



UNITED STATES ARMY RESEARCH LABORATORY



Secure Mobility Draft Concept Description

October 2006

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TARDEC
U.S. ARMY TANK-AUTOMOTIVE RESEARCH DEVELOPMENT AND ENGINEERING CENTER

Report Documentation Page

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RUX06 Experiment



- Capstone CAT experiment
 - Evaluate effectiveness of CAT program in improving the performance and/or reducing the workload for a mounted Soldier through the use of automated software tools and the integration of autonomous mobility systems on the manned platform
- Four Army S&T Programs
 - Crew-integration and Automation Testbed (CAT)
 - Robotic Follower (RF)
 - Fire Control Node Engagement Technologies (FC-NET)
 - Robotics Collaboration (RC)





RUX06 Goals



Autonomous Mobility

- Evaluate the impact of autonomously driven manned vehicles on Soldier capability.
- Examine Soldier performance and workload associated with robotic following.

Mission Planning

- Examine automated planning algorithms to improve Soldier planning speed and accuracy.

HRI Control Device

- Assess usability and impact on training of “scaled” dismounted control devices.





RUX06 Goals



Live-Virtual-Constructive Simulation

- Explore techniques, tactics, and procedures (TTPs) for a Mounted Combat System (MCS) platoon.
- Examine the impact of integrating live assets with virtual and constructive simulation.

Fire Control

- Examine weapons-munitions pairing and target prioritization algorithms to improve Soldier performance.

Local Area Awareness

- Examine Soldiers capability to understand their local environment through indirect vision.



Discussion and Recommendations



Preliminary results suggest increased Soldier performance and reduced workload through:

- Autonomy for both manned and unmanned assets.
- Crew aiding behaviors.
- Automated weapons pairing and target prioritization algorithms.

Preliminary technological assessments suggest the need to provide the Soldiers with:

- Greater potential control over the autonomy.
- Access to the “thoughts” of the autonomy.
- Clear awareness of the status of robotic convoy.
- Tasking that allows vehicle supervisors to be locally aware.



Secure Mobility Concept

Allow a crew to perform mobility tasks and to have a continuous, real-time understanding of their local environment during high-tempo missions without relying upon direct vision.





Secure Mobility Scope

- Mobility Function
 - Indirect Vision Driving & Tele-operation
 - Integration of Autonomous Mobility with Soldier (Supervised Mobility)
- Scanning Function
 - Indirect Vision Systems
 - Integration of Local and Networked Sensors with Soldier
- Secure Mobility Function
 - Indirect Vision Operations
 - Combine Mobility and Scanning into single function





Future Force Secure Mobility Issues

System Performance

Limited Direct Vision
Crew Repositioned in Vehicles

Indirect Vision
*Poor Performance
for Scanning and Mobility*

Network
*Poor Temporal and Spatial
Resolution*

**Insufficient
Capability**

Crew Workload

Scanning
High Workload

Mobility
High Workload

Manning
Smaller Crews and More Assets

**Extremely High
Workload**



Problem Definition

Problem:

- Soldiers are unable to move vehicles quickly while maintaining local area awareness

Challenges:

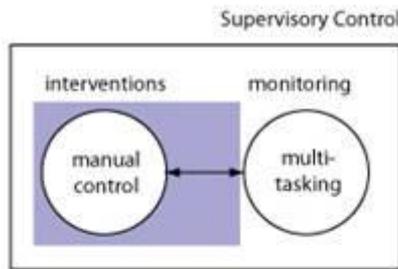
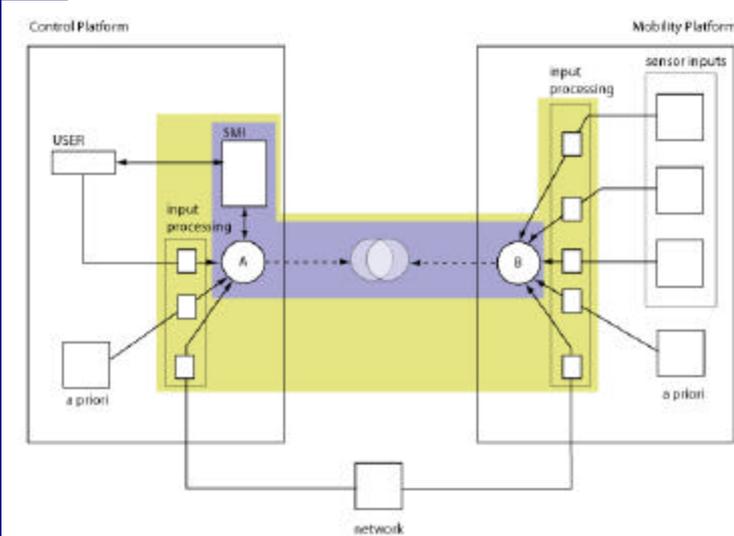
- Best vision is in unprotected mode (out of hatch)
- Limited FOV while protected (vision blocks, periscopes, indirect vision)
- Local sensors not integrated for local area awareness presentation to Soldier

