for discussion with the M&S community on the need for more SISO and NMSG guidance on what standards are missing and how to capture that in a roadmap for standards development.

18F-SIW-022

## MSaaS Standards - Finding Our Assets

Tuesday, Salon 3, 0830-0850, SVCS Track

Simon Skinner | simon.skinner@uk.thalesgroup.com

There is great interest in the concept of Modelling and Simulation as a Service, and as the work moves from research into implementation there is a need to discuss how standards to enable composable simulations will be generated and maintained.

Our presentation will provide some initial views about standardization of metadata used to describe M&S assets and so enable global search for simulation content (discovery) within repositories of these assets held by governments and industry internationally.

Work drawn from the UK Dstl Architecture Infrastructure and Management of Simulation (AIMS) research programme as well as the NATO task groups MSG-136 and MSG-164 will be used to guide the discussion, and to look at forming a community of interest that may lead into a SISO study group.

18F-SIW-023

## Healthcare Data and Models Need Standards

Tuesday, North 2, 0850-0910, SPEC Track

Jacob Barhak | jacob.barhak@gmail.com

Medical knowledge that used to be held by humans or published in paper form is now slowly being encoded into computers. This transition is not trivial and is still ongoing. Fortunately Electronic Medical Records (EMR) seem to have replaced old paper work in the modern world. This opens opportunities that are noticed by the modeling community and modeling efforts are on the way. However, privacy constraints prohibit the free exchange of individual data. Therefore despite existence of data, modelers are restricted with regards to data access. However, model exchange can be the future remedy to this problem. Even when it is impossible to transfer data, it may be possible to transfer models that describe the data between different entities. Moreover, summary data from clinical trials is now becoming available to the public through the NIH database ClinicalTrials.Gov thus making medical data more accessible. Despite those recent trends, there are technical difficulties such as different modeling tools used by different modelers, thus making model exchange difficult. Moreover, the data held in ClinicalTrials.Gov is in electronic format and is far from standardized and modeling it requires effort. This presentation will discuss two efforts to solve those problems: 1) The use of the Systems Biology Markup Language (SBML) to help facilitate transfer of models. 2) The standardization effort of ClinicalTrials.Gov towards modeling this data in machine comprehensible models.

18F-SIW-025

## Exploration of Next Generation Technology Application to Modeling and Simulation (ENGTAM); An Update on Our Progress

Tuesday, Salon 2, 1050-1110, SLT Track

Chris McGroarty | christopher.j.mcgroarty.civ@mail.mil

Since 2015, SISO has fostered discussion on emerging commercial technology advancements through the Exploration of Next Generation Technology Applications to Modeling and Simulation (ENGTAM) Study Group, which has evolved into a Standing Study Group (SSG). The technology advances have not slowed down in the last three years, making the number of potential technologies to explore and determine their applicability to the Modeling and Simulation (M&S) domain that much more challenging to keep up with.

During this presentation, we will discuss our progress thus far on a methodology to minimize the struggles that are typical when trying to select and adopt a new technology, specifically a five phased process: understand your current state, technology exploration, evaluation, adoption, and long-term management. We will also discuss emerging paradigms in commercial solutions under examination in order to spur discussion on how we as a SISO can be agile in our standardization.

We welcome all interested parties to attend and join the SSG to learn about the latest technologies that can support M&S as well as discuss best practices for technology adoption.

18F-SIW-026

## Modeling the Effects of a Cyber-Attack on the Tactical Edge

Tuesday, North 2, 1530-1550, SPEC Track

Vikram Mittal | vikram.mittal@usma.edu

Combat modeling involves opposing forces following set processes coupled with uncertainty to determine the winner. These models are built around traditional weaponry and tactics; however, cyber-attacks do not follow the traditional rules. Moreover, due to the very nature of a cyber-attack, it is difficult to model their effects especially as it relates to a tactical mission. This study provides a simplified method to model the impact of a cyber-attack on a dismounted Army squad. Different pathways for the attack are identified. This method then assumes that the cyber-attack was effective and looks at the change in Soldier performance as a result of the attack. In particular, it looks at the degradation of a Soldier's ability to shoot, move, and communicate. This degradation can then be modelled in the Infantry Warrior Simulations (IWARS) to capture the changes in performance metrics to include survivability and lethality. Two case studies are presented. The first looks at the degradation of a Soldier with a hacked Facebook account that received personal misinformation. The second looks at a spoofed surveillance drone that provides the Soldiers with the wrong information.

