Modeling, Virtual Environments
and Simulation

applied to

Helicopter Training, Navigation, Airspace
Management and Utilization
• MOVES background
• Helicopter research history
• Future work
To enhance the operational effectiveness of our joint forces and our allies by providing superior training and analysis products, education, and exemplary research in the field of modeling and simulation.

-- MOVES Mission Statement
“If I had asked my customers what they wanted, they’d have asked for a faster horse.”

-- Henry Ford

“A hiatus exists between inventors who know what they could invent, if they only knew what was wanted, and the soldiers who know, or ought to know, what they want, and would ask for it if they only knew how much science could do for them. You have never really bridged that gap yet.”

-- Winston Churchill, The Great War

NPS is uniquely positioned to bridge this gap.

We combine military operational expertise with technical expertise towards relevant, cost effective, sustainable solutions.
Scope of M&S Workforce

Modeling & Simulation professionals who build tools (new capabilities) for acquisition, analysis, training, test, evaluation, and planning

Acquisition, Analysis, Training, Test, Evaluation, and Planning professionals who know how to use Modeling & Simulation tools

Modeling & Simulation (MOVES)

Conduct research and development in the discipline of modeling and simulation towards increased capabilities for …

… all these disciplines which use modeling and simulation tools as one (among many) technique for problem solving.

- Business & Public Policy
- System Engineering
- Human Systems Integration
- Mathematics
- Electrical & Computer Engineering
- Mechanical & Astro Engineering
- Physics
- Meteorology & Oceanography
- Space Systems
- National Security Affairs
- Defense Analysis
- Operations Research
- Computer Science
- Information Science
- Homeland Defense & Security
- Human Systems and Training
  - Training system design and human factors
  - Human performance evaluation
- Cognitive Agents and Adaptive Systems
  - Learning agents in rich environments
  - Predictive agents
- Computer Gaming, Visual Simulation, Augmented Reality
  - Methods for game-based training design
  - Highly cost efficient software and simulation development
  - Mixed-mode, real and virtual, simulation environments
- Web-Based Simulation
  - Web standards for simulation and interoperability
- Simulation Modeling for Analysis
  - Composable models, large-scale reusability
  - Experimental designs for large studies
• Helicopter overland navigation
  – MITAVES I, II
  – Urban operations
• Simulator fidelity
  – Visual cues required for hovering
  – Physically based NVG simulation evaluation
• Novel training applications
  – Chromakey Augmented Virtual Environment
• Airspace utilization
  – SNI/PVFR
  – HEMS PinS Approach
• Training
  – Inadvertent Instrument Meteorological Conditions Visualization
• Simultaneous Non-Interfering Precision VFR
  – Investigate training and operating procedures for GPS-equipped helicopters
  – Validate simulation as test platform
• Simultaneous non-interfering routes
  – Compared real world pilot performance to simulation
  – Established new FAA guidelines for GPS-equipped helicopters

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### Average Navigation Error By Leg Type and Pilot Rating Excluding Leg to WPT-03 (Fly-over error)

<table>
<thead>
<tr>
<th>Pilot Type</th>
<th>Average Error (met)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS Only Leg</td>
<td>104.85</td>
</tr>
<tr>
<td>Visual and GPS Leg</td>
<td>85.24</td>
</tr>
</tbody>
</table>

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### Average Error (met)

- Excluding Leg to WPT-03
- Distance: 3 nautical miles
Reconsidering air ambulance usage
By Robert Davis, USA TODAY
Posted 7/18/2005 11:12 PM
MARBLE FALLS, Texas —

A USA TODAY investigation found that federal air safety regulators have failed to keep pace with the rapidly growing industry. As a result, patients and crew members have died in crashes that could have been prevented. More patients have died in helicopter ambulance crashes in the past five years than in the 10 previous years combined. Over the past five years, helicopter ambulance crashes have killed 60 people, including seven patients and two mothers of sick infants.

