

Generating Adaptive Behaviors for Simulation-based Training

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Abstract

In order for simulation based training to help prepare soldiers for modern asymmetric tactics, opponent models of behavior must become more dynamic and challenge trainees with adaptive threats consistent with those encountered increasingly in the real world. In this presentation we describe an adaptive behavior modeling framework designed to represent adversaries within a multi-player virtual environment.

Two distinct areas of investigation are covered. The first area is a survey of the space of asymmetric tactics and adaptations from real-world military operations, to generate a set of reference scenarios. The second research area, and the focus of this presentation, is the design and development of machine learning techniques for creating adaptive adversaries. The approach makes use of an authoring tool for specifying adaptive behavior models as partial plans that can adapt over time in conjunction with training events. This approach focuses on supporting both a natural method of encoding existing domain knowledge and the rapid adaptation of encoded behaviors. The overall objective for this approach is that the adversary behavior models should constantly challenge, and occasionally surprise, the human trainees, to help them learn to be more proactive in recognizing asymmetric threats.

The reference scenarios were central to the construction of a decision making model for the adaptive adversary behaviors, providing scope for the inputs and outputs that constrain the space of possible actions and reactions of the adaptive adversary model. Although the set of scenario instances represents only a sample sequence of adaptations motivated by preceding successes and failures, the behavior models described in this presentation provide support for all of the adaptations identified in these scenario designs with sequencing entirely driven by exercise events rather than a predefined ordering.

Our approach to the problem of behavior adaptation and creation for asymmetric adversaries contains two primary elements:

1. Initial Adversary Behaviors: An initial set of behaviors are created by a subject matter expert (SME) in a graphical hierarchical state machine environment. This captures the current knowledge of adversary tactics.
2. Behavior Adaptation: Adaptive choice [Andre & Russell, 2002] and reward points are embedded in the initial adversary model to allow for partial specification of adaptive behaviors.

Building from both the developed training scenarios and the hierarchical dynamic scripting algorithm [Ludwig & Farley, 2008] (see also Dahlbom & Niklasson, 2006; Ponsen & Spronck, 2004 for related work), we created behaviors to determine adaptively the best initial training scenario configuration. To do this we specify the possible training scenarios as a hierarchical set of choice points, where the objective is to learn to select the scenario configuration most likely to succeed against the current players.

A feasibility study was carried out to demonstrate what a training event would look like, where human role-players performed the tactics generated by the adaptive behaviors. This study made use of the distributed and massively multi-player On-Line Interactive Virtual Environment (OLIVE) virtual environment as well as 6 ROTC cadets who played the role of human trainees.

References

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