18F-SIW-027

## DIS Version 8 Development Update

Tuesday, Salon 3, 1550-1610, SVCS Track

Robert Murray | bobmurray222@gmail.com

Development continues for Distributed Interactive Simulation Version 8, the next version of IEEE 1278.1 DIS Application Protocols. For the first time since the 1995 DIS standard (Version 5), a clean-sheet design of the DIS Protocol Data Units (PDUs) is being developed. The break in compatibility with past versions is necessary to make significant improvements in capabilities and ease of use. The effort goes by the conceptual name "Gen3" as it is the third generation of DIS PDU design since the original 1993 standard.

A full description of the Gen3 effort appears in paper 18W-SIW-028 titled "Gen3: What's Up with DIS Version 8", presented at the 2018 Winter Simulation Interoperability Workshop. This presentation is an update of the progress that has been made since that paper was published.

The DIS Product Support Group (PSG) is actively working to write Problem/Change Requests (PCRs) that will eventually lead to a Product Development Group (PDG) to create new drafts of the DIS standard. The design of about half of the PDUs has reached a stable protocol format. This includes a means to make every PDU extensible for improved future enhancement. An XML schema to describe the PDU syntax is mature. The overall organization of the standards document has been simplified for easier use. Related topics such as dead reckoning, coordinate systems, timestamps, and protocol simplification is ongoing.

There is still much work to be done and help is needed from experts in the various areas of simulation interoperability: sensors, communication, weapons, synthetic environment, and simulation management. The DIS PSG meetings at SIW and weekly telecon are open to anyone interested in contributing and improving simulation interoperability.

18F-SIW-029

## Training in a Cyber-active Environment Using C2-Simulation Interoperation

Tuesday, Salon 2, 1550-1610, SLT Track

J. Mark Pullen | mpullen@netlab.gmu.edu

Critical needs in a cyber-active environment include both training cybersecurity technical personnel to provide for defense of operational systems and preparing operational military organizations to continue to function in such an environment. The latter is mostly unmet today, for two reasons: (1) a real cyber-attack on the information systems supporting an exercise would be so disruptive as to preclude any other training; and (2) modifying those supporting information systems to emulate an attack would be expensive, especially so in coalitions where every system would have to be modified.

The authors have reported in previously on the Command and Control - Simulation Interoperation (C2SIM) capability which enables a coalition to interoperate their C2 and simulation systems for training, course of action evaluation, and mission rehearsal. Typically, C2SIM information is exchanged via interface to a server. Reviewing capabilities introduced for single systems such as the Network Effects Emulation System (NE2S) simulation and recent UA Army COBWebS project, we recognize the C2SIM server as an ideal place to emulate a wide range of cyberattack effects by modifying or deleting information as would happen from compromised software or networks and electronic warfare attacks. This results in a training environment that requires the operational military organization to function while under cyberattack. While this approach does not provide training under all possible cyberattacks, it does allow a broad range that mitigates the previously identified concerns. This paper provides an expanded version of the above rationale for adding cyberattack effects to C2SIM and also explains what attacks and actions are possible and how we have imposed them. Much of the content of this paper is drawn from our ICCRTS 2018 original accepted paper "Training Operational Military Organizations in a Cyber-active Environment Using C2-Simulation Interoperation."

18F-SIW-030

## Ready Player Next - Paving the Path Toward Experiential Interoperability

Tuesday, North 2, 1050-1110, SPEC Track

Paul Gustavson | pgustavson@simventions.com

The next generation of workers, soldiers, educators, and professionals have begun their learning, and now experience a predominate part of their social interactions in the digital domain. Those of us that are older think of it as isolated, but to them, it is not. It is blended - or at least it will be.

This next generation is what we call the digital native. And when you think about the digital domain - of what's coming -- it's going to be centered on how we will use models, VR and AR, and how we will use simulation for the purposes of training, testing, connecting and working. The future is about the digital native, and it's about using simulation to create defining moments.

