Evaluating Behavior Modeling Toolsets

Jennifer Pagan
Kaegan Corporation
12350 Research Parkway
Orlando, FL 32826
jennifer.pagan1.ctr@navy.mil

Beth F. Wheeler Atkinson
Melissa M. Walwanis Nelson
Naval Air Warfare Center Training Systems Division (NAWCTSD)
12350 Research Parkway
Orlando, FL 32826
beth.atkinson@navy.mil, melissa.walwanis@navy.mil

1. Introduction

Simulation-based training is increasingly important in Navy training. However, replicating real-world environments has inherent challenges such as the necessity to provide realistic human behaviors in the simulated environment. One solution is to use human role-players for friendly and enemy forces. However, using role-players is costly in terms of money used to hire outside contractors, operational time foregone by volunteer role-players, and the added equipment for role-players. Semi-Automated Forces (SAFs) provide a less costly alternative to replicating friendly, enemy, and neutral platforms in the virtual environment. They are controlled and monitored by a human that pre-scripts command processes (Department of Defense, 1998). Although SAFs decrease the costs associated with using human-role players, the pre-scripted nature of their behaviors presents some inherent challenges. This paper provides an overview of the current state-of-the-art in human behavior modeling and outlines remaining challenges. The authors then provide a practical framework for evaluating rapid human behavioral modeling toolsets to overcome the presented challenges.

2. Challenges of Pre-scripted Behaviors

While SAF behavior significantly contributes to the realism of training scenarios, limited behaviors provide an unrealistic situation that may hinder training transfer (Gelenbe, Hussain, & Kaptan, 2005). This lack of realism is often because SAFs must be scripted prior to the training event. For this reason, many mission variations are preprogrammed to facilitate realistic tactical behaviors. Further, some training scenarios require thousands of SAF entities that must be pre-scripted to successfully execute training. However, pre-scripting this many entities with several behavioral variations is impractical due to time constraints and increased manpower requirements (Cox & Fu, 2005).

Even when SAF entities are scripted with few behavior variations, scripting large numbers of SAFs in short periods of time also presents challenges. There is often an increase in manpower to support scenario generation, (albeit, less than using live role-players) and instructors work long hours to ensure that training events are kept on schedule. Increased work hours contribute to cognitive fatigue and thus could limit the quality of training provided by an instructor (Whelan, Loftus, Perme, & Baldwin, 2002). Finally, as large scale simulation-based training events become more common and increase in scale, additional instructors are required to monitor SAF behaviors, causing training costs to increase (Furness & Tyler, 2001).

3. Behavior Modeling Evaluation

The previously mentioned challenges to SAFs limit fidelity and increase costs, showing a need to practically evaluate current human behavior modeling toolsets in a manner that can help overcome these challenges. A review of current behavior modeling technologies indicates two prominent technical approaches for creating more realistic SAFs: algorithms and hierarchies. While algorithmic approaches use behavioral instances to capture demonstrated behaviors, hierarchal approaches decompose high level tasks or goals into primitives to elicit behaviors. Both approaches of behavior modeling have shown to be effective methods of producing more realistic behaviors (Banks & Stytz, 2003). While these approaches are effective means of modeling realistic behavior, toolsets using these approaches should be evaluated on several criteria to practically increase Return on Investment and drive future scientific inquiry.

We have developed a behavior modeling toolset evaluation framework which can be divided into three categories: cost, schedule, and performance. Each category has its own set of evaluation criteria.

3.1 Cost

The cost category is broken into three criteria thought to reduce the cost of implementing a behavior modeling toolset. The three evaluation criteria are:
1) *Domain Independence*. Can entities be reused in a variety of training scenarios and simulations regardless of developmental domain?
2) *Technology Readiness Level (TRL)*. What is the level of maturity of the technology?
3) *Resource Requirements*. How much funding is required to increase product maturity?

3.2 Schedule

The time category consists of one criterion:
1) *Rapid Scripting Capabilities.* Can the toolset rapidly script entity behaviors?

3.3 Performance

The performance category is focused on the actual performance of the entity or toolset, and consists of two components:
1) *Autonomy*. Does the toolset reduce the manpower required to monitor entities?
2) *Communication Capability*. Does the toolset support more realistic interaction with entities?

4. Benefits

There are numerous anticipated benefits of evaluating toolsets using this framework. First, training fidelity and transfer are expected to increase, as rapid scripting reduces the time necessary to produce more behavior variations than current SAFs provide. Communication capabilities can also enhance realism by allowing the trainee to simulate communication with entities (Furness & Tyler, 2001). Next, manpower requirements are expected to decrease as the reuse of behavior models in various training scenarios and simulations reduces scenario generation time. The production of autonomous entities is expected to further reduce manpower costs by reducing monitoring requirements. Costs are further reduced by selecting toolsets that have higher TRLs and fewer resource requirements. Finally, reduction in scenario generation time and monitoring requirements can also alleviate the cognitive strain placed on instructors allowing them to focus on other aspects of the training scenario, such as performance measurement.

Authors' Note. The views expressed herein are those of the authors and do not necessarily reflect the official position of the organizations with which they are affiliated.

5. References

Banks, S., & Stytz, M. (2003). Progress and prospects for the development of computer-generated actors for military simulation: Part 2 – Reasoning system architectures and human behavior modeling. *Presence*, 12(4), 422-436.

Cox, C., & Fu, D. (2005). AI for automated combatants in a training application. *Proceedings of the second Australasian conference on Interactive entertainment.*

Department of Defense (1998). *Department of Defense Modeling and Simulation Glossary*, Manual No. 5000.59-M., Washington DC.

Furness, Z., & Tyler, J. (2001). Fully automated simulation forces (FAFs): A grand challenge for military training. *Proceedings of the 2001 Fall Simulation Interoperability Workshop.*

Gelenbe, E., Hussain, K., & Kaptan, V. (2005). Simulating autonomous agents in augmented reality. *The Journal of Stems and Software*, 74, 255–268.

Whelan, M., Loftus, J., Perme, D., & Baldwin, R. (2002). Reducing training costs through integration of simulations, C4I systems, and expert systems. *Proceedings of the 2002 Winter Simulation Conference.*

Authors' Biographies

Jennifer Pagan is a Research Psychology Assistant at Kaegan Corporation, Orlando FL. She has an M.S. degree in Industrial/Organizational (I/O) Psychology from the University of Central Florida.

Beth F. Wheeler Atkinson is a Research Psychologist at NAWCTSD. Her research interests include human-computer interaction, instructional tools, and distributed mission training. She holds a M.A. in General Psychology from the University of West Florida.

Melissa M. Walwanis Nelson is a Senior Research Psychologist at NAWCTSD. She has a M.S. degree in I/O Psychology from the University of Central Florida. Her research interests include distributed mission training, leadership development, simulator instructional tools, and network centric warfare concepts for coalitions.