

Directions in Modeling, Virtual Environments & Simulation (MOVES)

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Talk Outline

The MOVES Academic Group

MOVES MS Curriculum

MOVES Students Come From Where?

MOVES Research Center

The MOVES Academic Group

MOVES is one of the newest Academic Groups at the Naval Postgraduate School.

- MOVES has a Provost-appointed Chair, an Academic Associate, an Executive Committee, a number of committees (PhD Program Committee, Joint Combat Modeling Planning, ...) and an Interdisciplinary Faculty.
- MOVES has a seat at the Deans/Chairs Council.

MOVES Academic Program

MOVES has an approved MS Program, an MS in MOVES, a degree signed by the MOVES Chair.

MOVES has a PhD Program, a PhD in MOVES, the only M&S PhD program in the world.

Rationale for the MOVES MS Curriculum

- We had a successful degree program - an MS in Computer Science, with specialization in Computer Graphics & Visual Simulation.
- We had a sponsor desire for students who understood
 - applied computer simulation technology &
 - the application of quantitative analyses to human-computer interaction in simulation technology.

The MOVES MS Program

- We constructed a two year, eight quarter program that is roughly 1/2 computer science and 1/2 operations analysis.
 - The program is almost a double major with a fully packed eight quarters.
 - We educate people in fundamentals and their application.

What is MOVES trying to achieve with the double-major structure?

MOVES is trying to provide the DoN/DoD with a corps of officers that can answer any admiral's questions on modeling, virtual environments and simulation.

- There is a lot of material to cover to generate such graduates. MOVES is one of the hardest NPS programs.

MOVES Graduate Capabilities

With the MOVES MS degree, we expect our graduates will be capable of supporting and developing M&S systems another order of magnitude more complex than those of today.

MOVES MS Tracks

Two tracks in MOVES -

- Visual Simulation - technology development for virtual environments.
- Human Computer Interaction - technology utilization and evaluation for virtual environments.
- We have plans to create additional tracks as per sponsor requirement.

The Interdisciplinary Nature of MOVES

The MOVES degree program is interdisciplinary, utilizing courses from several departments.

The faculty for MOVES is interdisciplinary.

Scope of the MOVES MS Curriculum

Programming

Object-oriented programming, data structures, artificial intelligence, symbolic computing

Mathematical Fundamentals

Multivariable calculus, linear algebra, probability & statistics, linear programming

Modeling & Simulation

Stochastic models, system simulation, physically-based modeling, simulation methodology, high & low-resolution combat modeling, modeling human & organizational behavior, agent-based adaptive simulation

Systems & Architecture

Computer systems principles, computer architecture, operating systems, distributed operating systems

Communications & Networks

Computer communications & networks, virtual environment network & software architectures, wireless mobile computing

Human-Computer Interaction

Interactive computation systems, human performance measurement, human performance evaluation, human factors in system design, C4I systems evaluation

Computer Graphics

Computer graphics, image synthesis, computer animation, computer graphics using VRML

Virtual Environments

Virtual world & simulation systems, human factors of virtual environments, training in virtual environments

MOVES MS Thesis Requirement

- We strongly believe that a graduate curriculum is only as good as the research it produces. One is a reflection of the other. All MOVES students must successfully complete a thesis to graduate. Topics for MS theses are often, but not always, selected from projects funded reimbursably to participating MOVES faculty.

Some thesis titles

Dynamically Extending A Networked Virtual Environment Using Bamboo and the High Level Architecture

A Benchmark Usability Study of the “Tactical Decision Making Under Stress” Decision Support System

Methodology and Design of Adaptive Agent-Based Simulation Architectures

Some thesis titles

An Analysis of High Level Architecture Virtual Environment Performance

Development of a Dynamically Extensible Agent-Based Adaptive Simulation Module and Interface

Agent-Based Modeling - Current & Future Army Simulations

Where do MOVES MS students come from?

Approximately

- 7 from the US Navy (6202-P code)
- 5 from the USA STRICOM (FA-57s)
- 6 from USA National Simulation Center (FA-57s)
- 7 from USMC Office of Scientific Innovation (MOS 9625)
- 4 from the Turkish Military
- 1 from Singapore

MOVES Research Center

The Navy Modeling and Simulation Management Office, N6M, has funded a research center to utilize NPS MOVES students and faculty to study N6's mid-term, long-term, fundamental modeling, virtual environment and simulation problems.

Directions for the MOVES Research Center

Networked Virtual Environments

All aspects of large-scale, networked 3D virtual environments, from their design & construction to their evaluation & fidelity requirements. High-Level Architectures (HLA) for virtual environment interoperability, RTI & next-generation RTI. Cross-platform interoperability. Web-based virtual environments.

Visualization

Immersive ship & building walkthroughs (damage control, hostage extraction, urban warfare), ocean environment tactical visualization, C4I/IW information visualization.

Computer-Generated Autonomy

Computer-generated virtual environment characters & semi-automated forces. Human & organizational behavior modeling. Agent-based adaptive simulation. Software architectures for computer-generated autonomy.

Modeling & Simulation

Dynamic & state space modeling for IW/IO. High-resolution combat models. High-level aggregate models. Network centric warfare. Modeling of plan-based actions for intelligent agents in simulations. Theater, tactical and campaign level modeling. Decision making in test & evaluation.

Human-Computer Interaction

Human factors, psychophysics, evaluative research. Spatial sound for the improvement of performance in the virtual environment. Training in the virtual environment. Fidelity requirements for wayfinding in the virtual environment. Human body tracking technology development (inertial motion tracking, locomotion devices, human modeling - articulated body kinematics & dynamics).

MOVES Research Center FY99 Specific Tasks

Task 1 – MOVES Research Center Laboratory Upgrade Continuation

- Intergraph GT1, three pipe graphics workstation.
- Four Silicon Graphics 320 Visual PCs and one 520.

MOVES Research Center FY99 Specific Tasks

Task 2 - High Level Architecture Test, Evaluation & Support

- Our work is looking at how the HLA can be made to be dynamically extendible. Currently it is not and all simulations must be developed statically ahead of time.
- We have a staff member dedicated to HLA. He provides technical guidance on HLA, and educational support on HLA for MOVES courses.

MOVES Research Center FY99 Specific Tasks

Task 3 – Modeling Human & Organizational Behavior (MV-4010) & Agent-Based Adaptive Simulation (MV- 4015)

- We are examining how agent-based adaptive simulation can be used to provide computer generated characters for simulations and how this technique can be used to model large organizations.

MOVES Research Center FY99

Specific Tasks

Task 4 – Develop Courses and Research Capability in Training with Virtual Environments (MV-4001/4002)

- We have a research focus on how training can be accomplished with virtual environments. We are examining how we can determine VE effectiveness for various training arenas.

MOVES Research Center FY99 Specific Tasks

Task 5 – Develop High Quality Combat Modeling Courses and Research Capability

- OA/MV-4655 Introduction to Joint Combat Modeling
- OA/MV-4656 Aggregate Joint Combat Modeling
- OA/MV-4657 Current and Advanced Topics in Combat Modeling

MOVES Research Center FY99 Specific Tasks

Task 6 - Miscellaneous MOVES courses & support

- MV-4030 Modeling & Simulation of Ocean Environments
- MV-4204 Computer Graphics Using VRML

NPSNET Web Sites

MOVES Page:

<http://www.moves.nps.navy.mil>