MODSIM 2026 Abstract Submission:

Integrating Realism, Readiness, and Repeatability into Synthetic Training Environments

Modern military medical operations demand performance under conditions defined by uncertainty, time pressure, and physical risk. Preparing personnel for these realities requires training approaches that move beyond traditional instruction and isolated simulations toward integrated, team-based experiential learning. The Wide Area Virtual Environment (WAVE) at the Uniformed Services University of the Health Sciences (USUHS) offers a mature example of how synthetic training environments can enhance mission readiness and human performance through the integration of realism, repeatability, and adaptability.

Over more than sixteen years of continuous use and evolution, the WAVE has supported graduate medical education across multiple branches of the U.S. Armed Forces. Designed as a large-scale, shared physical space, the system combines immersive visual environments, standardized patients (trained actors), and high-fidelity human patient simulators into a unified training ecosystem. This multi-modal approach enables learners to practice communication, procedural skills, and team coordination simultaneously within dynamic, scenario-driven contexts. Unlike head-mounted display-based solutions, the WAVE prioritizes shared-space immersion, reinforcing physical interaction, complete situational awareness, and team-based decision-making that mirror operational conditions.

The WAVE addresses persistent challenges in readiness training, including the difficulty of physically replicating high-threat, multi-casualty scenarios, the logistical burden of live exercises, and the need for scalable, repeatable training experiences. By bringing the situational environment to the learner, the system reduces reliance on staging of large spaces, and allows rapid reconfiguration across a wide range of operational contexts, from urban infrastructure and civil unrest to combat zones and medical evacuation pathways. A modular scenario library—comprising more than sixty adaptable simulations—supports diverse training objectives and enables rapid response to evolving mission requirements.

Technological evolution has played a critical role in expanding the system's effectiveness. Transitioning from projection-based displays to direct-view LED significantly increased the effective training space, improved durability, and reduced maintenance demands. These changes will enable higher throughput of learners and more complex team scenarios without altering the system's core instructional philosophy: technology in service of

training outcomes. The result is a platform capable of supporting physically intensive, high-frequency training while maintaining scenario fidelity and operational relevance.

While long-term outcome attribution remains a challenge in simulation-based training, practical indicators suggest substantial value. These include sustained utilization, positive learner engagement, broad scenario applicability, and improved logistical efficiency compared to live reenactments. Importantly, the WAVE demonstrates how reducing environmental setup time and increasing repeatability allows greater focus on skill refinement, coordination, and decision-making under stress—key components of mission readiness and survivability.

This paper presents the WAVE as a reference model for organizations exploring advanced applications of modeling and simulation in training. It examines design decisions, modality integration, scenario development practices, and lessons learned from sustained, real-world use. The findings highlight how synthetic environments can extend existing M&S tools into operationally relevant training systems that enhance human performance without increasing risk. By aligning immersive technology with instructional goals, such systems offer a pathway to more resilient, scalable, and effective preparation for complex, high-stakes missions.

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