Customer/champion:

- TBD

Requirement:

- FCS PIDS





Focus on Integration



Work directly with Army, industry, and academic partners to address the issues critical to complex systems development.



Soldier-System Interface

Timely and Critical Information
Interaction with User
Optimized Workload

Information Fusion

Spatial and Temporal Resolution
Database Management
Sensor Processing

**Secure
Mobility
System**

System Constraints

Vehicle Dynamics
Sensor Capabilities
User Capabilities

Automations and Aids

Asset Control
Environmental Cues
Force Tracking





Research Approach

Mobility ↔ Scanning

Basic Research on Human Performance Issues with **Functional Significance**

Behavior ↔ Modeling

Neurophysiology

Multiple Approaches to Assess and Predict Soldier Performance in **Operational Environments**

Transition to Developers

Design Recommendations ↔ Field Experimentation

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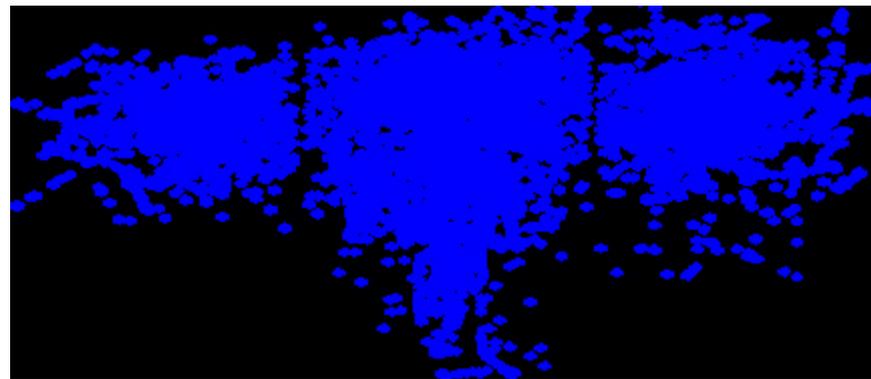
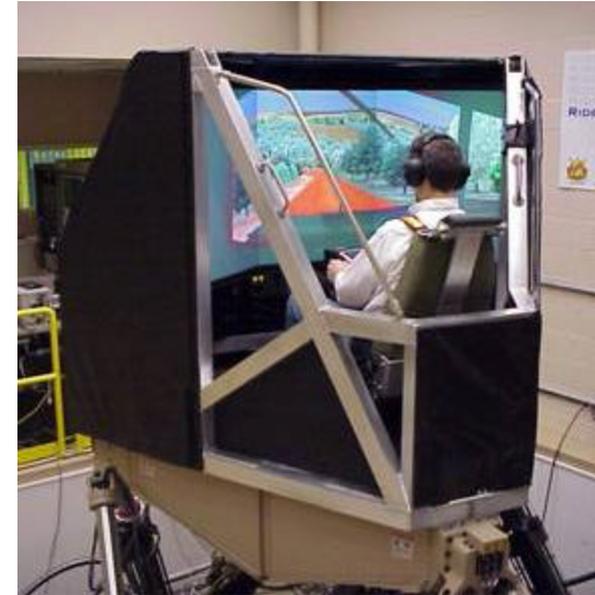


Fundamental Capabilities



2006 Pilot Experiment (TARDEC)

Tracked participants eye-movements and performance in full 6-DOF motion base simulator while executing supervisory control.