A recent book, which is now a movie, that does an amazing job of showing us the effect of simulation, and defining moments in the digital domain is READY PLAYER ONE. And in this book -- and movie to some degree -- we learn that Models (and simulations) are part of the real world. They are used as a means to interact and connect systems, people, environments and effects. It represents not the far-off future, but the near future.

The question though, is what path will we take? And what are the needs to make sure M&S, as we understand and value it, continues to support our real world needs. More, specifically, how do better use M&S to create defining moments.

Moments, which are meaningful experiences that will stand out in our memory, in our afteraction review, and our learning.

A defining Moment is defined as a short experience that is both memorable and meaningful. It contains pits and peaks. Pits are the challenges, moments of hardship, pain or anxiety that we experience. Peaks on the other hand, can be milestones, and achievements that we also experience. Both Pits and Peaks can be modeled and represented - triggered for us -- using simulation.

The question though is how? How do we trigger these experiences and create defining moments using M&S.? Moments, which are meaningful experiences that will stand out in our memory, in our after action review, and our learning?

In this presentation we explore this topic. We examine the four elements to memorable and meaningful experiences, and how we can begin to allow those experiences to be shared with others using interoperability.

We also explore the world of VR. VR, while a powerful visualization tool, presently lacks the ability to create meaningful experiences in a collaborative world. The experience of that Virtual World is difficult to share, and we know defining Moments are meant to be shared. VR, to really work, needs experiential interoperability, and the future of M&S can help paint that path.

18F-SIW-031

## Analysis and Optimization of Time-Management Services in CERTI 4.0

Tuesday, Salon 3, 1610-1630, SVCS Track

**Primary Author:** Jean-Baptiste Chaudron | jean-baptiste.chaudron@isae.fr
**Presenter:** Martin Adelantado

Time management services are one of the key features of the High Level Architecture (HLA) IEEE simulation standard. Several algorithms allow the implantation of HLA time management services ranging from the Chandy-Misra-Bryant (CMB) null message conservative algorithm up to optimistic Jefferson time warp one. For years now, we are interested in enhancing the high and/or real-time performance of our open source RTI (CERTI). In this paper, we precisely describe our updated conservative time management algorithm which, under some assumptions, limits the time creep problem inherent to the classical CMB algorithm. We will provide detailed analysis and experimental results for different implementations of HLA time management services using our new release version called CERTI 4.0.

18F-SIW-034

## Unifying Cyber M&S through Collaboration in SISO

Tuesday, North 2, 1610-1630, SPEC Track

Katherine L. Morse | katherine.morse@jhuapl.edu

The last several years have seen a significant increase in the number and variety of cyber M&S research and development efforts across government, industry, and academia. These efforts have resulted in methodologies and technologies for cyber testing and training that are functionally relevant, but largely independent. Broad and deliberate collaboration across these efforts is necessary to meet the rigorous and evolving cyber test and training demands of the defense community. The Cyber M&S study group is identifying key cyber M&S activities, documenting best practices, highlighting lessons learned, and identifying areas for potential standardization in order to facilitate adoption by the cyber M&S community. This presentation will report on progress with data calls and requirements development for a Cyber Reference Data Exchange Model (CyRDEM).

