

Symbiotic Simulation

A Touch of Gaming for Crisis Management

Presentation to the Society of Simulation And Gaming of Singapore

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0. Outline

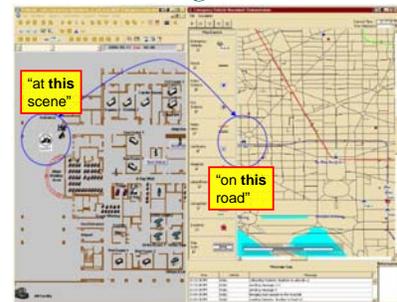
- Crisis Management Overview
- Introduction of Symbiotic Simulation
- Tie-Ins to Gaming
- Rough Sketch of Our Approach

1. High-Tech Crisis Management

- What exactly *is* a crisis?
 - “a condition of instability or danger, leading to a decisive change.” *dictionary.com*
 - Social
 - Economic
 - Political
 - International Relations
 - Geological
 - Notion of a “decisive change” is the motivation to plan for crises.

1. High-Tech Crisis Management

- Example:
Training Teams to react to bomb threats.
- Why so high-tech?



Integrated Sim.

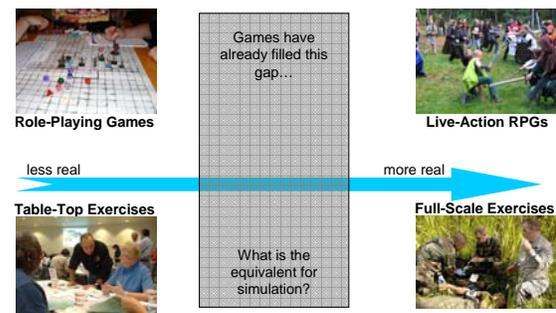
Vehicle Sim.

Jain et al, 2006

1. High-Tech Crisis Management

- A solid software framework:
 - Expert Models → Arbiter
 - Visual Output → Accessibility
 - Integrated Statistics Gathering → Analysis
- Simulation Used for:
 - Training, Evaluation
 - Urban Planning with respect to crises
 - What-If Scenarios & Plan Assessment

1. High-Tech Crisis Management



1. High-Tech Crisis Management



1. High-Tech Crisis Management

■ What Simulation Borrows from Gaming

- Lightweight Communication
 - More rigorous standards exist (e.g., the High-Level Architecture, but complexity is a "barrier to the development and... widespread use of distributed simulations outside the military domain.")
- Techniques to Avoid Irrelevant Messages
 - "Grids" and "auras" showed up in gaming first, then were incorporated into the HLA and other systems.
- A Cost-Effective Abstraction
 - Configuring & running a simulation is much cheaper than a full-scale exercise, but more accurate than a table-top exercise.

1. High-Tech Crisis Management

- For example, McGrath *et al*:
 - Supported a large number of users (~180ms delay for 10,000 entities with 16 features each – this is *just about* acceptable delay for a networked game.)



2. Building Realistic Agents

- Crisis Management Simulations are usually agent-based.
 - This allows user agents to freely interact with simulated agents.
- For anything non-trivial, realistic agents need to be created.
 - Fortunately, current simulation studies are already working on this.

2. Building Realistic Agents

- Pan *et al*, 2004 & Shendarkar *et al*, 2006
 - Multi-agent simulation
 - Pan: How people flock when exiting buildings
 - Shendarkar: How support personnel affect the egress time & number of casualties.

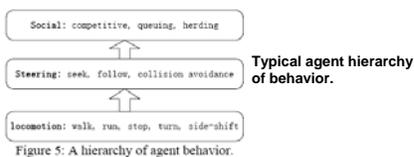


Figure 5: A hierarchy of agent behavior.

2. Building Realistic Agents

- Pan: Distinguish between "herding" and "queuing"
 - Get rid of false assumptions of egress as simple "optimized search"

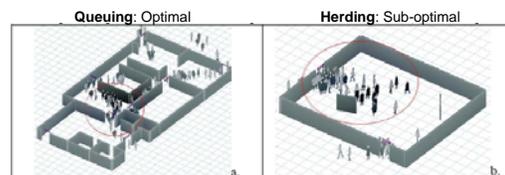


Figure 9: Queuing and herding behavior.

