QinetiQ

AI for OOTW

Representing Plausible Behaviour in OOTW Simulators

HVR CONSULTING SERVICES LIMITED

SELBORNE HOUSE . MILL LANE . ALTON . HAMPSHIRE GU34 2QJ

T 01420 87977 F 01420 89819

W www.HVRGroup.com

Dr Stephen Curram
HVR Consulting Services Ltd
steve.curram@hvr-csl.co.uk
♦
Dr Mark Cusack
QinetiQ, Malvern
♦
Mirek Gliniecki
HVR Consulting Services Ltd

Background

Purpose of overall study is to create simulators that allow commanders who may be involved in OOTW to experience the sorts of situations they may be faced with :

- Multiple factions and agencies
- Highly political environment
- Restrictive RoE
- Media coverage and public opinion
- Multiple information sources

Background (2)

- Purpose of simulators is to provide a challenging and thought provoking environment
- The simulators are not designed to be analysis tools
- They will conform to the High Level Architecture (HLA) requirements
- Use Java and JavaBeans™ technology
- AI is only one component of the study
- Pilot is a peace-keeping scenario

Study Approach

- Identification of behaviour types and requirements of AI for OOTW simulators
- Review of technology and case studies to generate shortlist of approaches for further investigation
- Develop stand-alone AI objects for analysis
- Test AI objects in an integrated environment
- Use in pilot simulation model

Aims of the AI

- Provide plausible behaviour in simulation from a player's perspective
  - computer generated actors
  - occurrence of events
- Give player something to think about
- Be responsive to player's actions
- Not to be too transparent - player should be immersed in environment rather than trying to beat the AI

It's Artificial Intelligence, BUT

- It is more important that behaviour appears plausible to a player rather than for the mechanism to conform to any psychological theories
- The AI should be reasonably quick and easy to set up
- Probably more akin to the requirements for commercial computer games than traditional military models

Soft AI

Approaches Considered

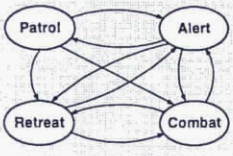
- Random Sampling - does not take account of conditions, though not entirely predictable - could be combined with other approaches
- Knowledge-Based Systems (& related) - can be too predictable if rules are simple, while ease of setting up falls rapidly as rules become more complex
- Fuzzy Logic - rules are generally simpler but more powerful than KBSs, needs some experience in choice of fuzzy regions, linguistic terms can help trainers in tweaking scenarios
- Case-Based Reasoning - full systems can be time consuming to set up and have overhead of a shell, simpler versions may be useful for recognising when scripted events can occur

Approaches Considered (2)

- Finite State Machines - commonly used in computer games, simple to set up, can get predictable for player
- Fuzzy State Machines - adaptation of Finite State Machines using fuzzy rules, becoming popular in computer games, membership functions could be used for random sampling
- Bayesian Belief Networks - powerful representation of factors on behaviour, can be difficult to set up, difficulty of validation
- Neural Networks (various types) - adaptive, powerful representation but time consuming and difficult to set up and validate
- Genetic Algorithms - adaptive, but too slow for interactive simulation

Short-listed Approaches

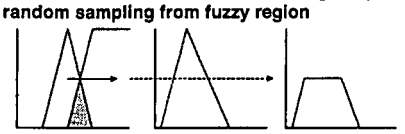
- Finite State Machine (FSM)
  - for simple behaviour
  - create generic FSM object to which states and transitions are added
  - easy to set up



START STATE	TRANSITION CONDITION	END STATE
Patrol	Sound Heard	Alert
Patrol	Armed Unit Spotted	Alert
Patrol	Fired On	Combat
Alert	Unit Recognised & Attitude Hostile & Unit Outnumbered	Combat
Combat	Significantly Outnumbered	Retreat

Short-listed Approaches

- Fuzzy State Machine (FuSM)
  - for more complex behaviour
  - linguistic or numerical inputs
  - smoother transitions between states
  - create generic FuSM to which terms and fuzzy rules can be added
  - state can be selected from centre of gravity or using random sampling from fuzzy region

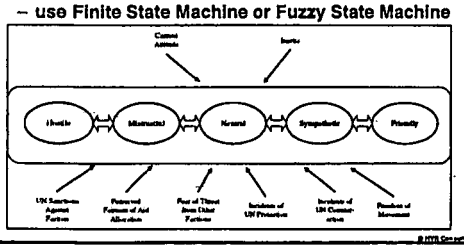


Short-listed Approaches

- Simplified Case-Based Reasoning
  - pre-scripted events or event generators
  - conditions for launching events, including time windows
  - random element
  - generic object that links to event and allows conditions to be specified based on other objects present in simulation

Behaviour Type - Attitude

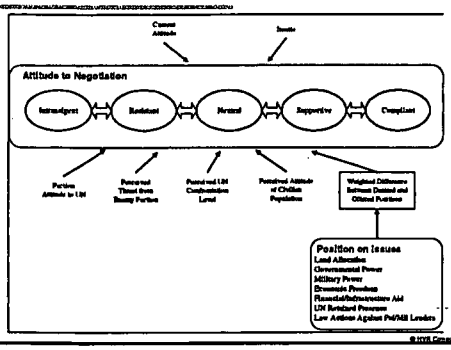
- Attitude of an actor towards other actors
  - may differ at different levels, e.g. faction leaders towards UN, or faction soldier towards UN
  - use Finite State Machine or Fuzzy State Machine



Behaviour Type - Negotiation

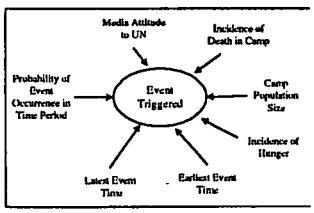
- Negotiation between actors
  - player has role as a mediator, and suggests compromise solutions
  - response of actors depends on the weighted distance from their ideal solution and their attitude towards the negotiations
  - Use Fuzzy State Machine
  - likely to be iterative process over time

Behaviour Type - Negotiation



Behaviour Type - Event

- Scripted events need to occur at plausible times
  - e.g. negative newspaper stories on refugee camp conditions only when conditions are bad



Current Work

- Finite State Machine and test rig developed
- Fuzzy State Machine and test rig (shown) developed
- Allows absolute rules - outcome is state membership values
- Allows change rules - outcome is amount of change to current state value
- Experimenting with different fuzzy regions and rules
- Looking at integration with JavaBeans HLA framework