Track:

Emerging Capabilities

Title:

Synergizing Fidelity and Scale: Integrating VANE and OneSAF via an Unreal Engine Bifrost Client

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Abstract:

The Modeling and Simulation (M&S) community is increasingly turning to modern game engines to provide higher fidelity visualization, deep immersion, and advanced interaction capabilities. By harnessing the capabilities of existing simulation software like One Semi-Automated Forces (OneSAF) through a Bifrost client, developers can synergize these distinct environments. This integration creates a comprehensive platform essential for testing emerging capabilities and advancing autonomy, while also unlocking greater potential for human-in-the-loop (HITL) training. Moving beyond automated systems testing, this architecture allows a human operator to natively control a battlefield entity with greater interactive and visual fidelity than is available within existing full-scale, aggregate simulation software.

This presentation details a pilot project within the Army's M&S Enterprise Innovation Environment (MSEIE) that demonstrates a Modular Open Systems Approach (MOSA) for simulation. The effort focused on establishing the architectural design and implementing the base functionality of the Bifrost Unreal Client, enabling real-time interoperability between Unreal Engine projects and standard military constructive simulations such as OneSAF. By architecting the client as a plugin using native Unreal Engine Subsystem, it integrates seamlessly as a module within the engine. This approach significantly reduces the barrier to entry, allowing any Unreal project to become an interactive node on a distributed simulation network. The Bifrost Plugin facilitates two-way communication of simulation data between Unreal Engine and interconnected clients via visual scripting (Blueprints) or C++ code, which facilitates the synchronized sharing of entity states,

organizational structures, and dynamic battlefield events such as movement, weapon fires, and detonations. Developers and operators can use this to leverage Unreal Engine's advanced rendering capabilities without being isolated from the broader, complex tactical scenarios generated by systems like OneSAF.

To validate this MOSA-based capability, the "Simulating Robotic Breach" pilot project was conducted in collaboration with the U.S. Army Engineer Research and Development Center (ERDC), utilizing the Virtual Autonomous Navigation Environment (VANE). For this effort, VANE served as a proof-of-concept, demonstrating the Bifrost Plugin's ability to bridge high-fidelity virtual prototyping and HITL interaction with large-scale constructive simulations. The scenario, derived from the Combat Engineer Company-Robotic (CEC-R) formation and related to Project Convergence Capstone 5 (PCC5), featured a complex manned breach operation.

In this demonstration, a manned breach force was simulated entirely within OneSAF, which provided the broader tactical context. A Human Machine Integrated Formation (HMIF), consisting of a teleoperated Squad Multipurpose Equipment Transport (SMET), Robotic Combat Vehicle (RCV), and Unmanned Dozer, was simulated and sensor-modeled within the Unreal Engine/VANE environment. Showcasing the human-in-the-loop potential, these robotic assets could be actively piloted by human operators. The Bifrost Plugin served as the critical data conduit, allowing the high-fidelity robotic platoon and its operators to perceive and interact with the OneSAF-generated entities in real-time.

This presentation will explore the technical challenges overcome during the development of the Bifrost Unreal Subsystem and the results of the "Simulating Robotic Breach" use case. This capability represents a significant step forward for the M&S community, providing a standardized methodology for linking the visual and physical fidelity of game engines with the tactical depth of military simulations, accelerating future development of autonomous systems and immersive training applications.