

Testing Behavioral Models with an Online Game

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The WarPipe massively multiplayer online game engine promises to enhance games and more serious applications.

The US Department of Defense seeks to expand its research in modeling and simulation to include not only traditional physics-based models but also models of individual and societal behaviors. This endeavor has been well-documented in a recently published National Research Council study, *Behavioral Modeling and Simulation: From Individuals to Societies* (G.L. Zacharias, J. MacMillan, and S.B. Van Hemel, eds., National Research Council, National Academies Press, Washington, D.C., 2008, ISBN 0-309-11862-X). The study notes that a technological infrastructure and analysis capability must be developed for behavioral modeling that the DoD can properly select and deploy.

COMMUNICATION AND TRAINING

Verified and accredited behavioral models are necessary for the DoD's new mission areas of Stability, Security, Transition, and Reconstruction (SSTR), where the main goal focuses not on the physics of breaking things, but rather on communication and interaction with individuals and groups. Achieving this goal requires developing behavioral models for both analysis and training.

Analysis seeks to understand the space of potential outcomes with respect to planned operations in areas in which we are not culturally native. Training focuses on providing a real-time interactive experience in which personnel can execute operations in nonnative environments.

This analysis and training tests proposed behavioral models in an environment in which it is possible to probe and virtually operate against them sufficiently to verify and accredit those models. If we can do this, we can build training and analysis systems to provide military personnel with an on-ground understanding of their mission areas before their deployment overseas.

GAMEPIPE ANALYSIS

Ongoing efforts at the USC GamePipe Laboratory focus on developing the technological basis for the analysis capability called for in the NRC study, including a massively multiplayer online game (MMOG) infrastructure that can be used as a testbed for models of individual and group phenomena. A first task for this effort is selecting an appropriate open source or openly available MMOG that will include a set of US force, opposing force, and civilian

animations and behaviors, a network game infrastructure, and a well-defined software interface for the insertion of externally developed individual and group models.

An infrastructure for analyzing online gameplay in real time, also under development, provides visualizations of what happens in the game, with the eventual goal of providing a real-time analysis and understanding the potential outcomes space for the ongoing game and embedded model computation. An architecture for obtaining game inputs from real-world news feeds is also under development, and will provide variability and emergent behaviors in our game populations based on extracts from each day's events.

The overarching goal of all this work is to develop the technology for providing the analysis capability currently missing from the behavioral models being developed for SSTR.

STATE OF THE ART

In the current state of the behavioral modeling art, models are developed in government, corporate, and academic environments far from the modeled individuals and cultures. Those models provide a great story using highly abstracted and distilled

