

A military helicopter is shown in flight, hoisting a person from a height. The helicopter is positioned in the upper left quadrant of the frame. A person is suspended from the hoist, and another person is visible further down the rope. The background features a tall, dark skyscraper with a grid-like window pattern, and other city buildings are visible in the lower portion of the image. The sky is clear and blue.

The MOVES Degree & the MOVES Research Program

Michael Zyda, Director
zyda@movesinstitute.org

The MOVES Degree

A little history ...

MOVES began in March, 1996 with the M.S. degree program

The MOVES Ph.D. was approved in March, 1999

Originally intended to be pragmatic mix of Computer Science and Operations Analysis

MOVES has now evolved to become its own field.

Program objectives

Our students go on to manage M&S systems,
not build them

We believe this means that they have to know
how to architect next-generation M&S
systems

Q: How can someone manage and/or architect
a system who does not know the
fundamentals of what is being built?

A: They can't.

Where do our students come from?



- MOVES defines
 - the Navy's subspecialty in modeling and simulation (6202/xx99 P-code),
 - the Marine Corps' modeling and simulation subspecialty (MOS 9625),
 - the US Army's Simulation Operations functional area (FA-57), and
- MOVES supports the International M&S community (Turkey, Greece, Singapore, Germany)

MOVES MS Program

Mathematical Fundamentals

Matrix algebra, single variable calculus, intro to finite math, probability & statistics, statistics & data analysis, advanced data analysis

Modeling & Simulation

Simulation & training, stochastic models & military applications, system simulation, intro to combat modeling, survey of combat models, management of M&S development

Programming

Objects & programming, data structures & intermediate programming, C++ as a 2nd language, artificial intelligence

Virtual Environments

Computer graphics programming, computer graphics modeling, virtual environment technology, human factors in system design

Systems & Networks

Computer systems principles, operating systems, computer communications & networks

MOVES Blocks

Combat Modeling
Networked Visual Simulation
Web-Based Simulation
Agents & Cognitive Modeling
Training Systems
Human Factors
Physically-Based Modeling
Optimization
Management & Acquisition
SIWCC
JPME

The MOVES Research Program

Mission

Research, application and education in the grand challenges of modeling, virtual environments and simulation.

- 3D Visual Simulation & Networked Virtual Environments
- Computer-Generated Autonomy & Computational Cognition
- Human Performance Engineering & Immersive Technologies
- Game-Based Simulation, Understanding & Analysis
- Combat Modeling & Analysis

Organizational Structure

Director

- Michael Zyda

Technical Directorate

- John Hiles - Computer-Generated Autonomy & Computational Cognition
- Don Brutzman - 3D Visual Simulation & Networked Virtual Environments
- Rudy Darken - Human Performance Engineering & Immersive Technologies
- Ted Lewis - Software Engineering & Homeland Security
- Alex Mayberry, Creative Director
- LtCol Tom Cioppa, USA - USA TRAC Monterey

MOVES Size

68 NPS faculty/staff participate in our weekly meetings, faculty/staff from all four NPS schools.

- We are the largest interdisciplinary group on campus.
- We are paying those faculty/staff from MOVES reimbursable funding, budget pages totaling \$19M.

We are working with approximately 70 students from all four NPS schools.

Communications

Weekly Meetings

- Monday - Directors/PhD Students
- Tuesday Noon
 - ◆ Agents & Autonomous Behavior
 - ◆ Human Performance Engineering
- Wednesday Noon - Networked Virtual Environments
- Thursday Noon - MOVES Brown Bag
- Friday 11am - Combat Modeling & Analysis
- Friday Noon - Directors

Communications cont.

MOVES Institute Mailing List

Focus Group Mailing Lists

Directors Mailing List

Weekly Research Project Meetings

MOVES Institute Open House 24 - 26 August
2004

MOVES Institute Annual Report

Web site

Advisory Board

Advisory Board provides guidance on funding for research and products.

- RADM Steven Tomaszczeski, USN - N61
- RADM Lee Kollmorgen, USN (ret)
- CAPT Dennis McBride, USN (ret), PhD - President, Potomac Institute
- COL Jack Thorpe, USAF (ret), PhD
- Dr. Harold Hawkins, ONR
- Gilman Louie, In-Q-Tel
- LCDR Dylan Schmorrow, USN – ONR VIRTE Program Manager & DARPA Program Manager
- Michael Kapp - Founder & President Time Warner Special Projects (ret)
- Stephen Moore, Technical Director J7, JFCOM

Advisory Board cont.

COL Mike Finnern, USAF - Director, DMSO

CDR Henry Brus, USN - Director, Navy Modeling & Simulation Management Office, N61M

Jim Weatherly - Deputy Director, Navy Modeling & Simulation Management Office, N61M

Dr. Estrella Forster, Science Advisor, Third Fleet

Dr. Mike Bailey - Technical Director, USMC Training & Education Command

Dr. Mary Fischer, Air Force Agency for Modeling & Simulation

Dell Lunceford - Director, AMSO

Dr. Phil Barry, DMSO OOTW Technical Lead

Dr. Bowen Loftin - Old Dominion University, Director Virginia Modeling & Simulation Center

Dr. Mark Pullen, George Mason University

Dr. Randy Shumaker - Director, UCF Institute for Simulation & Training

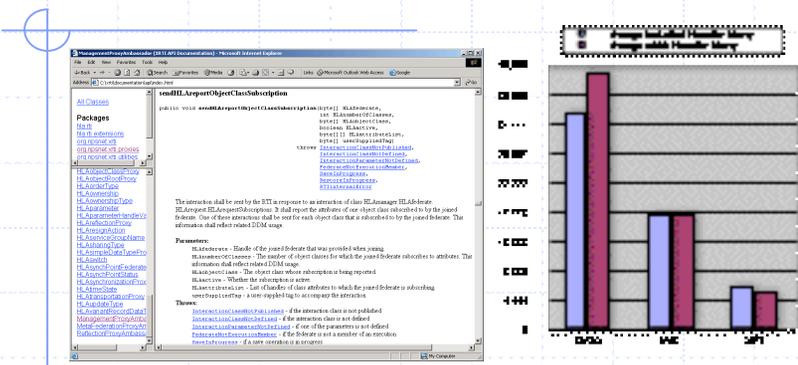
RADM David Bill, USN (ret), NPS Foundation

Directions

3D Visual Simulation & Networked Virtual Environments

In networked virtual environments, we are architecting the technology that allows us to build large-scale, dynamically extensible virtual environments, virtual environments that are semantically interoperable and always on.

In addition, we are building prototype applications for the web-enabled force.



Extensible Run-Time Infrastructure (XRTI)

Sponsor – N61M

Researcher – Andrzej Kapolka

Goals – Design and implement open-source HLA RTI with experimental extensions: enhanced ease-of-use, standardizable message protocol, and ability to dynamically extend federation object models

Deliverables

Designed and implemented XRTI prototype. All software open-source, available through web site: <http://www.npsnet.org/~npsnet/xrti>

XRTI master's thesis by Andrzej Kapolka

Extended abstract published at NSF Collaborative Virtual Reality and Visualization Workshop, 2003