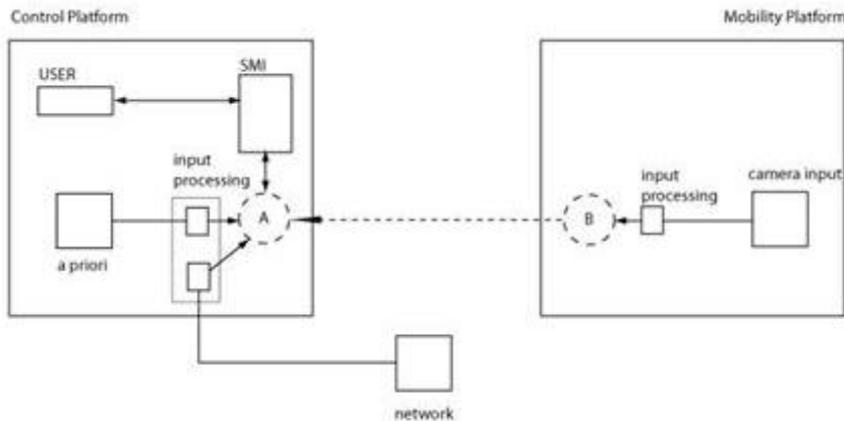




Mobility Focused Activities

On-going Efforts

Evaluating the impact of gains and lags on manual vehicle control.





Scanning Focused Activities



On-going Efforts



Examining scanning behavior of static and dynamic environments.

Assessing brain activity in full motion environments.





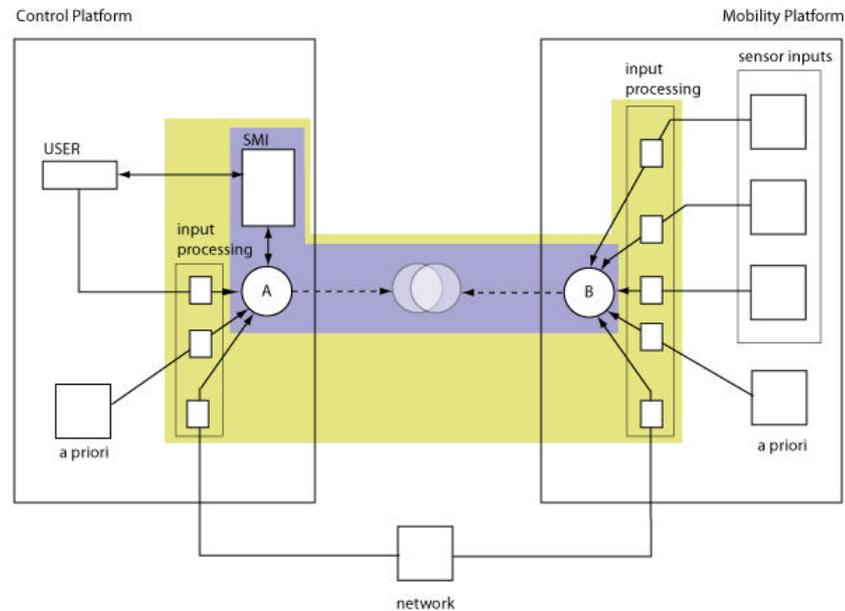
Research Direction



Near-term transition focus on manual and supervisory control and driver assist functions to relevant systems.

Long-term Goal

Gain the fundamental understanding needed to enable the development of effective indirect vision Secure Mobility systems.





Technical Approach

- **Mobility Function**
 - Indirect Vision Driving & Tele-operation
 - Integration of Autonomous Mobility with Soldier (Supervised Mobility)
- **Scanning Function**
 - Indirect Vision Systems
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 - Indirect Vision Operations
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FCS Increment 1

Manned Systems



Infantry Carrier



Command and Control Vehicle



Mounted Combat System



Recon and Surveillance Vehicle



Non-Line of Sight Cannon



Non-Line of Sight Mortar



FCS Recovery and Maintenance Vehicle



Medical Treatment and Evacuation

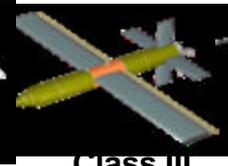
Unmanned Air Vehicles



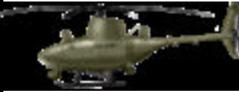
Class I



Class II



Class III



Class IV



Unattended Ground Sensor

Unattended Munitions

NLOS LS



Intelligent Munitions System



Unmanned Ground Vehicles



ARV RSTA



ARV Aslt



Small (Manpackable) UGV

Armed Robotic Vehicle



ARV-A (L)

MOLE (Countermine)