18F-SIW-035

## Quantum Annealing and Deep Learning: Advances for Virtual Humans

Tuesday, North 2, 1030-1050, SPEC Track

Dan M. Davis | dmdavis@acm.org

Conversation-like exchanges of information between users and computer-generated virtual humans can be computationally demanding. Many of the Grand Challenges facing the simulation community will further stress the concerned computer resources. These computer/human interfaces are currently being enhanced and will require both technical advances and societal changes. This paper offers a list of Virtual Human Grand Challenges, solicited from leaders in the community, for purposes of this discussion. Then the authors report on emerging technologies that will further enhance the "human" qualities of the previously mentioned interfaces. Some of these technologies are hardware based while others come from software developments. Further, system engineering advances are presented with the intention of making better use of all the aspects of the system to achieve simulation goals. On the hardware side, there is the emerging technology comprised of several threads of quantum computing, e.g. USC's 2,000 Qubit Quantum Annealer. Software advances of note are discussed in the areas of voice recognition, natural language processing, and deep learning. The use of quantum annealing to enhance deep learning is particularly examined. Systems engineering issues are analyzed, as these emerging technologies do not stand alone and must be integrated into or replace legacy systems, mandating close adherence to a range of standards. In each of these cases, the authors discuss theirs and others' experience with the technologies and explicate both the benefits and the costs of such implementations. The paper is written so as to assist the researcher and the systems implementers in choosing which of the new technologies warrants consideration for inclusion in their own work and which technologies will eventually require adoption in order to stay compatible with other systems. Other technologies may require more effort in implementation than they would provide utility in practice.

18F-SIW-036

## Innovative Education Technologies: Optimizing Future Information Comprehension Capabilities

Wednesday, Salon 2, 0850-0910, SLT Track

**Primary Author:** Mark C. Davis | davismc@ieee.org
**Presenter:** Dan M. Davis

This paper focuses on the education of users as being as critical as the development of and the training for major information systems. The flow of information is critical to the nation's defense, including economic strength. Uniformed warfighters at virtually every level complain that they are inundated with too much information. Throughout history, a big part of the information flow issue is the artificial friction hampering information dissemination. Improvement in communications and presentation software in the last decade have made fundamental changes to improve information freedom resulting in: 1) information friction is greatly reduced by technology; rear guard action by institutions and governments can delay, but not prevent this trend, 2) what people know is much more limited by their interest than by the cost or effort of accessing the information, and 3) there are military counterparts to these issues. Current education methods have inadequately prepared the population to deal with this environment. This paper will identify and address the military concerns, both historically and prospectively. It will revivify time-honored theories on the "friction" of war, and recast them in terms of the friction of Information flow. During current research, the authors observed need for a practical approach to enable people to learn differently e.g. assigning a book to read may no longer be optimal. Pedagogical and technical advances developed at the University of Southern California would address these issues. Artificial Intelligence (A/I) programs have been shown to be effective in enhancing any requisite education. USC's Quantum Annealer should demonstrate quantum computing's untapped power in the exploitation of very large data management. The paper describes these capabilities and sets out how they would be employed. The lowering of information friction should dramatically improve both economic strength and defense communication efficacy, but only if innovative education is implemented to enable this.

18F-SIW-037

## Enhancing Education Menteeship: Improving On-Line Career Selection for STEM Personnel

Wednesday, Salon 2, 0910-0930, SLT Track

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The nation suffers from a personnel shortfall in the Science, Technology, Engineering and Mathematics (STEM) fields and this paper addresses improving guidance for pre-college youth. As on-line educational systems become more prevalent, one aspect that may be impacted is educational and career counseling. This may well have a deleterious impact on the nation. The authors are experienced educational mentors who have identified major impediments in this area, e.g. the lack of profession-awareness among U.S. students. This lack of awareness is characterized and quantified in this paper and the negative impacts are described and analyzed. Both anecdotal and statistical data are adduced to show the need of significant reformation of the approaches currently implemented. Using statistics that enumerate the extent of untapped human resources in this country's public, private and schools, the paper outlines the societal and personal pressures that constrain the output of STEM personnel at all levels. Further, they present on-line approaches to ameliorating these problems. The authors discuss their activities in creating an on-line series of technical mentors for prospective technical professionals and they discuss their findings of a distinct lack of what they term "menteeship." They outline their experience with the students' inability to formulate good questions for the mentor, the preponderance of images based on fictional characters in the media, and the reliance on adults to make decision for them. They close by describing their early attempts and successes with using Virtual Humans as both trainers and as counselors to overcome these obstacles.