Talks given at MOVES Open House 2003, CVRV 2003

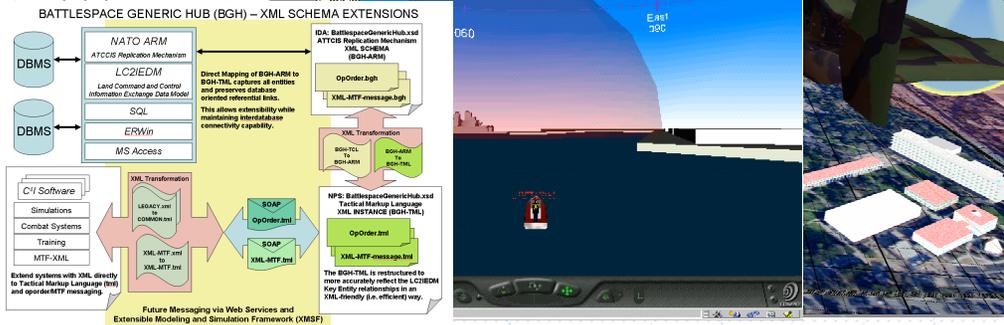
Milestones

August 2002 – Initial concept for XRTI presented at XMSF workshop

August 2003 – XRTI presented at MOVES Open House

October 2003 – Extended abstract published, talk given at CVRV 2003

December 2003 – Master's thesis completed, XRTI prototype published to Web. Prototype matches or exceeds performance of commercial RTIs in several metrics



Extensible Modeling and Simulation Framework (XMSF)

Sponsors – DMSO, DTRA, NUWC, JFCOM, SPAWAR

PIs – Don Brutzman, Curtis Blais

Goal – Multi-year project to define a composable set of standards, profiles & recommended practices for web-based Modeling & Simulation (M&S), enabling simulations to interact directly and scalably over a highly distributed network, achieved through compatibility between a web framework and networking technologies.

Deliverables

Conducted technical and management workshops on exploiting Web-based standards/practices for military M&S

Published technical papers and invited presentations at conferences, workshops, and symposia

Technical demonstrations and presentations at I/ITSEC 2002 and 2003

Student Research:

LT James Harney USN, Anti-Terrorism/Force Protection

LTJg Ekrem Serin, Turkish Navy, Cross-Format Schema Protocol

Maj Khaled Mnif, Tunisian Army, Simulation Data Interchange

Capt Claude Hutton USMC, Operations Planning Visualizations

Capt James Neushul USMC, Terrain Data Server

Others: LCDR Duane Davis (Ph.D.), Curtis Blais (Ph.D.), LT Scott Rosetti USN, Capt David Lowery USMC, Daryl Lee (Singapore)

Corporate/Academic Partners

Katherine Morse, SAIC

Mark Pullen, GMU

Andreas Tolk, ODU/VMASC

Milestones

August 2002 – Technical Challenges Workshop

September 2002 – Strategic Opportunities Workshop

December 2002 – briefs/exemplar demos at I/ITSEC 2002

February 2003 – Early Adopters Workshop

May 2003 – VMASC/JFCOM Workshop

October 2003 – Web-based Simulation Workshop

December 2003 – briefs/exemplar demos at I/ITSEC 2003

FY04 – multiple technical developments during the year demonstrating Web Services and Semantic Web for military M&S, leading to December presentations at I/ITSEC 2004

XTC Tactical Chat Must-Have Capabilities



- 😊 Faster Response Times
- 😊 Collaboration Support
- 😊 Used In OIF and Today
- 😊 Net-Centric Warfare
- 😊 Single-person or Group Messaging



TACTICAL CHAT

Proprietary: Bad!

- 😞 Can't Inspect Binary Messages
- 😞 Costly Licenses, Unpredictable Support
- 😞 Not Interoperable
- 😞 Can't Verify Source Code is Secure
- 😞 Not Allowed Across Network Boundaries

Standards: Good!

- 😊 XML messaging, Web Ready
- 😊 Jabber: Free Software, Open Standards
- 😊 Can Bridge Multiple Protocols
- 😊 Open Source: Inspect, Modify, Improve
- 😊 Firewall Friendly, Many Applications

JID: savage@conference.xchat.MovesInstitute.org

mailto:xmsf-contact@MovesInstitute.org



XML-based Tactical Chat (XTC)

Sponsor – Joint Forces Command (JFCOM), others

PIs – Don Brutzman, Don McGregor, Curt Blais

Goal – Adapt chat-room technology to provide focused many-to-many communications channels for operator, software agent and combat control system use. Adapt multiple open standards and XML interchange to field software usable in tactical environments.

Deliverables

- Open source software
- Open standards for interchange
- Demonstrate bridges to other chat technologies
- Explore FORCEnet collaborations and data distribution

Student Research

LT Dan Devos, XML-based Tactical Chat (XTC)

Corporate/Academic Partners

- Yumetech Inc.
- Naval Undersea Warfare Center (NUWC) Newport RI

Milestones

- Chat rooms operational through NPS firewall
- Technical demos, presentations at I/ITSEC 2003
- January 2004: initial technical report
- June 2004: masters thesis
- Ongoing: experiments, demonstrations

Anti-Terrorism Force Protection (AT/F)

Using XML & Agent-based Simulations

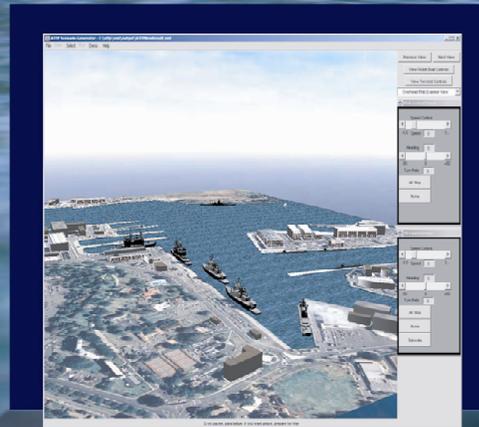


Visualization

- Rehearse with first-person point of view
- Realistically assess defensive tactics
- Replay dangerous "what-if" scenarios



Simulation

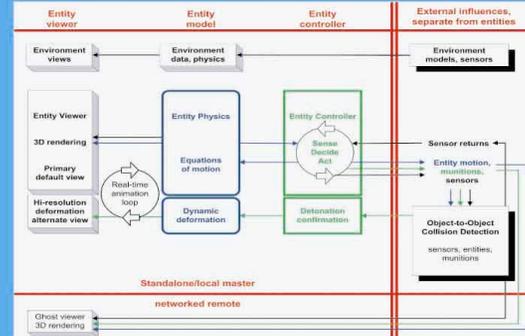


Planning



Analytical Combat Modeling and XMSF

Goal: Provide new tools and methodologies able to quickly construct and conduct advanced analysis supporting emergent operational needs.



Separation of Model, View and Controller

design patterns and standardized protocols

Web-Based Standards for Multi-Model Run-Time Interchange

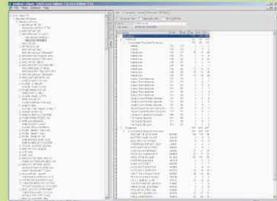


Naval Simulation System

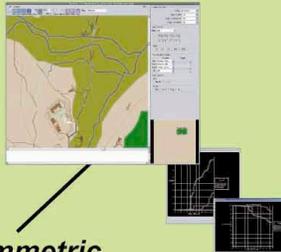
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Web-Based Standards for Multi-Model Static Data Interchange

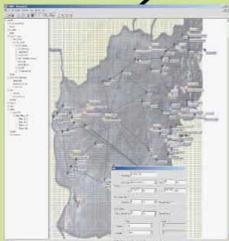
UOB DAT



JCATS



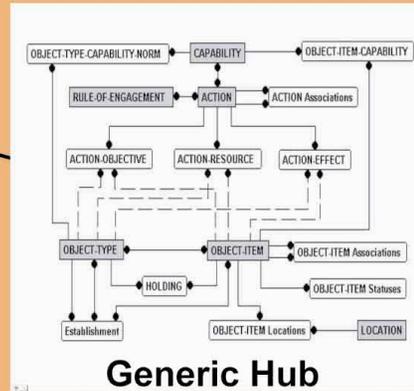
Flexible Asymmetric Simulation Toolbox Data Interchange Format (FAST DIF)



