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Systems Geometry: A Dimensional Approach to T&E Systems of Systems Understanding

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Abstract

The test and evaluation (T&E) environment represents a complex system of systems (SoS) setting that is configured to perform developmental and operational testing of developing warfighter systems. Significant problems encountered during integration with SoS configurations can interfere with the ability to execute a successful experiment or test. SoS engineering techniques need to include detailed analysis during preliminary design to identify potential areas for problems or unintended emergent system behavior. SoS can be characterized along different “dimensions” of definition, depending on the view or perspective that is desired. For Department of Defense (DoD) SoS, there are three dimensions of interest when planning the development of a SoS: operational, functional, and technical. The operational dimension addresses the warfighter environment and includes military operations, command and control support and activities required to support the operational mission. The functional dimension highlights different roles within the SoS whether a participant is a warfighter using the system, an analyst collecting data for system evaluation, or an infrastructure engineer working to keep the individual systems up and running to support the mission exercise. Finally, the technical dimension addresses the specific systems, the computers and the network infrastructure required to support the functional and operational activities. Each dimension can be analyzed to understand roles, interfaces and activities. While a wide variety of engineering analysis techniques exist to analyze each dimension of a SoS, such methods fail to explore the cross-dimensional effects found in SoS. Such effects may include how changes in the mission scenario can impact the throughput on the physical network, or how metrics collection contributes to achieving the experiment objectives. A methodology called Systems Geometry has been developed to address these cross dimensional effects and to identify potential risky emergent behaviors in the SoS under development. This presentation will provide a summary of Systems Geometry and how it addresses the cross-dimensional analysis problem. A specific T&E example will be discussed.

Biography

Dr. Christina Bouwens is the Chief Technologist for MSCI where she supports system of systems engineering analysis and architecture development for ASA(ALT) SoSE&I Always On – On Demand Initiative. Before coming to MSCI, she spent 18 years at SAIC / Leidos supporting simulation systems engineering, distributed simulation development, high performance computing and more recently, cloud-based simulation initiatives. Her research interests include system of systems architectures, architecture frameworks, and analysis of emergent behaviors in distributed systems of systems. Christina has a BS in Mathematics from Geneva College, an MS in Mathematical Science and a Ph.D. in Industrial Engineering from the University of Central Florida.