Tutorials
2024 Simulation Innovation Workshop (SIW)

Monday, February 26

0800-1000
HLA 101 - Introduction to High-Level Architecture
Forum East 4
Dr. Katherine L. Morse, JHU/APL
Prerequisite: A general understanding of modeling and simulation

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 1516™ - 2010, IEEE Standard for Modeling and Simulation (M&S) High Level Architecture (HLA) – Framework and Rules
- IEEE Std 1516.1™ - 2010, IEEE Standard for Modeling and Simulation (M&S) High Level Architecture (HLA) – Federate Interface Specification
- IEEE Std 1516.3™ - 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, and available tools are also described. Finally, some advice is given on how to get started with HLA, including the use of the related process standard:

- IEEE Std 1730™ - 2010, IEEE Recommended Practice for Distributed Simulation Engineering and Execution Process (DSEEP)

- SISO-STD-012-2013, Standard for Federation Engineering Agreements Template (FEAT)

0800-1000
HLA Federation Object Modeling and an Overview of HLA 4 (HLA 203)
Forum West 1 & 2
Bjorn Moller, Pitch Technologies
Prerequisite: 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.

The purpose of this tutorial is to give participants an update on the most recent advances in HLA object modeling, services, scalability, security, and deployment. The tutorial consists of three parts:

1. Principles and process for developing Federation Object Models
HLA FOMs are information exchange data models. The relationship to conceptual models as well as object-oriented programming models is explained. Development of a FOM for a simple HLA federation is shown, step by step. More complex examples are then introduced, as well as commonly used Reference FOMs for the aerospace and defense domain. Lastly, FOM modeling is mapped to the IEEE-1730 DSEEP process.

2. Extending Federation Object Models using new HLA Evolved and HLA 4 features
HLA Evolved, IEEE 1516-2010, introduced FOM modules in 2010, providing a powerful tool for developing complex FOMs as well as for extending Reference FOMs. Some best practices for FOM modules are presented. HLA 4 (soon to be released) provides additional constructs to extend reference FOMs, specify relationships, and perform directed interactions. These new HLA 4 capabilities will be described.

3. New services in HLA 4
HLA 4 provides several new features which are presented. Secure authorization of federates that participate in a federation is one such new feature. Another is the standardized protocol for federates to communicate with the Run Time Infrastructure (RTI). This new protocol makes it easier to support HLA in many programming languages, to deploy HLA-based applications over wide-area networks and mobile networks, as well as elastic cloud deployment. Improved Data Distribution Management (DDM), to optimize data flow in support of more scalable federations, is also described.

At the end of the tutorial, we will open the floor for questions, answers, and discussions about the new HLA 4 features.

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1030-1200
DSEEP 101 - Distributed Simulation Engineering and Execution Process
Forum East 4
Dr. Katherine L. Morse, JHU/APL **and Mr. Robert Lutz,** JHU/APL
Prerequisite: A general understanding of modeling and simulation.

This tutorial provides an overview of:

- IEEE Std 1730™ - 2022, 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)
- IEEE Std 1730.2™ - 2022, IEEE Recommended Practice for Verification, Validation and Acceptance/Accreditation of a Distributed Simulation: An Overlay to the Distributed Simulation Engineering and Execution Process
- SISO-STD-012-2013, Standard for Federation Engineering Agreements Template

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1030-1200

NATO Education and Training Network FOM v4 - Best Practices and Experiences Using HLA4 Object Modelling

Forum West 1&2

Bjorn Lofstrand, Pitch Technologies, **Oscar Bergman**, Pitch Technologies, and **Mikael Karlsson**, Pitch Technologies

The NATO Education and Training Network Federation Object Model (NETN FOM) is an extension and complement to the SISO RPR-FOM developed by NATO Modelling and Simulation Group (NMSG) activities since 2006. Currently it is maintained on by the NATO MSG-191 technical activity and is undergoing a major uplift using HLA4 and the new object modelling principles introduced in this upcoming HLA version. This tutorial will introduce HLA4 object modelling concepts and then focus on explaining how these concepts have been used in the evolution of NETN FOM v4.

The final part of the tutorial will explain some of the key FOM modules introduced in NETN including the NETN-MRM aggregation/disaggregation patterns, the NETN-TMR Transfer of Modelling Responsibilities pattern and NETN-METOC for the representation of environment conditions including weather.

Wednesday, February 28

0830-1000
DIS 101 & 201– Introduction to Distributed Interactive Simulation (DIS)
Salon 3
Robert Murray, SimPhonics, Inc.
Prerequisite: A general understanding of modeling and simulation.

IEEE 1278TM Distributed Interactive Simulation (DIS) is the result of a large industry and government effort starting in the 1990s to standardize a network protocol for simulation interoperability. The history and basic concepts of DIS are introduced in this tutorial. DIS uses the IEEE and SISO standards process to create a technically sound and widely accepted protocol and rules to link military training and engineering simulations. It enables real-time simulation interoperability of military land, sea, and air platforms, weapon interactions, radar, radio, IFF, laser designators, underwater acoustics, logistics, simulation management functions, and more.

Dead reckoning is a primary technique defined in DIS for achieving real-time high-fidelity interoperability over best-effort networks. This tutorial explains the basic concept and technical details of dead reckoning. Also discussed are techniques for efficient bandwidth usage. Improvements made in Version 7 for PDU extensibility are introduced. DIS Version 8 is an extensive overhaul of the DIS protocol currently in progress to provide a cleaner design and significant improvements in capability. Details of Version 8 are presented along with progress toward its completion in the mid-2020s.

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0830-1000
SpaceFOM 101 – An Introduction to the SISO Space Reference FOM
Forum East 4
Björn Möller, Pitch Technologies
Edwin "Zack" Crues, NASA
Prerequisite: General knowledge about Distributed Simulation

Spaceflight is difficult, dangerous and expensive; human spaceflight even more so. In order to mitigate some of the danger and expense, professionals in the space domain have relied, and continue to rely, on computer simulation.

This tutorial provides an introduction to the SISO Space Reference FOM ("SpaceFOM"). The purpose of the SpaceFOM is to facilitate a priori interoperability and reuse for space simulations. It makes it possible to compose federations consisting of simulations from one or several different organizations. It is an open, international standard, freely available from SISO.

The tutorial describes some early HLA federations for the space domain and the need for an interoperability standard. It then describes the key concepts in the SpaceFOM: (i) a flexible positioning system for bodies in space through Coordinate Reference Frames; (ii) a naming convention for well-established Reference Frames; (iii) descriptions of common time scales; (iv)

federation agreements for execution control and common types of time management (including soft and hard real-time) and (v) support for physical entities (e.g., space vehicles, rovers and astronauts).

Finally, it discusses practical use cases, how to implement and extend the FOM, and some currently available tools for the SpaceFOM.

1330-1500
Enumerations 101 - Introduction to SISO Enumerations Products and Processes

Forum East 4
Michael Penkrot, CAPE Technology Solutions
Prerequisite: A general understanding of modeling and simulation.

This tutorial session will introduce the SISO Enumerations products (SISO-REF-010 and the OPMAN) and will describe the processes used to update and review enumerations and the reference product.