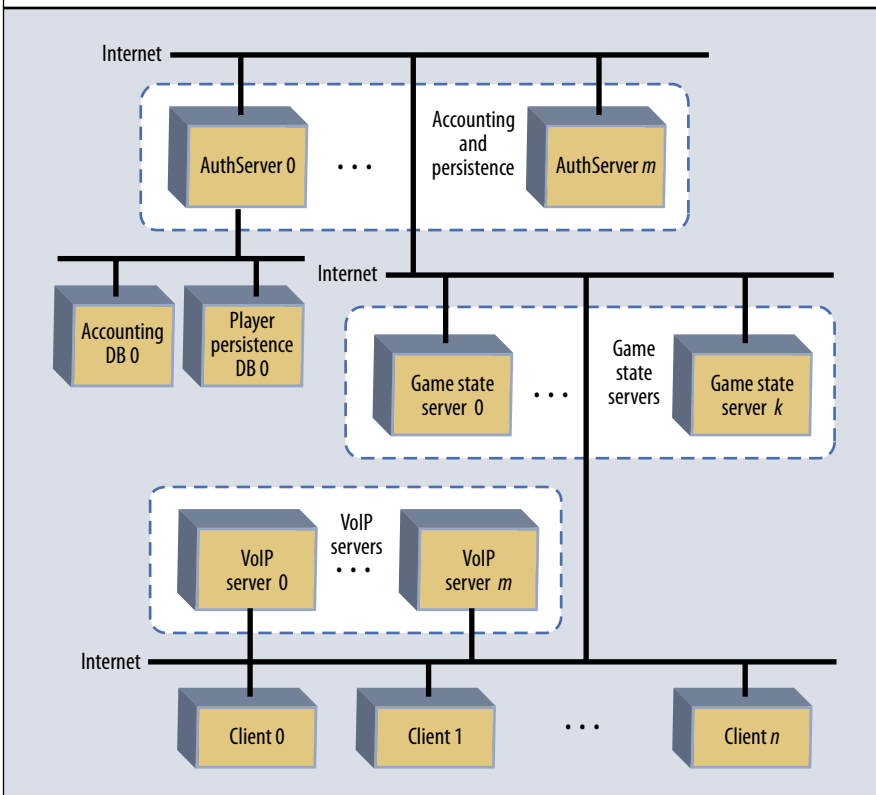


Figure 1. The GamePipe Laboratory is developing software architectures that can be connected to online game infrastructures.

inputs, but no certainty regarding how those models will perform when deployed where lives might be at stake.

Rather, we seek to provide real-world inputs for such behavioral models, then examine their outputs. Ideally, such models would be embedded into an online game infrastructure where live players can change the inputs into the models, with those models reacting and then changing the visual display, which live players can then analyze.

Currently, only the developers understand how the majority of behavioral models are built, thus they are not developed to be interoperable with any standard for display and interactivity. Our work studies how to define an interface for such models and their connection to an online game infrastructure that provides the visualizations and interactivity necessary for the behavioral models to be well understood.

KEY CHALLENGES

Some key scientific and technical challenges to our project mesh tightly with developing the following projects' goals.

MMOG infrastructure

We are developing an MMOG infrastructure that can be used as a game testbed for models of individual and group phenomena. An open source infrastructure is critical for developing the MMOG analysis capability and for unencumbered distribution of our results.

That MMOG will include a set of behaviors for US force, opposing force, and civilian animated models. We also provide a network game infrastructure and a well-defined software interface for the insertion of externally developed individual and group models. The USC GamePipe Laboratory has created an online game infrastructure that already runs in the laboratory, as Figure 1 shows.

WarPipe

The MMOG under construction, *WarPipe*, set on present-day Earth, has a two-level structure with an outer game and several subgames.

A city- and world-building simulation, the outer game includes player- and guild-level conflicts. Inner games—or subgames—can be housed in any of the world's buildings or areas, and can belong to any genre, such as sports, first-person shooters (FPSs), or gambling. Each player can choose to partake of the outer game, the subgames, or both. In the outer game, players can choose to compete in a city's subgames for their own gain or on behalf of their guild. The guild whose members win the most subgames in a given city will rule that city. Doing so lets them levy taxes, govern new construction, and attempt to conquer neighboring cities.

The outer game and subgames format supports our aim to attract as many players and player types as possible, providing more research data. Players can freely interact in peaceful venues, fight in small venues such as FPS subgames, or engage in guild-level wars with an entire city as the prize. Alternatively, players can explore new subgames in various distinctive locales, find and complete task assignments, and achieve top subgame ranking, guild rulership, or even world domination.

The GamePipe experience

The USC GamePipe Laboratory has developed software architectures that can be connected to the online game infrastructure, working with models from Carnegie Mellon University's Center for the Computational Analysis of Social and Organizational Systems as exemplars (www.casos.cs.cmu.edu) of this work. The proposed effort will work with CMU researchers to develop the software interface to the online game infrastructure, as Figure 2 shows. We are also reaching out to other organizations that create and deploy behavioral models.

CASOS created Construct, the first behavioral model that will analyze our game data (www.casos.cs.cmu.edu/projects/construct). It essentially tracks the dissemination of knowledge and the growth of communication networks. Game data extracted for Construct's analysis will include player statistics—guild membership, abilities, battles, tasks, and adjacency—and communications records such as who talked to or physically approached someone, and when. CASOS will also track knowledge dissemination for Construct via formal, in-game player-to-player training in various skills, such as fighting moves or emotes and gestures. Data logging will also capture various aspects of the game, including city construction, guild growth, and subgame rankings. All data logs can be presented either in real time or after the fact, as a graphical snapshot or a trend.