18F-SIW-038

## Extending Portico HLA to Federations of Federations with transport layer security

Tuesday, Salon 3, 1110-1130, SVCS Track

Thomas Roth | thomas.roth@nist.gov

The Internet of Things (IoT) promises to connect and manage an unprecedented number of heterogeneous devices that are not designed to interoperate as a system. Modeling and Simulation of IoT will face new challenges in the representation of this scale as an accurate model yet at the same time must consider the characteristics of each unique IoT device in the system. In addition, hardware-in-the-loop simulation of IoT will produce massive quantities of information that can overwhelm the processing power of the low-power devices often deployed in these systems. This paper introduces a new infrastructural component called a Forwarder to the Portico implementation of the High-Level Architecture (HLA). It transforms the flat structure of HLA into a hierarchical structure where federates are partitioned into different clusters that communicate through their respective Forwarders. A Forwarder acts as both a data router between the different clusters in the federation, and a firewall that limits the amount of information that traverses the boundaries of its local cluster. Using this approach, Portico now has a scalable architecture suited to IoT that simulates a federation of hierarchical federations. This technology resulted from a collaboration between the United States National Institute of Standards and Technology and Portico's core development team at Calytrix Technologies. The new Portico 2.2.0 will be used in the Universal CPS Environment for Federation (UCEF) and in other projects worldwide.

18F-SIW-040

## CSEEP: The Consortium for the Study and Exploitation of Emergent Phenomena

Tuesday, Salon 2, 1030-1050, SLT Track

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Emergent phenomenon, often referred to only as emergence, is a topic of growing interest as we develop and encounter complex systems, i.e., systems with increasing connectedness, autonomy, and number. Loosely stated, emergence are those phenomena in which patterns that are observed at a global level arise solely from interactions among lower-level components acting on rules that are executed using only local information and without reference or relation to the global pattern. Whereas natural systems exploit emergence to achieve astounding capabilities, man-made systems have traditionally treated emergence as an unintended behavior because it has been difficult to detect and predict. Yet we increasingly build systems with rising complexity and so increase the opportunity for emergence. Simulation has been shown to be the Petri dish whereby our understanding of emergence can be cultured. Through simulation, we are developing our understanding of emergence with the promise of developing man-made systems that can achieve the efficiency and robustness of systems observed in nature. The Consortium for the Study and Exploitation of Emergent Phenomena (CSEEP) is comprised of university, government, and commercial leaders organized through the resources of the Georgia Tech Research Institute. CSEEP is establishing an internationally recognized collaboration of emergence researchers, producers, policy makers, and educators to lead business, government, and defense interests in the responsible, effective, and beneficial development and application of emergence arising from a future of complex systems. This paper presents the tenets and organization of CSEEP, how some of its constituents are utilizing simulation to advance the understanding of emergence, and how the simulation community can participate in this exciting endeavor.

18F-SIW-041

## Cyber-Physical Security for a 5th Gen Training & Simulation Environment

Tuesday, North 2, 1550-1610, SPEC Track
Chuck Louisell, PhD | chulouis@cisco.com

Traditional simulation cybersecurity strategies are largely centered on the idea of 'isolated' or 'closed' networks. The premise is that isolation equates to security. This notion is being challenged as the formerly isolated networks become more connected in the emerging blended (Live-Virtual) training environment as the industry progresses towards the distributed Live-Virtual-Constructive (dLVC) objective. The challenges associated with being connected are further amplified in the 5th Gen environment because of the degree to which simulators and the interactive training environments in which they operate potentially represent a higher level intrusion, exploitation, and exfiltration potential than physical aircraft operating in observable live-fly training events.

Most organizations employ approaches based on the United States Computer Emergency Response Team (US-CERT) cybersecurity framework – Identify, Protect, Detect, Respond, and Recover. This framework recognizes that cyber attacks will occur and that the optimum outcome is mitigation of the depth and duration of data exposure and operational impact. This framework has served as a leveling function to help set and maintain a cyber-physical security posture during, what has been, an early epoch in the cyber protection maturity journey. In looking forward, the next epoch can learn from the past leading to additions to observations made simultaneously across multiple pillars – the logical segmentation posture, the cyber security posture, the operational policy compliance posture, and the human reliability posture.

This paper presents such a framework founded on the principle that cyber events are normally the result of deviations in multiple dimensions and that variance in one or more can be observed, measured, assessed, and integrated to identify the emergence of a monitoring, exploitation, or exfiltration opportunity. Moving from the traditional information technology reactive posture to a national security appropriate proactive posture requires synchronization across the pillars of cyber-physical security.