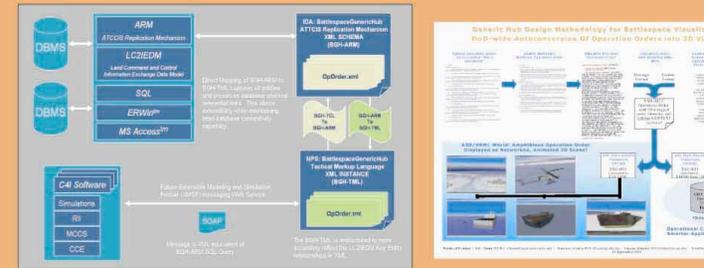
DIAMOND



NPS Agent Framework



Generic Hub



Common Modeling of Military Operations

Meeting the Transformation Challenge: New Analytical Agenda for

Deformable Buildings in Synthetic Environment



Physics-based Interactions using X3D Graphics and XML Interchange



Motivation

- Combined capabilities for OneSAF Objective System (OOS)
- Analytical and training applications
- Rehearsal, Reality, Replay
- Web-compatible standards for open data re-use
- Extensible Modeling & Simulation Framework (XMSF)

Technologies

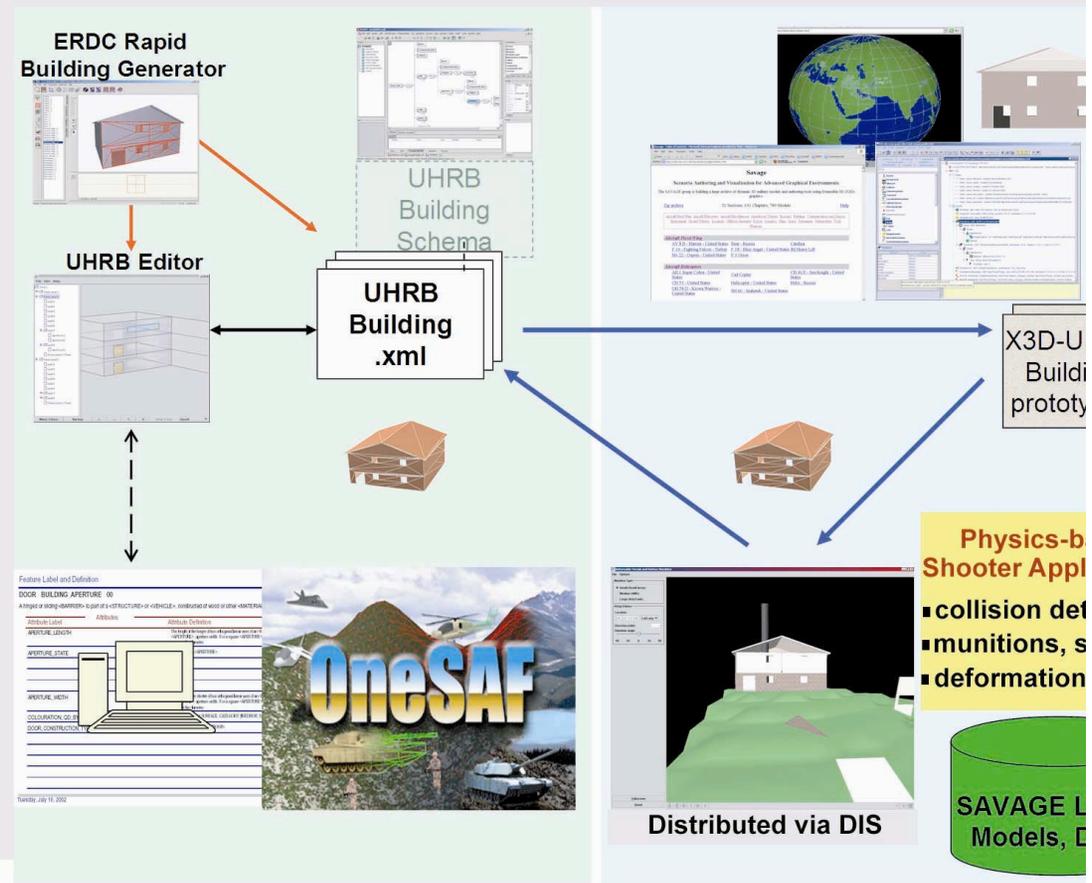
- Extensible 3D Graphics (X3D) for rendering & physics computations
- XML Interchange between formats
- CAD Model Conversion
- Ultra High Resolution Buildings (UHRB)



Future Work

- Integrate high-resolution physics engines
- Web Services accessibility, use of SEDRIS with XML
- Integrate open-source Java Xj3D software with OOS
- Possible Configuration Change Board (CCB) to ensure interoperability for future revisions
- Repeatable design pattern to connect multiple models
- Compatible approach for terrain rendering & deformation

Process

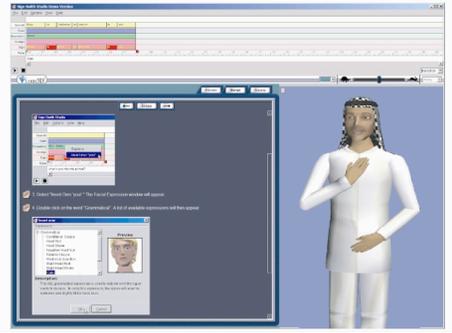


Online Mentors

Language Training Cultural Familiarization



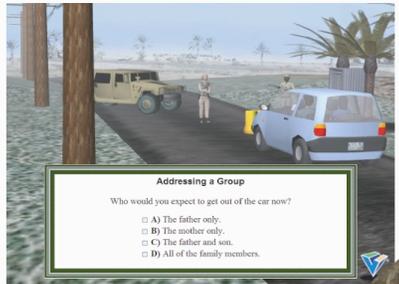
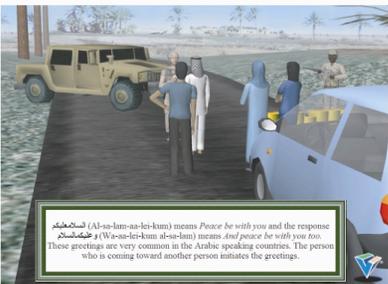
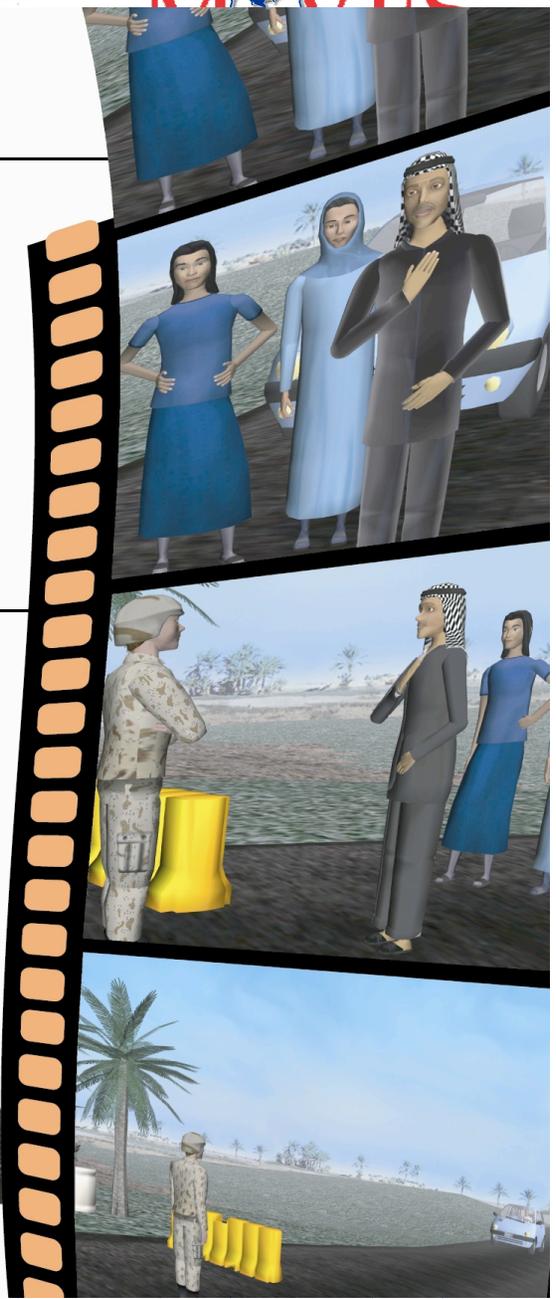
H-Anim Compliant



Multilingual speech with Lip-Sync



Export Reusable 3D Components and Learning Objects



Interactive 3D Simulations with Virtual Human Characters

Addressing a Group

Who would you expect to get out of the car now?

