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MILITARY SIMULATION: A UBIQUITOUS FUTURE

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ABSTRACT

The Department of Defense uses Modeling and Simulation (M&S) to support a variety of activities ranging from engineering to theater-level analytical studies, training, strategy evaluation and test. To conduct these activities, different simulation types have been identified and defined as shown in Figure 1. For each type: Live, Virtual, and Constructive (LVC), the essential difference is based on how aspects of reality are included, specifically from people or a system of interest. While this categorization is useful, the level or degree of realism is not specified.

Human \ System	*Real*	*Simulated*
Real	Live	Virtual
Simulated	Virtual	Constructive

Figure 1: Simulation Classification Framework (Hodson and Baldwin 2009).

This talk presents some of the current challenges, research directions and promising opportunities that exist by combining the simulation types (each including differing degrees of reality) to create mixed reality environments. In the military domain, mixed reality simulations are often constructed or assembled from existing LVC assets and simulation artifacts.

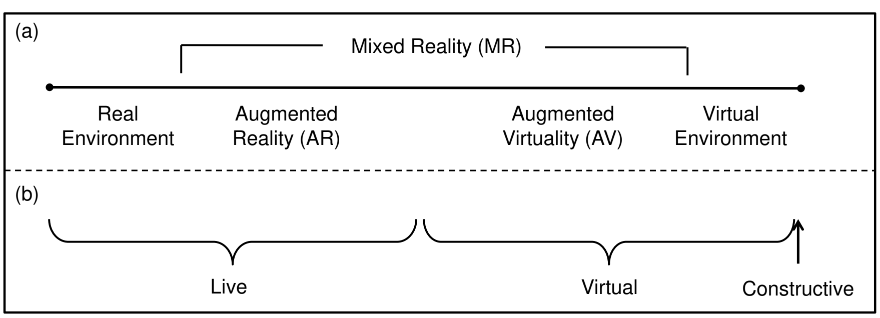

Figure 2: Relationship Between Mixed Reality Scale (a) to Simulation Types (b) (Hodson and Hill 2014).

As Figure 2 shows, the relationship between the mixed reality scale to LVC assets and simulation artifacts which provides a convenient way to understand and reason about degrees of realism. Even though the mixed reality scale was designed for display technologies (Milgram and Kishino 1994), we leverage it from the perspective of entities interacting within an environment (Hodson and Hill 2014). In other words, the realness or reality associated with entities in relation to the world in which they interact can be different (i.e., mixed). Thus, consider using the term mixed reality environment, as opposed to “LVC,” as it is somewhat ambiguous and often refers to *how* a simulation system is constructed (i.e., its architecture and implementation).

This talk highlights opportunities to use mixed reality simulations to support military M&S activities by presenting their essential dynamics and trade-offs that are applicable to all LVC-based designs. In this pursuit, a working definition is as follows:

> “Mixed reality simulations create a set of interacting entities within a situated environment (i.e., world) defined by computer-based models, real people and real physical assets.”

Mixed reality simulations are often assembled by interfacing a collection of existing LVC assets and simulation artifacts through an interoperability medium to merge aspects of the real with a non-real world. Thus, opportunities exist to exploit this technology to support testing, training, human factor studies and hypothesis generation about existing or envisioned systems.

If a mixed reality simulation’s inherent strengths are not well aligned to a given purpose, this type of simulation can complicate matters from several perspectives. For example, from a software architecture point of view, these simulations are distributed real-time systems in which trades concerning responsiveness and the consistency of shared state data must be made. In other words, the design of the software system can be viewed as a Consistency-Availability-Partition tolerance (CAP) theorem problem (Millar et al. 2016). From the standpoint of using the simulation as a test or experimental apparatus, concerns associated with consistent representation of the situated environment (i.e., world) might be an issue. From the analyst point of view, the inclusion of real (i.e., live) aspects might add credibility to system behaviors, but simultaneously include unwanted sources of noise into an experiment.

This talk presents some of the exciting opportunities that exist, as well as, illuminates some of the significant challenges and promising research paths to address and mitigate those challenges.

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DOUGLAS D. HODSON is an Associate Professor of Software Engineering with the Air Force Institute of Technology. He received a B.S. in Physics from Wright State University in 1985, and both an M.S. in Electro-Optics in 1987 and an M.B.A. in 1999 from the University of Dayton. He completed his Ph.D. at the Air Force Institute of Technology in 2009. He has over 25 years of experience in the domain of modeling and simulation, including mixed reality and distributed virtual simulations. He is active in the 9-University Science of Test Research Consortium supported by the Office of Secretary of Defense leading the work in the Live, Virtual and Constructive simulation initiative and is the lead technical developer and project manager for the open-source Mixed Reality Simulation (MIXR) Platform which has been used to develop a wide variety of standalone and distributed simulation applications. His email address is douglas.hodson@afit.edu.