Modeling Human Variability in Computer Generated Forces

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Overview

- Agent Oriented Software (UK) has recently been awarded a contract to improve the representation of human variability in computer generated forces for the UK Ministry of Defence (MOD)
- This presentation focuses on the cognitive modeling and behavior moderators aspects of the project
Cognitive modeling in the UK Ministry of Defence

Up until 2000....

- 1994 Soar (Sheppard, Nottingham & Portsmouth Universities)
- 1996 Broad Agents (Hepplewhite & Baxter)
- 1997 UK Stow (DERA Fort Halstead & Portsdown West)
- 1998 IMPE-based human science server to ModSAF (Russell, Belyavin, Sheppard)
- 1998-2000 RCAB (Sheppard, RMCS Shrivenham & Portsmouth University)
Current State

- Impressive advances in CGFs
- Relatively little improvement in representation of human behavior in CGFs
- Focus has been on normative behavior
- Interest has now shifted:
  - How do known factors affect individual and unit behavior?
Current UK Program

- MoD recognized these limitations & lack of progress in improving modeling
  - funded by the Synthetic Environments Coordination Office (SECO), under MoD’s Corporate Research Program
  - research completed in December 2002
  - contract award and substantial 2-year program started Feb 2003

- Contract focuses on
  - modeling of human behavior
  - representing the effects of external and internal moderating influences on the CGF entity and unit behavior in an effective and practical manner
International Team

- Prime Contractor **Agent Oriented Software Limited, UK**
  - Project manager: Andrew Lucas

- Software Development
  - Andrew Lucas, Martyn Fletcher **Agent Oriented Software Limited, UK**
  - Ralph Rönnquist, Dennis Jarvis **Agent Oriented Software, Australia**

- Cognitive modeling
  - Frank Ritter **Penn State University**
  - Emma Norling **University of Melbourne/Ramjet Software, Australia**

- Demonstration & CGF interfacing
  - Simon Russell, Jeremy Baxter **QinetiQ, UK**

- MoD scientific expertise
  - Colin Sheppard, Ian Greig **Dstl, UK**

- MoD customer
  - Roy McNee **Ministry of Defence Synthetic Environment Coordination Office**
BDI Agents

Human
- Beliefs - perceived understanding of the world
- Goals or desires
- Accumulated experience and behaviors

Belief, Desire, Intentions Agent
- Beliefs - database of perceived world knowledge
- Goals or desires
- Intentions - currently executing plans
- Behaviors - pre-compiled plans

Ref. Wooldridge 2000 “Reasoning about Rational Agents”

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BDI Agents and JACK

- JACK implements BDI reasoning, and also includes other features, such as
  - explicit representation of teaming,
  - development GUI,
  - debugging/tracing environment
JACK Component Architecture

Graphical Development & debugging

JACKTeams Model

BDI agent Model

Application code

Utility classes

JACK Kernel

Communication

agent capability event plan beliefset view
Cognitive modeling & Human Variability in JACK

- BDI is based on how we *think* that we think, rather than the actual mechanism in the brain.
  - This is a benefit in human modeling: models are relatively intuitive to build and to understand when running.

- Most human variability data is at a lower level – e.g. effects on processing time or memory capacity.
Challenge: A cognitive architecture wrapper that represents the necessary components of cognition but maintains the ease-of-use of a BDI system
Extending JACK

- Previous work has demonstrated:
  - the P/M models that have been implemented in Soar/ACT-R can be implemented in JACK (Norling and Ritter, 2001)
- Perhaps the biggest problem in the current system is the representation of memory:
  - beliefsets are prolog-like databases, views are java code
Current Status

- Identifying the effects of key behavioral moderators, e.g.
  - Stress
  - Fatigue
  - Sleeplessness
  - Stimulants (e.g. Caffeine)
  - Pre-task appraisal
  - Amphetamines(?)
  - …?

- Limited by available data – resources not available to conduct experiments
Current Status

- Preliminary stages of the development of the cognitive architecture wrapper for JACK Teams, influenced by
  - Implementation of JACK Teams
  - Cognitive elements that will be influenced by behavior moderators
Program Outcomes

- Model representing the effects of external and internal moderating influences on CGF entity and unit behavior in an effective and practical manner
- Implementation of Cognitive Modeling Architecture as a layer on top of JACK Teams
- Lightweight generic interface layer, facilitating integration with CGFs
- Demonstration of the project’s output using CGF entities within the OneSAF Test Bed (OTB)