- A) The father only.
- B) The mother only.
- C) The father and son.
- D) All of the family members.

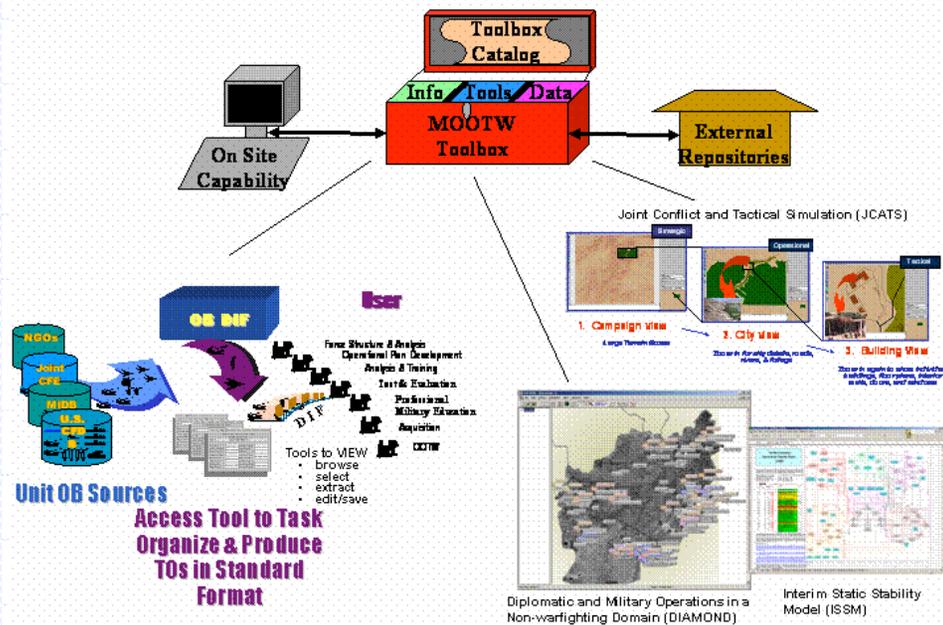


Bridging Cultures thru Technology

jdweekley@nps.navy.mil

Computer Generated Autonomy

We focus on developing computational structures and tools for the rapid deployment of agent-based simulation.



Flexible Asymmetric Simulation Technologies (FAST)
 Sponsor – DMSO

PIs – Don Brutzman, John Hiles, Curt Blais

Goal – Multi-year project to develop an integrated collection of modeling and simulation tools for deployed analysts covering a broad range of operations, to include Military Operations Other Than War (MOOTW). Apply Web-based technologies to promote more flexible data interchange across models.

Deliverables

Analyze current integration methodologies used on the project with recommendations of improved techniques

Demonstrate integration of agent-based simulation with the FAST data representations

Introduce FAST tools into NPS combat modeling, war gaming, military operations planning, and analysis curricula for assessment and testing of tools to guide ongoing development efforts

Technical demonstrations and presentations at I/ITSEC 2003

Student Research:

MAJ Glenn Hodges, Military Unit Data Representations

Corporate/Academic Partners

DRC, Northrup-Grumman, IMC, CoTS, ALION

Milestones

Alpha Test, October 2003

I/ITSEC 2003 demonstrations

Beta Test, February 2004

Transition to Service Use, September 2004

I/ITSEC 2004 demonstrations

Overview: Autonomous Software and Cognitive Computation Lab

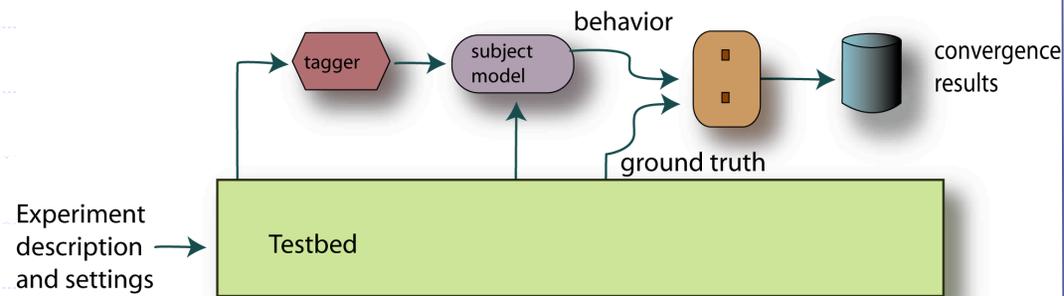
Research Project History:

Step 1. Multi-Agent coordination techniques motivated by the biochemistry of biological cells. The first three years of work focused on building software analogs to the control mechanisms that permit living systems to achieve stunning levels of complexity and compound hierarchy. Funded by N6M and the Army Game Project.

Step 2. Demonstration of Compound Multi-agent system behavior. The Story Engine, Project IAGO, and RTI have begun to demonstrate the possible application of Compound MAS. Army Game, CDTEMS funding.

Step 3. Computational Cognitive Blending (by Compound Multi-Agent Systems). In local and networked systems one of the most promising kinds of autonomous systems would seem to be those based on the cognitive ability to blend new knowledge for projecting purposeful behavior into future times and distant locations. Library Phases I and II. Current projects are developing architectures for accomplishing this and exploring possible practical applications. Funding from Navy, IC, CDTEMS, and other sources. Ongoing.

Overview:



Interactive Asymmetric Goal Orientation -- IAGO

Sponsor – CDTEMS

PIs – Hiles, Lewis, Blais

Goal – Demonstrate that a Compound Multiagent System could computationally produce analogs of the Cognitive Operations described by Cognitive Blending Theory and apply the resulting cognitive constructions to modeling the planning and behavior of a subject Individual.

Deliverables

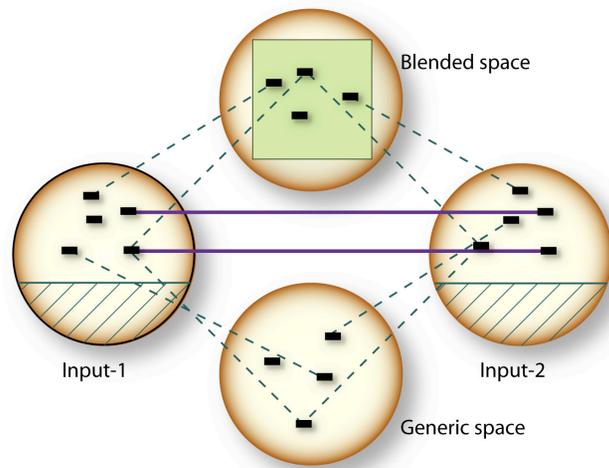
- Architecture for application of cognitive blending to anticipation problem
- First Multi-agent based production of Cognitive Blending (Simplex version)
- Subject Matter Expert tagging of input events suitable to drive IAGO model

Corporate/Academic Partners

MIIS – Gary Ackerman

Milestones:

Project demonstration complete,
 Whitepaper completed (Feb, '03)



- - - - - projection
- corresponding elements
- emergent properties

Blends: Integration Networks



IAGO Software Continuation

Sponsor – CDTEMS

PIs – Hiles

Goal – Generalize and smooth the first pass implementation of cognitive blending from project IAGO and complete the conceptual design of a library that assists in the construction of Compound Multi-agent systems.

