Operational Effectiveness Modeling of Intelligent Systems

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The Operational Effectiveness Team

- **The Team:**
  - ✓ Began this work in 1992
  - ✓ 5 Full Time Analysts
  - ✓ We use TRADOC's CASTFOREM model
  - ✓ MOA with TRAC-WSMR
  - ✓ Secure Facility with over 30 dedicated servers
  - ✓ Largest dedicated processing capability outside of TRADOC
- **Who we work with:**
  - ✓ TRADOC Analysis Center – White Sands Missile Range (TRAC-WSMR) - scenarios and scenario data
  - ✓ PEO-GCS - platform specifications and performance data
  - ✓ TARDEC - technology performance data
  - ✓ AMSAA - technology performance data
  - ✓ NGIC - threat data

What We Do

➢ **What We Provide To Our Customers:**

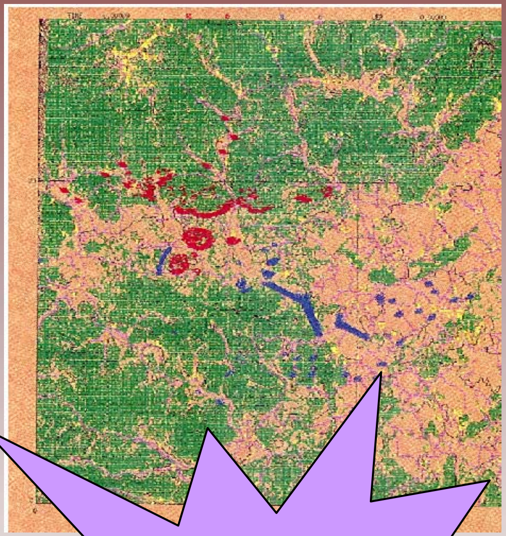
- ✓ Operational Effectiveness Analysis using the CASTFOREM model.
- ✓ Evaluate concepts
- ✓ Parametric “knee of the curve” analysis
- ✓ Trade studies

➢ **Who Our Customers Are:**

- ✓ TARDEC
  - Advanced Concepts
  - Special Projects Office
  - Survivability
- ✓ PM-HBCT
- ✓ PEO CS&CSS

The CASTFOREM Model

Combined
Arms
Support
Task
FORce
Evaluation
Model



Army's Approved Combat Model

Features

- High Resolution
- Two-Sided
- Digitized Terrain
- Smoke & Dust
- Minefield Breaching
- All Weather Conditions
- Direct and Indirect Fire
- Helicopters
- Multiple Sensors
- Graphic Playback
- Fully Documented
- VV&A

Measures of Effectiveness (MOEs)

- Force level loss exchange ratio (LER)
- System exchange ratios (SERs) by system
- Acquisition data by sensor type and range of both Blue and threat
- Loss data by weapon and munitions type for Blue and threat
- Measures of mission accomplishment

Past Work in Intelligent Systems

Rapidly reconfigurAble VEhicle (RAVE) - 2002

- Advanced Concepts (TARDEC)
- Composed of mobility module (manned) and mission module (unmanned)
- Three configurations played
  - ✓ One piece, manned
  - ✓ Two piece, Remote Control
  - ✓ Two piece, Semi-Autonomous
- Remote Control must maintain line-of-sight (LOS) with mobility module (controller)
- Semi-Autonomous must remain within 4km of mobility module (controller)

Past Work in Intelligent Systems

Rapidly reconfigurAble VEhicle (RAVE) - 2002

- TACOM developed a custom vignette to study RAVE issues
- TACOM worked with TRADOC (TRAC-WSMR) to develop the logic required to play intelligent systems
  - ✓ Remote Control platforms required approval from controller prior to moving to next waypoint or firing weapon
  - ✓ Semi-Autonomous platform required approval from controller prior to firing weapon
- The One Piece and Remote Control configurations both put the crews closer to harms way than the Semi-Autonomous

Past Work in Intelligent Systems

Rapidly reconfigurAble VEhicle (RAVE) - 2002

Study Limitations

- Loss of mobility module (controller) resulted in functional loss of mission module it controlled.
- Loss of mission module resulted in functional loss of mobility module (mobility module unable to control another mission module).

This study quantified the saving of crew lives through the use of a Semi-Autonomous intelligent platforms.

Current Issues

- Lethality
- Control Issues
- Time line issues
- Tree line movement
- Anti-tamper

Lethality

- **Primary Weapon**
  - ✓ Modeler can simulate the sensor, FOV, etc. that the controller has using the robotic platform.
  - ✓ Time delays associated with controller firing the remote weapon must be quantified.
- **Hard Kill Active Protection Systems (APS)**
  - ✓ Modeler must play explicit rules of engagement and Tactics, Techniques, and Procedures (TTPs) for use of APS.
  - ✓ Rules may differ significantly than for manned platforms.

Control Issues

- Quantify sensor fidelity, FOV, and time delays associated with working through the remote sensor

- TTPs for the loss of a robotic or controller platform
  - ✓ Can the controller switch control to another robotic platform?
  - ✓ Can one controller handle multiple robot platforms?
    - Degraded management of the platforms (metrics?)
    - Time Delays

- Movement of semi-autonomous platforms
  - ✓ Modeling the tentative movements as the platform seeks its path
  - ✓ Modeling the platform’s interaction with obstacles

- Modeling follower vehicles can be accomplished, but TTPs for when the lead platform is destroyed must be defined.

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Time Line Issues

- Critical in any combat simulation
- Need to obtain data to quantify delays in:
  - ✓ Threat acquisitions
  - ✓ Firing of main weapon / active protection
- Delays associated with controlling multiple platforms
- Movement delays for semi-autonomous platforms

Tree Line Movement

- Moving vehicles are harder to detect when in front of a complex background such as woods.
- Intelligent vehicles may be programmed to follow tree lines to avoid detection.
- By carefully selecting the waypoints for platforms in a scenario or vignette, they can follow the tree line.
- Alternate routes can be played in response to threat location.
- The ability to move into the woods when under fire cannot easily be modeled in a model like CASTFOREM.

Anti-Tamper

- Most difficult issue to address.
- The CASTFOREM model does not currently play “civilian” threats
- Threats to the platform would have to be given such low visual and thermal signatures that the platform would not identify them until they are very close (a few meters) from the platform
- A threat’s ability and dedication to resist increasingly dangerous anti-tamper technologies would have to be thoroughly quantified in order to be modeled.

Conclusions

- Significant work remains to properly model intelligent systems in a constructive simulation model like CASTFOREM.
- Obtaining adequate data to properly model some issues (i.e. timelines) will be the largest hurdle.
- Some issues, like anti-tamper, cannot be properly modeled without a major commitment of resources to obtain the model changes and the detailed data required.
- TTPs for intelligent systems are still in the infant stages.