A specific set of data to be presented for CASOS analysis includes the record of conflicts from FPS subgames and guild wars: team formation, weapons used, communications patterns, casualties, and city takeovers. CASOS will also track the effects of these conflicts and of rare "terrorist attacks" and "natural catastrophes" staged by the game administrators, as well as the behavior of noncombatant populations.

Online gameplay analysis

Our infrastructure for analyzing online gameplay in real time will create visualizations of what happens in the game. Its eventual goal will be to provide real-time analysis and understanding of the potential outcomes space for the ongoing game and embedded model computations.

This task's core challenge will be to generate meaningful visualizations in the game space with respect to the state of behavioral model computations. Much experimentation and prototyping must be done to generate meaningful visual results. We are working closely with the behavioral model developers on this task.

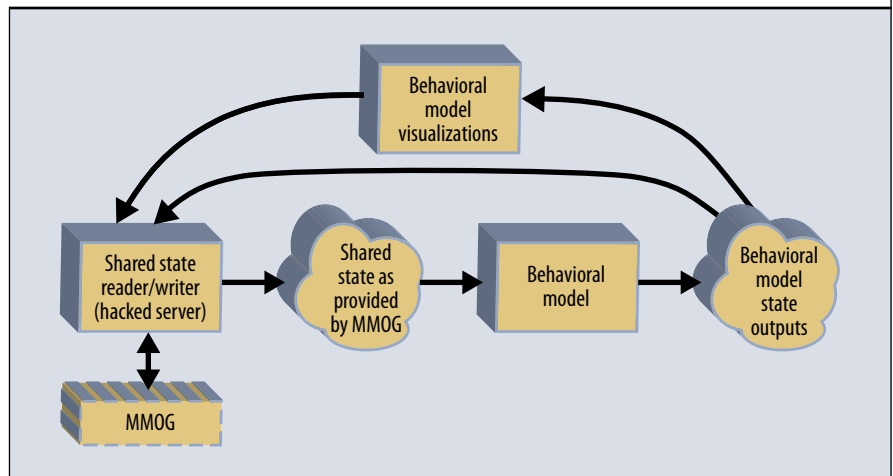



Figure 2. Carnegie Mellon University's Center for the Computational Analysis of Social and Organizational Systems is developing behavioral models and working with the USC GamePipe Laboratory's researchers to develop a software interface to online game infrastructures.

All data-logging parameters—such as timeslice granularity and the tracking of players, guilds, attributes, and presentation format—will be adjustable via a Web-based research interface. Our game will offer a critical degree of research flexibility beyond the standard MMOG's data-logging capability. Our overall design composes a federated model architecture: Each subgame provides a potential lab for a different social and behavioral model, maintaining interoperability with the outer game. Subgames can be added, and outer world gameplay tweaked, all to meet the analytical needs of any behavioral model creators who use our game as a research testbed.

Incorporate real-world RSS feeds

To allow behavioral models to track the effect of public information on social groups, we will include real-world RSS feeds on in-game billboards, news screens, and similar media. The first application of this technique will address in-game resources. Each region in the game world will have various natural resources to exploit via mining, harvesting, and so forth. The value of a given resource will rise and fall with the price of its real-world counterpart.

Thus, the daily price quote for gold according to the *Wall Street Journal* will govern the in-game cost of gold for a commensurate period. These real-world commodity prices will appear in the game's news sources. Eventually, disparity in resource value between areas might lead to people moving to a richer region, or to a hostile takeover attempt from a neighboring region.

We are rapidly completing the *WarPipe* MMOG's design and plan to show the first demo of the outer-world game at the USC GamePipe Laboratory's Demo Day on 12 May 2009. By August, we will have integrated the Construct model and begun to implement subgames and additional behavioral models. 

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