Deliverables

Design a Phase I library for constructing Compound Multi-agent Systems. Support and simplify the use of Tickets, Connectors, and Membranes.

Generalize the Cognitive Blending software from IAGO into an engine that will support multiple applications that require cognitive constructions: design for the engine is named MICE, for Modeled Intent Contact Engine.

Student Involvement (PhD and Masters)

Curt Blais, Zack Staples, Chisong Lee

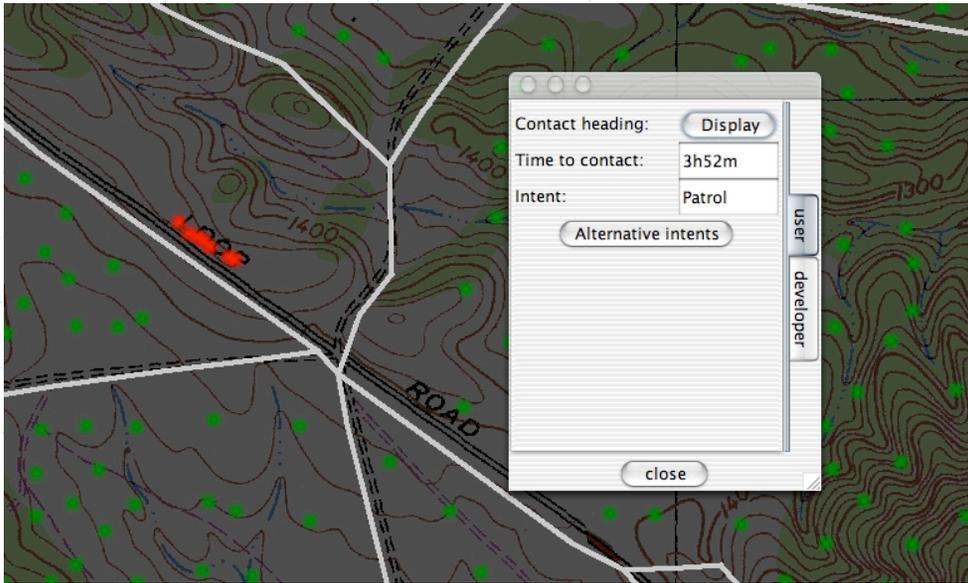
Corporate/Academic Partners

MIIS - Gary Ackerman

Milestones

Complete Library Phase I Conceptual Design – Sep '03

Complete MICE design – Nov '03



Red Team Intent (RTI)

Sponsor – CDTEMS

PIs – Hiles

Goal – Show how Intent Modeling based on cognitive blending operations can be applied to a contact surveillance application. Assign a contact agent to each contact and use that agent to maintain an up-to-the-second model of the contact's movement and intent.

Deliverables

Test Data Generator for use before required data stream is available from UAV's and experiments.

Demonstration of MICE design to monitoring of ground contact's intent.

Prototype human interface for use in conjunction with MICE.

Corporate/Academic Partners

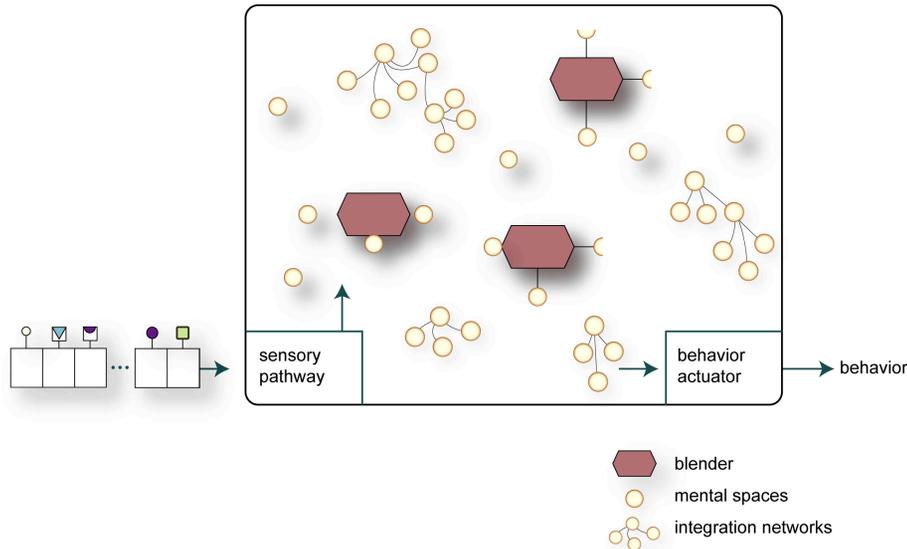
NPS UAV Project (D. Netzer)

Milestones

Test data generator for RTI development use – Oct '03

Demonstrate application of MICE (Modeled Intent Contact Engine) monitoring of ground contacts – Dec '03

Subject Model (composite cognitive agent)



Single-Scope Cognitive Blending by Agents

Sponsor – N61M

PIs – Hiles

Goal – Achieve the next level of Cognitive Blending (Cb) complexity through computational methods (following the simple (Simplex) Cb method already achieved, the next level is called Single-scope Blending). Convert these findings into an architecture for a software library capable of supporting Cb applications by students and researchers.

Deliverables

Technical Report – summarizing the research

Software Demonstration of Single-scope blending by software in support of goal-driven actions and planning.

Conceptual White Paper – describing the prospect and feasibility of software capable of Double-scope Blending.

Engineering Spec – for Phase II Software Library of basic Cb operations.

Corporate/Academic Partners

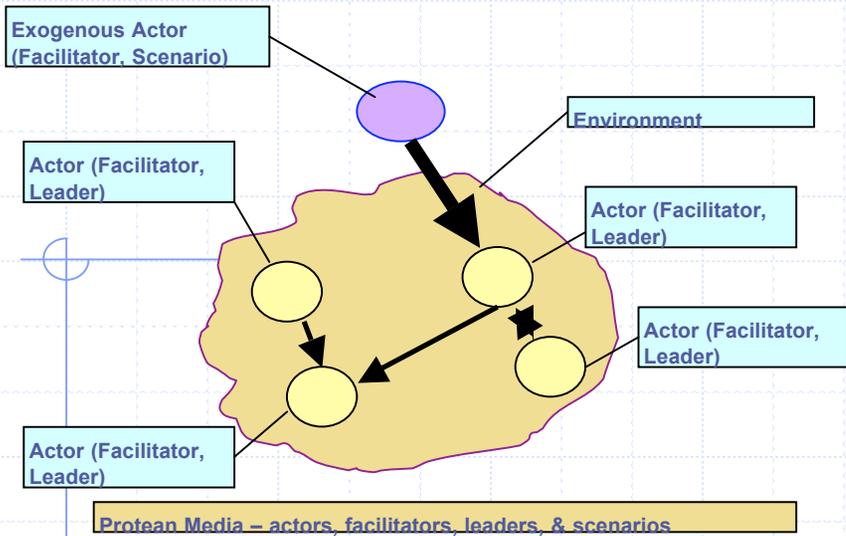
Center for Advanced Studies in Human Behavior, Stanford University (a source for Cognitive Science work in this field).