3. Overcoming Inherent Difficulties

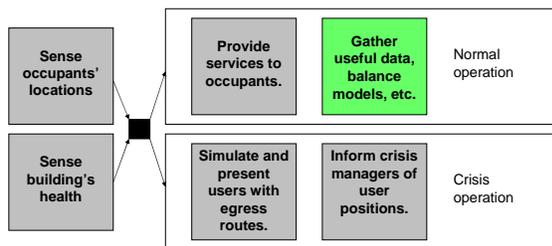
- “Classic” Symbiotic Simulation
 - A kind of “mutualism”
 - Optimize the system
- DDDAS
 - Commensalism
 - Only move the sensors; don't affect the system
 - Esp. good if there's too much data to measure all at once

3. Overcoming Inherent Difficulties

- Key Questions:
 - Can we set up a system that, after some training, can record relevant data during a crisis for use after in training & analysis?
 - Can the system eventually become capable of making decisions *during* the crisis, and effecting them (or presenting them to rescue workers and coordinators)?

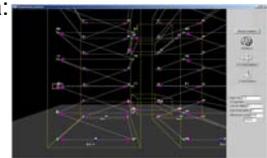
4. An Approach Based on Gaming

- Create a system with DDDAS and Symbiotic elements, and train it on “real” data gathered by game players.



4. An Approach Based on Gaming

- Sense users via:
 - Mobile phones, PDAs
- Sense building health via:
 - Bluetooth scatternet
 - One entry in 2002 already tried this, to some success

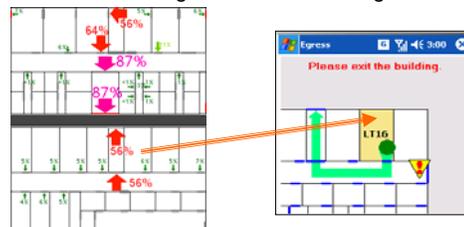


4. An Approach Based on Gaming

- Direct Gaming
 - Data gathered during staged evacuations can be saved for later input to training simulations.
 - Data gathered about “normal” flow can be used by Administrators to plan (e.g., which corridors to close if a VIP is visiting.)
- Indirect Uses
 - Data can also be used to validate other simulations & games.
 - Our current focus: an MMO game that can be used to test complex theories of egress.
 - E.g., we might test queuing versus herding
 - Real-world users provide “input” data, and we can cross-validate this with established guidelines (the density/speed measurements of Fruin, or calculations of Togawa) or with our own real-time simulation.
 - This abstraction is provided by all simulations, but ours gains validity by using DDDAS techniques on real users.

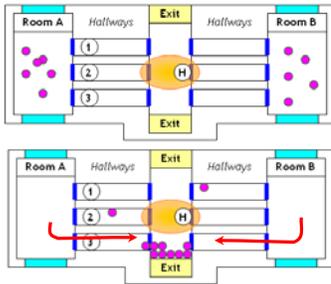
4. An Approach Based on Gaming

- Symbiotic simulations operate by running several “What-If?” scenarios, and *enacting* the best scenarios. We might inform users of egress routes:



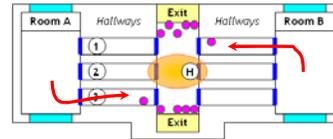
4. An Approach Based on Gaming

- This can avoid the basic conditions for herding:



4. An Approach Based on Gaming

- ...based off the observation that people make the best decisions when stress is low (i.e., before they feel “trapped”) and they have the most relevant information.



5. Additional Benefits

- Integrated approach:
 - Administrators can effect certain changes with the push of a button.
 - The system can be monitored in real-time, to detect bottlenecks, and to update users to sudden changes in rooms' safety.
 - Sensors connected to Bluetooth nodes can enhance our model's accuracy by, e.g., sensing gasses used for FED susceptibility data.

6. Research Goals

- **Short term:** Try and start work on using an MMO game as a *general research platform* –in our case, for egress simulation.
 - Secondary aim: show that a simple 2-D game provides an acceptable abstraction.
- **Long term:** Integrate symbiotic simulation & DDDAS into a crisis management prototype, and provide a framework based on this concept.
 - Still brainstorming possible applications.

7. In Closing

- Any Questions?