Helicopter Crash Kills 3 Near LA
POSTED: 11:08 pm CST December 10, 2006
DEVORE, Calif.
A pilot and two crew members are dead after a Medevac helicopter crashed on Sunday night near the Cajon Pass in Southern California.

Federal Aviation Administration spokesman Ian Gregor said the pilot may have flown into fog.

There are about 650 emergency medical service helicopters operating in the U.S., according to the FAA. A federal investigation earlier this year found there were 55 air ambulance accidents between 2002 and 2005. The number of medevac fatalities doubled to 62 in the 2001-05 period from the previous five years.
Legacy Airspace Management

- National airspace system
  - Optimized for commercial traffic
    - Based on fixed radio navigation aids
    - Terminal areas are airfields
  - Exactly what helicopters don’t need
    - Frequently operate out of radio navigation aid coverage
    - Terminal areas are accident sites and hospitals
Legacy Airspace Management

- **Katrina response**
  - “The first three days were pretty much freelance”
  - “We felt safe in a hover and above 1000’; anywhere in between it looked like a video game. It’s a miracle there were no mid-airs.”
  - No low-visibility approach procedures
  - Vital information disseminated via paper maps

- **Al Nasiriyah**
  - Tactical pause for weather

- **Pakistan earthquake relief efforts**
  - Combat surgical hospitals were only accessible by helicopter and only during daylight hours

- **Indonesia tsunami relief efforts**
  - “The hardest part was the coordination.”
Investigated Solution

• Ad-hoc GPS approaches and airways
  – Exploit GPS flexibility and coverage
  – Automate approach generation process
    • Using legacy system operators enter waypoints, system verifies the approach is safe
    • Investigated system generates waypoints based on user-entered point of interest
    • Apply approach clearance criteria (TERPS) to national databases of terrain and obstacles
  – Validate procedures using simulation and real-world exercise
• Improve data collection, validation and dissemination
  – Investigate and prototype optimal architecture
Point In Space Approach

- Ingest source data…
  - Terrain data
  - Obstacle data
  - Imagery
  - Approach criteria
- ...And user preferences:
  - Approach direction
  - Wind direction
- Apply:
  - Artificial intelligence (modified D-star search)
- To provide:
  - Automated approach path generation
  - Visualization and fly-through capability
• Conclusions
  – Ingesting terrain, obstacle and imagery data for approach generation and visualization
  – Approach generation, validation, visualization
• MOVES has traditionally focused on making Virtual Environments more life-like. MOVES is now at the center of a new effort at NPS to make real-life operational systems more game-like.

• Flexible Distributed Control describes our effort to bring new capabilities to Command and Control from three sources not associated with security or military operations:
  – Computer Game Interfaces: many computer games do an outstanding job of continuously informing the player about his tasks and his context. These displays are in fact a visual model of the player’s task environment. Changes to individual objects in that environment result in cascades of new information throughout the rest of the environment. The result is a dynamic map of the player’s context!
  – Massive Multiplayer Online Games -- these games form an industry that is larger than the movie industry. But its products contain so much fantasy, weirdness, and pizzazz that their presence on computers in almost all business and all government organizations is taboo. But underneath all that are software and network services that take the dynamic map from a single computer game and distribute it directly to all the players that are part of that group, directly linking a small group of players from all over the world and allowing them to focus on a single task. This contribution creates a distributed common understanding of the task.
  – Social Networking Tools on Internet also don’t look like something that would contribute to security or military operations, but underneath the Flickr, Facebook, and You Tube phenomena you find the following invaluable clue: these social networking utilities allow a huge population of people to effortlessly form groups, shaped to accomplish some purpose. This is accomplished without apparent cost, at blazing speed, and free of formal or even informal management oversight. The essential capability has been called “ridiculously easy formation of groups.”

• Flexible Distributed Control is the overall label for our effort to create the possibility, within security and military organizations, to accomplish missions through the efforts of purpose-formed, network-linked, dynamic map-equipped self-organizing groups.

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