Milestones

Technical Report – June '04

Software Demonstration – Sep '04

Engineering Spec for Phase II Software Library, supporting basic Cb operations – Sep '04



Protean Media

Sponsor – NPS Research, NIMA, others in Intel Community

PIs – Hiles, J. Kim (NSA)

Goal – Build a computer assisted political wargame applied to contemporary Iraq for the purpose of helping game participants understand the protean concepts involved in policy decisions made in a context of complex, adaptive uncertainty.

Deliverables

Design Workshop – bring IC members together with professors from NPS and Nat'l War College to collect design input for Protean Media

Conceptual Design – software description and training script for human facilitators

Wargame training and production materials, software, and scripts for first demonstration of Protean Media

Corporate/Academic Partners

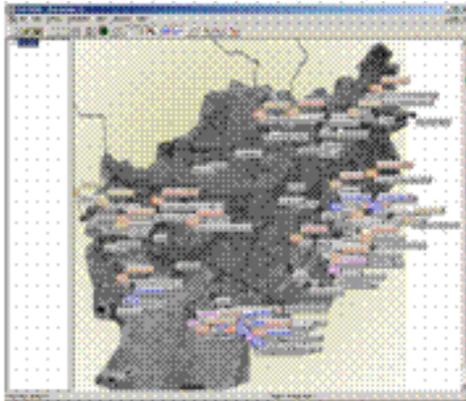
NIMA (now known as NGA), National War College, D-DCI, NPS (Research, Profs D. Denning, J.Arquilla)

Milestones

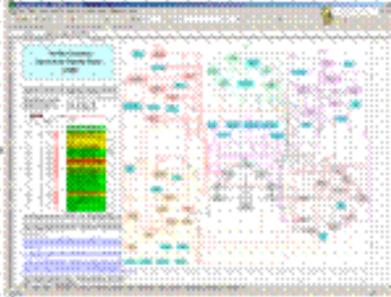
Complete Protean Media Design Workshop – Dec '03

Complete Conceptual Design of Protean Media – Feb '04

Obtain remaining funding for full project from additional sponsors by March '04



Diplomatic and Military Operations in a Non-warfighting Domain (DIAMOND)



Interim Static Stability Model (ISSM)

Operations Other than War Tool Kit

Sponsor – N61M

PIs – Hiles

Goal – Integrate remote coordination of Multi-agent systems through an open XML-based architecture that works with the agent framework produced here at MOVES by previous autonomous agent research

Deliverables

Architecture for XML facilitated, two-way operational transfer between Diamond and an agent framework.

Software library for supporting model interaction.

Demonstration of model interaction with Diamond.

Corporate/Academic Partners

Milestones

Demonstrate two-way operational transfer via XML between the Diamond Model Data Base and an object viewer – Sep '03

Connect the above pathway to a demonstration Multi-agent System – Oct '03

Demonstrate capability at ITSEC – Dec '03



Situation Understanding for Autonomous Agents

Sponsors – N61M, TRAC MRY

PI – Chris Darken

Goal – To build autonomous agents for virtual environments that understand the situations they find themselves in to an unprecedented degree, & leveraging this into the ability to understand natural language. Acquisition of the large amount of knowledge needed for such systems makes the development & application of machine learning techniques a practical necessity. Distinctive aspects include the modeling of elements of subconscious cognition such as associative memory, perception, & motor processing and rigorous characterization of the developed techniques.

Research Partners

Jack Jackson, TRAC MRY

Theses

LTC Rene Burgess, USA, Realistic Evaluation of Terrain by Intelligent Natural Agents (RETINA), Sept. 2003

MAJ David Morgan, USA, Algorithmic Approaches to finding Cover in Three Dimensional Virtual Environments, Sept. 2003

LTJG Fahrettin Akbori, Turkish Navy, ASW Trainer (Completion in March 2004)

Milestones and Deliverables

September 2003 – Presentation: Situation Understanding for Agents: Research Issues

February 2004 – Mental Simulation Testbed

September 2004 – Software: Natural Language Utterance Expectation Model

September 2004 – Software: Computational Perception Testbed

Human Performance Engineering & Immersive Technologies

In human performance engineering, we empirically validate trainers and systems based on human performance assessment. We believe the only way to prove a system actually trains Sailors, Marines, and Soldiers is to prove it experimentally.

In immersive technologies, we identify technological shortfalls that impede the progress or acceptance of a system for the fleet and then develop prototypes that address these shortfalls. Currently, we are working on very small sourceless tracking systems.

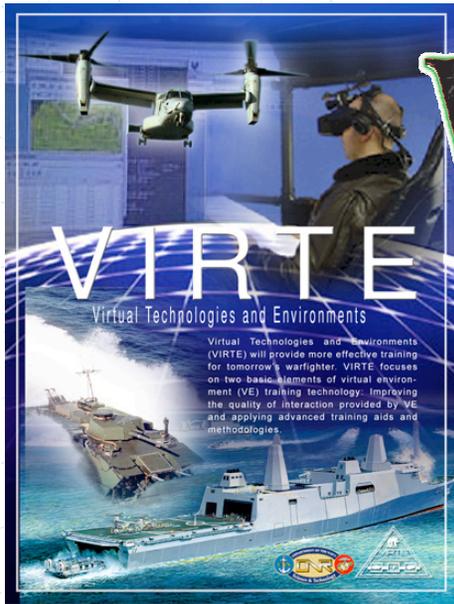


VIRTE: VIRTUAL TECHNOLOGIES & ENVIRONMENTS

Sponsor – ONR

PIs – Rudy Darken, CDR Joe Sullivan

Goal – To develop deployable training solutions for Navy and Marine Corps operations that are (1) low cost, (2) reconfigurable, (3) easy to use for both trainee and instructor, (4) experimentally validated.



Approach:

Demo 1. Naval Helicopter Operations, (completed FY03)

Demo 2. MOUT Operations

Demo 3. Combined Arms

ALWAYS a four phase approach: (I) Cognitive Task Analysis.

(II) Design and Usability Engineering, (III) Implementation

Test and Evaluate

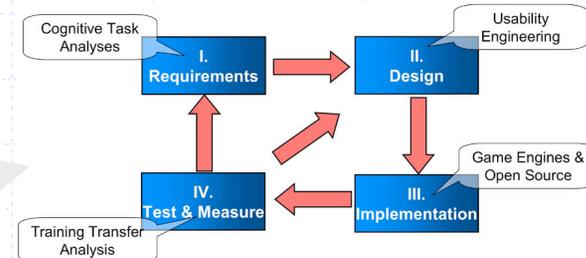
Student Research:

Major Walt Yates, USMC

LT Alex Mabini, USN

Capt J.P. McDonough, USMC

LT Dimitrios Filiagos, Hellenic Navy



Corporate/Academic/Government Partners

Lockheed Martin, NRL, NAVAIR Orlando, Clemson University

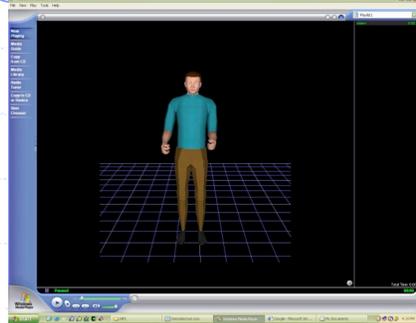
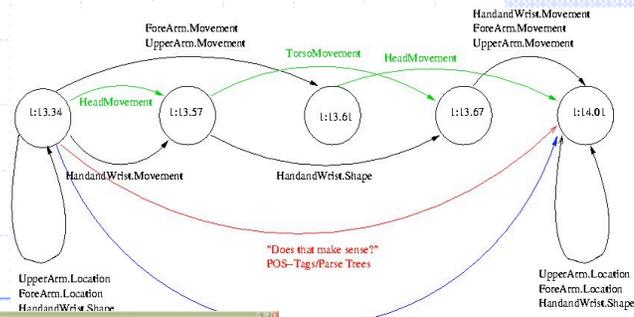
Milestones

Training transfer experiment with HS-10 NASNI, ongoing

I/ITSEC 2003 demonstration

ISMT-E training transfer study (Winter 2004)

I/ITSEC 2004 demonstrations



Signals in Language Lab (SIGNaL Lab)

PI – Craig Martell

Goal – Ultimate goal of the project is to discover and analyze the communicative aspects of the non-verbal behaviors accompanying speech. Current short- and mid-term goals concern developing statistical and rule-based models of gesture (the FORM Project) in order to both develop more realistic characters in training environments and for biometric analysis of surveillance video.

