

Announcement:

The Arizona Center for Integrative Modeling and Simulation ([ACIMS](#)) enters into long term relationship with Northrop Grumman Information Technology to support modeling and simulation at the Joint Interoperability Test Command.

Arizona Center for Integrative Modeling and Simulation ([ACIMS](#)) was founded by the Arizona State Board of Regents in 2001 to foster research and instruction that advance the use of integrative modeling and simulation to support multidisciplinary, large scale modeling of natural and artificial systems. The University of Arizona through ACIMS, has entered into a long-term subcontracting relationship with Northrop Grumman Information Technology ([NGIT](#)) at JITC. ACIMS will undertake tasks as requested throughout the lifetime of the NGIT contract for JDEP and other projects, a long term developmental effort. ACIMS will supply research and development expertise and services to support NGIT in line with the following major themes:

- ***Testing and evaluation in DoD's systems acquisition process*** – ACIMS will play a major role in the design of automated generation of capabilities to test DoD systems under development, now and in the future. For example, a current effort is to rigorously capture the informally-stated requirements for the Single Link Interface Reference Specification for Link-16 (SLIRS). The goal is to map the formal representation into test models that are federated in a distributed simulation with any system that claims to implement this specification. SLIRS is the basis for standards for tactical communications that many future C4ISR systems are likely to be required to adopt. A conference [paper](#)¹ describes the rudiments of the approach being taken. The approach is intended to be generic so that it applies to other standards conformance testing capabilities that JITC is developing. One such area is the newly emerging DoD use of XML, the extensible markup language gaining wide currency in industry and defense for exchanging information among systems on a network.
- ***Distributed Simulation for System Testing*** – ACIMS will provide expertise in the use of M&S methodology for distributed simulation and testing environments within JDEP. Currently such simulations provide the basic services for exchanging data among federates but do not assure that the composition of the federates behaves correctly. ACIMS will help develop distributed simulation protocols, such as those based on the Discrete Event System Specification (DEVS) that can coordinate both the data exchange and time management in a correct and efficient manner. Further, current distributed simulation exercises are set up in a manner that is very time consuming and requires large numbers of personnel located at the various sites. As described in a recent journal [article](#)² ACIMS will introduce more theory-based automated methods to reduce the cost and at the same time speed up the process of creating such test events.
- ***Formalized Model Development*** – ACIMS is well known for its development of the DEVS formalism for M&S and is playing a major role in a recent DEVS standards study group newly defined by the Simulation Interoperability Standards Organization ([SISO](#)). Such a standard would also allow modelers to reason about the validity of model composition independently of the underlying simulation middleware technology. Similarly, simulation developers would be able to integrate DEVS-conforming simulation federates into a federation using a component based

¹ Zeigler, B. P., Fulton, D., Nutaro, J., Hammonds, P., "[M&S Enabled Testing of Distributed Systems: Beyond Interoperability to Combat Effectiveness Assessment](#)": 9th Annual Modeling and Simulation Workshop, Dec. 8-11, 2003, ITEA White Sands Chapter

² James Nutaro and Phil Hammonds, "Combining the Model/View/Control Design Pattern with the DEVS Formalism to Achieve Rigor and Reusability in Distributed Simulation", Journal of Defense Modeling and Simulation: Applications, Methodology, Technology, <http://scs.org/pubs/jdms/jdms.html>

simulation standard that promotes the construction of verifiable, large-scale simulation systems³. The DEVS Formalism will be used in the core functional model for JITC to verify and validate expected system behavior⁴.

- **High Performance Simulation** – ACIMS has developed a number of approaches to executing DEVS simulation models in parallel and/or distributed fashion. While system testing, as mentioned above, usually involves geographically distributed simulation assets, parallel simulation is usually performed on clusters of co-located processing nodes connected via a high-bandwidth network. Such high performance simulation will be needed for many of the processing functions performed in a JDEP environment, such as automated test model generation. ACIMS will apply its expertise, and further refine its approaches, to support the development of high performance computation and simulation.
- **Education and Professional Development** – Basic and advanced education in modeling and simulation methodology is required to achieve the conceptual capabilities and necessary skill sets to perform JDEP development tasks consistent with the JITC adopted methodology. ACIMS will provide expertise, training materials (books, guides, manuals) and software to provide this education. Along these lines, ACIMS has recently spearheaded the introduction of a new [Masters of Engineering in Modeling and Simulation](#) offered online by the Arizona State University. Contributing to the professionalism in defense M&S, ACIMS faculty play key roles in the [Society for Modeling and Simulation International](#) and in editing the newly funded [Journal of Defense Modeling and Simulation: Applications, Methodology, Technology](#).