18F-SIW-046

## Lessons learnt from distributing video over an HLA backbone

Tuesday, Salon 2, 0850-0910, SLT Track
Stefan Sandberg | stefan.sandberg@pitch.se

Abstract: Video capture and replay in various simulation solutions is becoming increasingly important and today there are many reasons why you would avoid analogue solutions. There are many options when it comes to streaming digital video over a network but very few of those support the capture and replay of video streams in sync with simulation data and audio streams resulting from comm system simulation.

The video streams may come from student stations screen capture, live cameras monitoring student performance or simulator instrument or out the window view. Capturing video streams coming from non-intrusive software or hardware screen capturing solutions may prove to be a good and a training system neutral way of supporting after action review activities without the need to use any simulator specific solutions.

In this example a modern HLA compliant RTI implementation was selected to distribute streaming video which would allow video data to be captured in sync together with other simulation data using a standard HLA compliant recording software. The advanced data filtering mechanisms available in HLA was also expected to prevent the networked to be unnecessarily swamped with data. With the increasing interest for CDS or Cross Domain Security solution it was also important to find a solution with could use the same accredited data release mechanism for all types of data.

Initial test showed that performance was limited, not by the HLA RTI implementation or the network, but the speed of the hard drive that was used to store the video data streams. 16 4K channels could be distributed over an HLA backbone, almost saturating the network, onto an HLA recorder that stored the data on a SQL server that was using a high performance SSD drive without the need for any special tuning.

This paper discusses lessons learnt from building an after action review solution, based on a standard COTS HLA RTI implementation and COTS software tools that enables the simultaneous capturing of video and audio streams and simulation data.

18F-SIW-047

## Air Force Research Laboratory Modeling, Simulation and Analysis Support to the Air Force Strategic Development Planning & Experimentation (SDPE) Office

Tuesday, Salon 2, 1110-1130, SLT Track
Bret Givens | bret.givens@sti-tec.com

The Air Force Strategic Development Planning & Experimentation (SDPE) Office is responsible for supporting Air Force Development Planning efforts and conducting experimentation campaigns that will result in planning choices for senior Air Force-level resource decisions. While the SDPE office is established within Air Force Material Command (AFMC) for organize, train, & equip considerations, it receives its operational taskings through the Capability Development Council from the CSAF and SECAF. The SDPE was created as the 10th AFRL Directorate due to the Lab's flexibilities and multi-domain perspectives of air, space, and cyber. The office is responsible for tracking the execution of approximately 120 action items from the Air Superiority 2030 Enterprise Capability Collaboration Team (ECCT) as well as facilitating the new Multidomain Command and Control ECCT. There are also four experimentation campaigns in development: Data to Decisions (D2D), Defeat of Agile Intelligent Targets (DAIT), Future Attack Capabilities Experimentation (FACE), and Directed Energy (DE).

Over the past year, AFRL's Enterprise MS&A Working Group has been evolving MS&A from ad hoc individual Technical Directorate (TD) engagements to an enterprise level coordinated activity that requires enterprise level governance and associated processes and oversight mechanisms to efficiently and effectively exercise this critical capability. One tool, the Advanced Framework for Simulation, Integration and Modeling (AFSIM), paired with complementary tools, is enabling game changing analytical methodology for translating military utility at the campaign level into COCOM, MAJCOM, AF and AFRL investment strategies. The Working Group is taking a holistic approach with Tools, Data, People, Processes and Partnerships (TDP2) to support the SDPE mission.

This short presentation will introduce SDPE, review progress to date, and provide details on the processes and tools being employed on an exemplar effort between AFRL and SDPE called the Multi-Domain Challenge Problem (MDCP) at an unclassified level.

18F-SIW-048

## The UFOS Framework Enabling Formalized Execution of Physics-integrated Descriptive Architecture Languages

Wednesday, North 2, 0850-0910, SPEC Track
Gregory Haun | ghaun@agi.com

A core goal for an efficient and scalable simulation and analysis framework is the separation of the models, from the simulation execution, from the chosen methods for orchestration and/or analysis. In doing so, the analysis concepts, simulation architecture, and simulation execution can be abstracted and constructed in such a way to support inherent interoperability with diverse and best-of-breed models and tools assuming that the underlying context is well described and semantically grounded during data interchange. This alleviates inherent challenges found in monolithic simulation environments where the models are deeply interwoven within the simulation framework making changes difficult to perform without costly code reviews and/or access to the original developers, thus becoming outdated.