Deliverables

Analyze non-verbal, communicative behavior to discover which aspects are useful for modeling and simulation and for virtual training

Develop underlying representation to allow for automatic generation of non-verbal behavior (e.g., gesture) in virtual humans—an aspect of computer-generated autonomy

Discover subset of non-verbal, communicative behavior that is most useful for biometric analysis in surveillance video.

Corporate/Academic Partners

University of Pennsylvania, Carnegie-Mellon University, The RAND Corporation

Milestones

FORM v1, Pilot Corpus and Study, 2001
 LREC 2002, Conference Presentation, May 2002
 LREC2002/MITRE Workshop, June 2002
 FORM v2, Corpus and Pilot Studies, April 2003
 FORM v2, Corpus Publication, July 2003
 Biometric Corpus and Analysis, Fall 2004

Validation of Cognitive Models for Combat Simulations

Sponsors – N61M

PIs – Dr Rudy Darken, MAJ Simon R. Goerger

Goal – Provide procedures for the DoD Modeling and Simulation (M&S) community to validate cognitive model implementations for future use in legacy and emergent combat simulations.

Corporate/Academic Partners

Infantry Captains Carrier Course (ICCC)

– Study Participants; Subject Matter Experts (SMEs)

Marine Corps Combat Development Command (MCCDC)

– for use of MANA agent based model

Natick Soldier Center – use of human performance data

TRAC – for use of COMBAT^{XXI}, entity level analytical model

Milestones

Oct '02 – Foundation '02; Validation Workshop

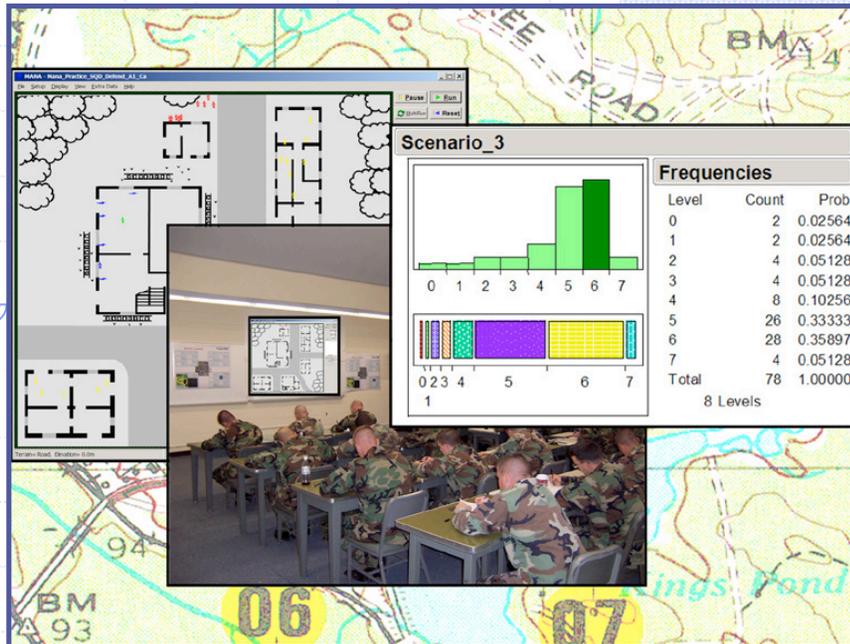
Jun '03 – MORSS presentation on Validation

Jul '03 – SCSC '03 Validation Working Group presentation

Jul '03 – Pilot studies for SME bias of HBR validation

Dec '03 – Complete studies of SME bias of HBR validation

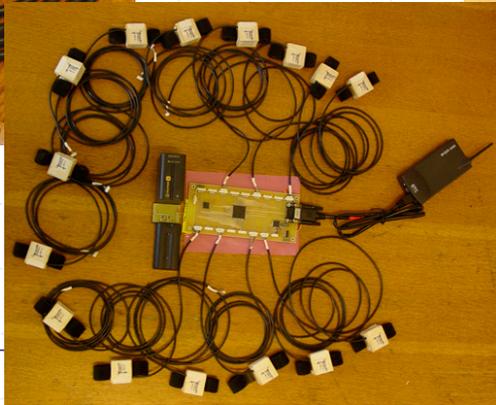
Jun '04 – Technical report submitted to DMSO



Deliverables

Research human performance evaluation and cognitive task analysis techniques to incorporate them into the a series of procedures for validating human behavior representation (HBR) models to quantify the biases of subject matter experts (SMEs). Will conduct a series of HBR model validation studies to identify SME biases and identify procedures to reduce these biases. Final products will be:

- Dissertation on the validation of HBR models
- Technical report submitted to DMSO and subordinate agencies describing issues behind and means of reducing SME biases in validation of HBR models
- Journal article submission
- Research methodology for future validation efforts



Full Body Tracking Using Inertial/Magnetic Sensors

Sponsor - N6M, USARO

PIs –Xiaoping Yun, Eric Bachmann

Goal – Develop a full body tracking system based upon the use of small inertial/magnetic sensor modules. Posture tracking portion of the system will be completely “sourceless.” Avatar will be positioned by tracking a single point.

Deliverables

Quaternion-based filter developed to estimate the orientation of a rigid body. Avoids singularities in orientation representation and is able to continuously correct for drift without the need for still periods.

Recently Published Papers:

2003 IEEE International Conference on Robotics and Automation (ICRA 2003)

IEEE International Symposium on Computational Intelligence in Robotics and Automation (CIRA 2003)

IEEE/RSJ International Conference on Robot and Intelligent Systems (IROS 2003)

Student Research:

Alex Mabini, Faruk Yildiz, Eric Montgomery, Christopher Peterson, Andreas K. Kavousanakis, Ioannis Saliaris

Milestones

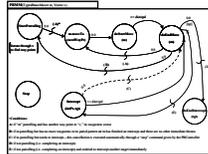
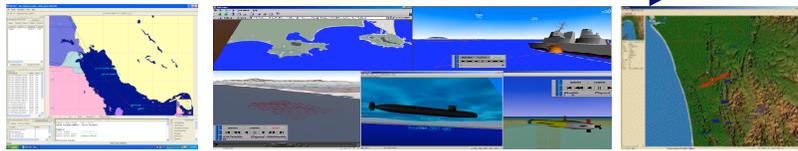
August 2003 - Third generation of the MARG digital sensor module (MARG III) design and fabrication completed. MARG III sensors measure 3.3x3.0x2.1 cm. Custom-designed Communication Interface Unit (CIU) developed and built. Performs three functions: (1) accepts inputs from up to 16 MARG III sensors; (2) provides power to the sensors connected to it; and (3) packages sensor data and wirelessly transmits tracking data to a server.

Summer 2004 – Prototype wireless full body tracking system to be completed. System will incorporate an inexpensive optical position for indoor use.

Combat Modeling & Analysis

We have been working on revitalizing NPS's combat modeling courses, & working with the Center for Homeland Defense & Security.

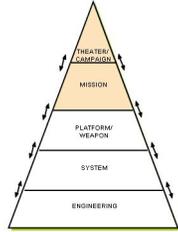
We are working to make NPS known as the place for combat modeling & analysis.