Background: JITC and JDEP

The Joint Interoperability Test Command ([JITC](#)), located in Fort Huachuca, Arizona, is concerned with testing interoperability of joint information systems – those of all Department of Defense (DoD) services and agencies as well as those of coalition forces (U.S. and other countries). Interoperability, narrowly understood, is the exchange of critical information between two or more information systems. However, JITC’s broader [mission](#) is to “support war fighters in their efforts to manage information on and off the battlefield.” Its [vision](#) is to be “the preeminent information systems evaluator throughout the life cycle of DoD systems.” [Modeling and simulation](#) (M&S) is critical to achieving this vision. “JITC will strengthen the test and evaluation process by applying M&S technology to improve product quality and function, reduce technical risk, and enhance performance assessments.”

A recent [article](#)⁵ by key leaders of the JITC states that the “need for joint C4ISR⁶ capabilities has never been greater. World events have amply demonstrated that war fighting using network-centric command and control has become both the norm and the key to dominating the information battlespace of the 21st century. Joint and coalition interoperability continues to be an increasingly urgent priority for DoD as a direct consequence of forward-looking war fighting doctrine that mandates extensive joint, combined, and coalition operations. These conditions represent significant challenges to the weapons system development and testing communities. They call for a flexible, responsive, cost-effective, reliable, and reusable testing architecture employed to develop interoperable systems that assure dominance of the information battlespace.”

³ Mark Barrett, Neil Barrett, and James Nutaro, “A Case Study of Discrete Event Simulation (DEVS) Formalism” [The Testing Times](#), Vol 12, No. 3

⁴ JITC’s Commander’s introduction to the issue, [The Testing Times](#), Vol 12, No. 3

⁵ Denny F. Beaugureau, Clayton K. Hashimoto, Randon R. Herrin, “Interoperability testing and the new acquisition guidance: joint interoperability test command embraces the ideals - Test & Evaluation” [Program Manager](#), July-August, 2003

⁶ Command, control, communications, computers, intelligence, surveillance, reconnaissance

Testing and evaluation is integral to DoD's systems acquisition process. The [article](#) continues, stating that recent acquisition processes defined by DoD gives “the testing community the opportunity to take the initiative and become active participants in any phase of the acquisition cycle from concept exploration to production and deployment.” Although JITC is historically associated with interoperability certifications, “it is taking advantage of this opportunity to ensure that it is involved early on, and remains involved continuously throughout different aspects of the acquisition cycle. In line with the new acquisition guidance, testing organizations must be involved early in the concept exploration phase of a program to ensure that changing requirements are consistently evaluated and cross-referenced up to and through the production and deployment phases. An example of successful continuous and evolutionary developmental and operational test activities is the Defense Message System program. The initial requirements were not well defined, but with JITC input, they evolved into testable criteria for functionality and capability that were adapted to meet each incremental fielding phase.”

JDEP (Joint Distributed Engineering Plant). A principal long term project technically coordinated by JITC is the Joint Distributed Engineering Plant ([JDEP](#)). A national asset, JDEP will “assist in building and employing interoperable forces across multiple mission areas by providing means for developers to engineer interoperability into systems, testers to test and evaluate interoperability among systems, and war fighters to assess the operational capabilities of forces.” JDEP is a funded initiative created to support systems engineering, integration, and testing of distributed systems. A recent Simulation Interoperability Workshop (SIW) [paper](#)⁷, describes the role of JITC as the agency “responsible for maintaining the technical framework, assisting users to identify and access simulation capabilities across the DoD and industry, and providing technical support to federate these into distributed system environments for use in development, integration, testing, and assessments. These simulation and hardware/software federations provide the environment 1) to address the challenges of engineering complex distributed systems early in the life cycle, 2) to assess performance and interoperability in controlled environments long before deployment, and 3) to examine the impact of design and development options before making costly implementation decisions.”

Formalized Model Development. The SIW [paper](#) continues, “In order to facilitate future interoperability between major DoD systems in distributed testing venues, JDEP has established an outreach effort to major acquisition programs. The focus of this effort is to identify common framework requirements, facilitate common implementation of solutions, and to assist the acquisition community in positioning itself for testing in a distributed and joint environment. JDEP is focused on identifying *formalized model development* that can facilitate verification and validation (“goodness”) of the models for use in the joint environment, as well as ensuring the acquisition programs define information and data management, data exchange, and application interface services. The networking solution tends to be the most emphasized area in system development as DoD has tremendous experience in resolving communications and connectivity issues. However, without the emphasis on the other M&S components, the ability of simulations to work in a joint, distributed environment can be severely impeded. *JDEP places a strong emphasis on addressing these other (non-network) framework components.*”

⁷ Richard Clarke and Janet Forbes, “Joint Air and Missile Defense Mission Area and Beyond”, Fall 2003 SIW