

Agent-Based Simulation for Modeling Complex System Behaviors

This one-day seminar provides a comprehensive introduction to agent-based simulation (ABS), which is currently the “hottest” topic in simulation modeling. In an ABS autonomous agents (people, vehicles, organizations, etc.), which have attributes and potentially complex behaviors, interact with each other and their environment over time toward the accomplishment of their goals. This allows an agent’s behavior to depend on the current and past states of its environment, rather than being “scripted,” which permits much more complex behaviors to be represented as compared to traditional models.

ABS has been successfully applied to a diverse set of problems, and improved software packages have facilitated the model-development process. However, learning ABS on one’s own is **difficult**, at best, due to the genuine lack of specificity in the literature. Much of the confusion is due to the “smokescreen” of attributes that are often associated with ABS, including autonomy, sensing and interacting with the environment (including other agents), learning, adaptation, behavior based only on “local” information, emergence, and complex adaptive systems. We address this conundrum by discussing what we believe to be the **real** essence of ABS. The development of this seminar has benefited from funding by the U.S. Army.

What You Will Learn:

1. Agents and Agent-Based Simulation

- Agents as autonomous entities with attributes and complex behaviors
- Reactive versus adaptive (learn from previous experiences and change behavior rules) agents
- Bottom-up modeling and possible emergent system-level behavior
- When to use ABS
- Relationship of ABS to discrete-event simulation (DES)

2. The Structure of an Agent and Time-Advance Mechanisms

- Agents with memory, rules, and a behavior engine
- Time stepping versus next-event time advance and advantages/disadvantages of each

3. Historical Perspective

- Cellular automata
- Growing artificial societies
- Complex adaptive systems

4. Software for Agent-Based Simulation

- Commercial DES software with capabilities for ABS
- Latest developments in public-domain toolkits for ABS, and their modeling flexibility, ease of use, and quality of documentation
- Important defense-related ABS

5. Development of Several Agent-Based Simulation Models

- Example to illustrate how to implement basic reactive rules for agents
- Example to illustrate learning and adaptation for agents

6. Successful Applications of Agent-Based Simulation

- Defense (e.g., irregular warfare)
- Homeland security (evacuation of crowds, border control, etc.)
- Traffic modeling
- Epidemiology
- Supply chains
- Consumer behavior
- Sociology
- And many more ...

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