Savage, SimKit



U.S. Army Combat^{XXI}



Realign all M&S Models to Support New Analytical Agenda

Adopt Extensible Modeling & Simulation Framework (XMSF) for Web-based Composability



Transformation of Modeling and Simulation: Meeting the New Analytical Agenda

Sponsor: OPNAV N81

PI's: Don Brutzman, Arnie Buss, Curt Blais

Goal: Multiple coordinated world-class modeling projects to advance the new DoD analytical agenda. Web-compatible framework of open standards + open source for analysis by extending legacy model interoperability, composability.

Technologies: Hybrid of Naval Simulation System (NSS), U.S. Army Combat XXI simulation system linked via SimKit discrete event simulation and Web Services messaging.

Tasking and Deliverables (8 total projects)

Analytical Modeling Framework: Establish software framework of composable, scalable analytical models via XMSF Web Services

Analytical Workbench: Capture, consolidate prior SimKit models by NPS students and faculty into a powerful analytical toolkit

Analyses: Perform analyses of interest to N81 using the extended hybrid modeling capabilities of NSS/Combat XXI, including _ Joint Forcible Entry Options, and _ Improved Strike Module

Force Protection/Anti-Terrorism Modeling: Enhance FP/AT tool, combine 3D visualization, port defense rehearsal, tactical analysis

Special Operations Forces (SOF) Modeling: ship-to-shore and then return, visualized using SAVAGE X3D Model Archive

Advanced Methodology: extend/connect model hierarchies

Diverse Approaches: multiple Operations Research (OR) theses

Logistics: integrated theatre logistics M&S (under consideration)

DoD/DoN Impact

We are showing how to create an open marketplace of ideas, rather than products, by connecting multiple models together

NPS Involvement

- Several dozen student theses led up this project
- 15 faculty (MOVES, OR) are participating
- 6 staff for software development, analysis

Milestones

- MORS Symposium, Monterey June 2004
- OPNAV presentations, September 2004

Partners

- Rolands + Associates Inc., Metron Inc.
- USMC MCCDC, USA TRAC White Sands & Monterey
- XMSF efforts include DMSO and additional partners



CENTER FOR
**HOMELAND
 DEFENSE & SECURITY**



Modeling and Simulation for the Center for Homeland Defense and Security

Sponsor – CHD/S

POC – Rudy Darken, LTC Saverio Manago

Goal – To develop modeling and simulation products in support of the Naval Postgraduate School's Center for Homeland Defense and Security's education and research efforts.

Classes of Products:

- Strategy and Policy
- Not operational or tactical
- High level decision making, consequence simulations
- Organizational Learning
- Suitable for the National Exercise Program
- Technical/Analytical
- Vulnerability analyses along multiple dimensions
- Measures of preparedness
- Education and Training
- Any application where learning or skill acquisition is the goal
- Consumer
- Applications meant for the general population rather than a niche group

Initiatives

- Organizational Learning in the National Exercise Program
- How do organizations learn from exercises?
- How to measure success? Preparedness?
- Funded by ODP, (Darken, Manago)
 - "Protect America" game educating the public about terrorism and preparedness
 - "SimCity" game for Homeland Security Leadership Development M.A. Program: resource allocation, critical infrastructure, civil-military relations, etc.
 - HazMat game for Center for Homeland Security (Ft. McClellan) training school
 - Maritime Domain Awareness simulation (Manago)
 - JCATS/HOPS for Homeland Security (Manago)

Game-Based Simulation, Understanding & Analysis

We are the lead DoD organization in game-based simulation, learning & analysis, all from our successful production of the America's Army PC game.



P-51: An Open Source Game Engine for Naval Education and Training

Sponsor s: NETC, NAVMSMO
 PI: Rudy Darken

Key Objective

- Develop an open source game engine that is robust (full featured), general purpose (able to construct games of multiple genre), and supportable (documentation, technical support, training) for use in Naval education and training.

Milestones

- Project began with MOVES Institute seed funding from NAVMSMO in 2001
- Completed full prototype system with demonstrations (Close Quarters Battle for Marine Corps)
- Re-architected to be completely open source (prototype was “free” but not open)
- Completed demonstration training game for ship board firefighting (image above) for IITSEC 2003 shown in the NETC booth -- developed in two months by three people
- NETC desires to fully specify and standardize on this architecture for all future training and education “games”

DoD/DoN Impact

- The overall objective is to transform Naval training and education by making simulation “games” for training so affordable and easy to build that they become pervasive
- This will radically change the business model as to how training simulations are acquired -- the Navy will never pay for commodity level components again
- The vision of vast numbers of simultaneous trainees in shared virtual environments will become achievable through standards and cooperative development -- hallmarks of the open source community

NPS Involvement

3 student theses completed on this project
 8 student theses in progress on this project
 3 faculty have been involved
 5 staff
 ... and growing all the time



Demonstration of Applicability of P-51 as Game Engine by Developing a Naval Damage Control Trainer

Sponsor – NETC

PIs – Erik Johnson, Perry McDowell, Rudy Darken

Goal – Produce a Proof of Concept application to demonstrate:

- P-51 is usable to build a military trainer
- Naval training is improved by using gaming technology

Deliverables

A prototype training simulation to train personnel in shipboard damage control. The simulation will consist of an interior of a DDG-51 destroyer, with certain compartments modeled in sufficient detail to allow training of damage control teams.

Student Research

None yet, but the project is only two months old and is expected to generate interest, especially among SWO's and Submariners.

Corporate/Academic Partners

NIST

Milestones

Proof of Concept, I/ITSEC 2003.

Presented to VADM Harms (NETC)

2004 - Increase scope and interactivity of current system



America's Army
Sponsor - ASA M&RA
Developer - The MOVES Institute

Key Objectives

Create a game in support of Army strategic communication, a game that simulates a potential career in the Army in 3D game form.

Results

3M+ registered players, the fastest growing game of all-time. The most effective marketing tool the Army has ever created. The game is being used as the basis for the development of a number of training & simulation systems. AA is viewed as decreasing number of recruits dropping out of basic & the number of people getting out after their first tour due to people getting a realistic intro to the Army before getting to boot camp. Reduced disillusionment == Increased Retention == \$\$ Saved.

DoD/DoN Impact

- We have become the lead DoD organization on the utilization of game technology for the development of all future combat modeling systems, homeland security training systems & DoD/DoN training systems.
- We have become the lead organization on the employment of game technology for application to advanced learning.
- We have become the lead organization in the analysis of game play from massively multiplayer online gaming.
- The entire NPS agent-based simulation effort (teaching & research) originates from the America's Army project.

NPS Involvement

- 19 student theses directly on this project
- 27 student theses facilitated by this project
- 10 faculty have been involved
- 30 staff



America's Army Game Enhancements
Sponsor - USAF Force Protection Battlelab
Developer - The MOVES Institute

Key Objectives

The Air Force's Force Protection Battlelab desires a convoy force protection scenario built into the America's Army PC game.

The purpose of that enhancement is as a part-task trainer for force protection.

The developed scenario will be integrated into the publically releaseable America's Army game as much as is possible within security guidelines.

Scenario

For Opposing Force win: Elimination of all defense forces within the time limit set at scenario execution (configured by the server Admin) or the destruction of the asset. In order to destroy the asset the opposing force must open the transport vehicle (locked with a padlock that is either picked through the use of the action key or destroyed by explosive or weapons fire) and using explosives destroy the package.

For Defense Force win: Elimination of opposing forces within the time limit set at scenario execution (configured by the server Admin) or expiration of time limit and arrival of additional support forces (helicopter flyover or arrival of vehicles indicated by approaching vehicle noise or some other appropriate manner of audible or visual indicators).

Questions?

Web site for additional information:

<http://movesinstitute.org>

MOVES Open House

24 - 26 August 2004