Towards a Discrete Event Methodology for Modeling Agent Behavior

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http://hdl.handle.net/10945/44398
Towards a Discrete Event Methodology for Modeling Agent Behavior

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Overview

• Problems with Time Step
• Discrete Event Methodology and Event Graphs
• Listener Patterns
• Referee and Environment
• Next Steps
Problems With Time Step

• Anomalies in results due to time step
• Examples include
  – Missed waypoints
  – “Skipping” – missed detections
  – Problems with range-based detection probabilities
Skipping Phenomenon (Al Rowaei, 2011)

Speed = 7 m/s, CC sensor range = 14 m, 20 stationary targets, 200 replications, 2000x2000m grid size
- Issues lie not with movement mechanism of MANA 4 and 5 but due to TAM effects.

- How to ensure this phenomenon is detected in complex simulations, or it is not affecting non-visible variables?

12/12/11 2011 Winter Simulation Conference
Event-oriented World View

• States with piecewise constant trajectories
• Instantaneous state transition identified with Event
• Perspective
  – Spend some time “doing one thing”
  – Then switch to “doing another thing”
Event Graph Methodology

- Nodes = Events
- Edges = Scheduling Relationships
LEGO Component Framework

• Each simulation component (LEGO) encapsulates
  – Parameters
  – State variables
  – Events (Event Graph)

• LEGOos communicate via Listening
SimEvent Listener Pattern

• When Source component’s event occurs, all registered listeners “hear” Event

• Listener’s Response
  – Default: execute matching event (name and arguments)
  – Other responses possible
Listening

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Application to ABS Modeling

• Agent is a compound LEGO
• Each LEGO component listens to certain other components
• “Environment” is also a LEGO
• Certain events are only scheduled by “Environment”
Agents and Environment

Agent 1  
Agent 2  
Agent 3  
Agent 4

Environment

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Simple Example: Sensing

• Sensor
  – Maximum range
  – Detection rule once target is in range
  – State: target detected (or not)
  – Events: Detection/Undetection

• Environment Component ("Referee")
  – State: target in or out of sensor’s range
  – Events: EnterRange/ExitRange
Sensing (cont)

• Referee schedules EnterRange or ExitRange based on hearing target’s StartMove or EndMove events
• Mediator schedules Detection event for sensor following EnterRange event of Referee
• Mediator schedule Undetection event following ExitRange event of Referee
Summary

• DES Worldview offers potential for different perspective for ABS
• Using states and events as primary building blocks gives much flexibility
• Listener pattern supports scalability and loose coupling
• Key Idea: all interactions with agents and environment through events
Next Steps

• Flesh out methodology
• Develop toolkit based on Simkit
• Address some traditional Agent models
• More scenarios where time step is problematic