Consistent simulation context and semantic agreement of data objects produced and consumed during transaction is crucial in the design and construction of a model agnostic simulation infrastructure and orchestration framework. These concepts necessitate a formal knowledge construct, which describes the overall physics phenomenology, operational domain concepts, systemic functions, and methods for process interaction. This formal descriptor captures the ontological relationships of objects, concepts, and actions thus becoming the basis for integration, as well as the very language for simulation represented through ontologically adorned behavioral definitions. Ultimately, these behavioral ontologies not only serve knowledge mapping and relational reasoning, but also provide a mechanism for formal execution and thus deeper reasoning extended through physics-integrated simulation. Additionally, this common vernacular also ensures consistency during object and data interchange and additionally subordinate meta-models guaranteeing unit transformation for efficient orchestrated execution and simulation.

This presentation will describe the development and utility of an orchestration and simulation framework, UFOS (Unifying Framework for Orchestration and Simulation), founded on an executable architecture methodology, leveraging behavior-rich ontologies, allowing for the orchestration, execution, and examination of formalized process interactions. A constituent agent framework, the AMoEBA (Agent Modeling of Event-based Architectures) framework allows for the interpretation and direct execution of semantically-formalized agent interactions representing doctrinal/policy motivations, systemic modes of operation, and human behaviors; constrained by integrated models, tools, and data imposing limitations, such as those realized through a holistic and multi-dimensional physics-based environment. Concept, system, and actor architectures constructed through these semantically formalized behaviors and physics constrained events allow for non-developers and experts in the field to easily and graphically capture, vet, and adapt these models for analysis and simulation needs without being burdened with additional development translation and explanation.

For this effort, an open, industry standard for architecture capture has being chosen which facilitates graphical construction, examination, and vetting; while also exhibiting the important aspect of being inherently machine executable. The Unified Modeling Language (UML) forms the basis for the model definition through the provision of structural and behavioral mechanisms allowing for the capture of the doctrine, concepts, systems, and operational methods with semantic formalism, while depicting the models for review and vetting with an inherently graphical nature. UML ontologies, forming a set of domain specific languages, are used to formally describe the concepts/systems of interest in a human readable vernacular, while also lending to machine interpretation and execution. The structural elements provide the ability to capture structured knowledge and property-based information, while the behavioral elements allow for the representation of state machine and activity flows balanced by use-case descriptors. Ontological representations with performance limitations orchestrated through adapter-linked physics tooling and behaviors constructed graphically as state machine and activity diagrams utilizing the inherent semantic formalism can be easily explored with respect to parametric sensitivity discovery, system/concept mission utility, and course-of-action/what-if analysis. These architectural representations fulfill both documentation requirements, while also serving as the very model for simulation playout and analysis discovery.

The architected simulation infrastructure allows for the marrying of discrete-event, discrete-time, and continuous simulation methods in order to capture and preserve the representative physics constraints as necessary to initiate the realistic response of the underlying model. The execution of the orchestrated UML is foundationally discrete-event in nature, while being moved forward by events, produced by algorithmic calculations or presented as discrete-time signals, thus ensuring that interactions and propagated activities are never missed nor biased to an artificial simulation time-step.

Current tasks have focused on building ontological delegates for AGI's System's ToolKit (STK), realized as various property and method implementations of the ontological information layer base class in order to provide algorithmic physics-based event determinations, that when coupled with the state-machine behavior execution provides for the accurate preservation of spatial and temporal relationships and interaction feedback across all domains. The initial use-cases being explored are the rendezvous, proximity operations, and docking aspects of space vehicle interactions. The entire process has many permutations with respect to the concepts of operation (CONOPS) and the multi-domain process chains, allowing for discovery of sensitivities of these systems from both physics and behavioral perspectives as synergistic limitations on the various operational methods being explored.

SISO Simulation Interoperability Standards Organization

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# 2019 Simulation Innovation Workshop (SIW)


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