



# RUX06

## Experimental Review

for

# Technology Transfer

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# Report Documentation Page

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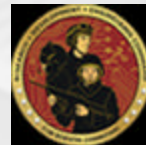
# Overview

## Purpose:

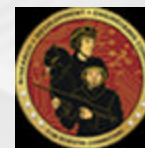
- Review RDECOM – UAMBL Experiment FY06 (RUX06) efforts to be transitioned to Future Combat Systems (FCS) Common and Mission crew station developers under a Technology Transfer Agreement.

## Outline:

- Collaborators
- Experimental goals
- Review experiments (with preliminary results)
- Discussion and recommendations



# Principal Investigators





# Critical Collaborators



UNITED STATES ARMY RESEARCH LABORATORY



**GENERAL DYNAMICS**  
Robotic Systems

**GENERAL DYNAMICS**  
Land Systems



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



# 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.



# Autonomous Mobility Overview

POCs: Kaleb McDowell, Ph.D., ARL  
Patrick Nunez, TARDEC

RUX06 Efforts: X2, X6 (*Field*), Pilot (*Motion Base*)

Soldiers: Each individual (11) completed the experiment.

General Structure: Soldiers conducted a road march for an MCS vehicle (AM or Indirect Driving) with a 2<sup>nd</sup> vehicle in robotic following. During the movement, the Soldiers provided local area awareness and planned a recon for a ARV-RSTA.

Primary Areas of Interest:

- Two levels of autonomous mobility and indirect vision driving.
- Area awareness during mobility.





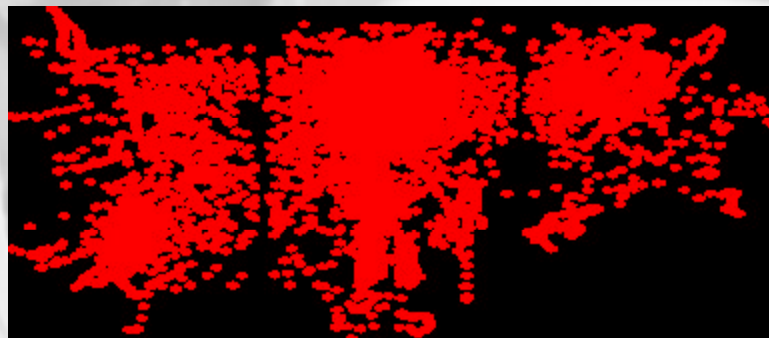
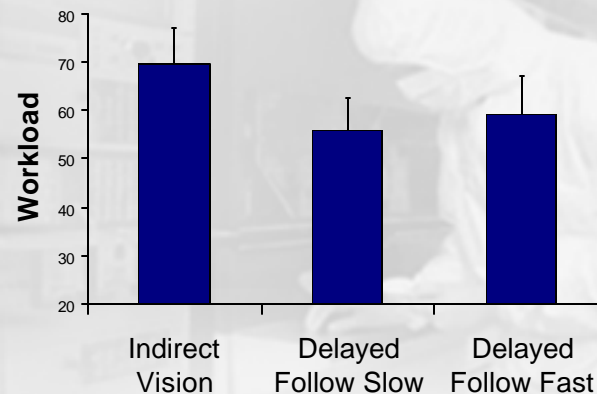
# Autonomous Mobility Results

## Preliminary Results for X2

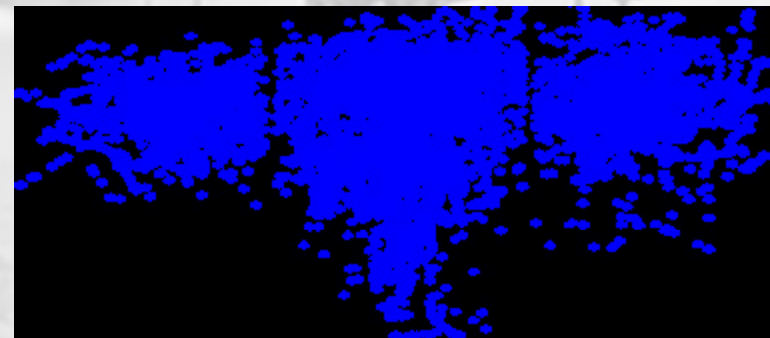
Autonomy associated with:

- Lower Mental Demand than for indirect vision driving.
- Greater percentage of target detection (speed matched) (75% vs. 70%).
- Greater instances of planning under motion (59% *slow*, 50% *fast* vs. 23%).

### Mental Demand



Sample Subject Eye-tracking Data  
Indirect Vision Driving (Pilot)



Sample Subject Eye-tracking Data  
Autonomous (Pilot)





# Mission Planning Overview

POCs: Kaleb McDowell, Ph.D., ARL  
Patrick Nunez, TARDEC

RUX06 Efforts: X1 (Simulation), X2 (*Field*)

Soldiers: Each individual (12) completed the experiment.

General Structure: Soldiers planned a road march and a movement to contact of an MCS platoon. This process was repeated for manual planning and automated planning.

Primary Areas of Interest:

- Manual versus automated planning
- Stationary and motion conditions



# Mission Planning Results

## *Preliminary Results for X1*

### Crew Aided Behaviors (CABs)

associated with:

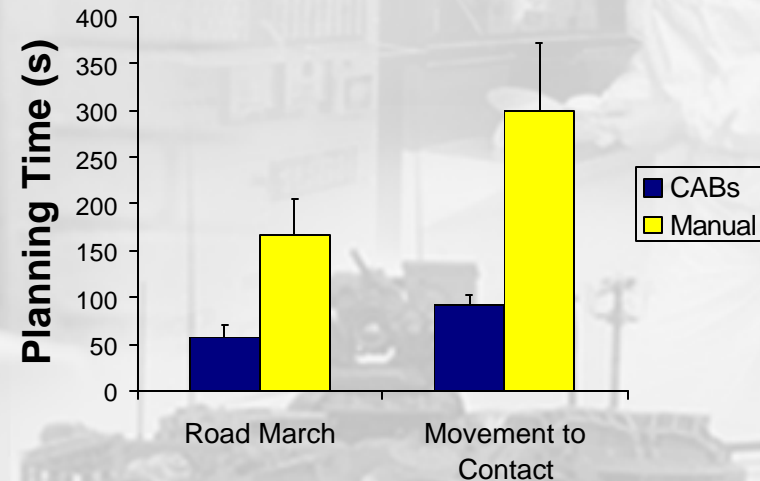
- Faster planning times.
- Greater time savings with increased plan complexity.

## *Preliminary Results for X2*

CABs associated with:

- Faster planning times.
- Greater instances of planning under motion (64% vs 24%).

## Mission Planning



# HRI Control Device Overview

*POCs:* Keryl Cosenzo, Ph.D., ARL  
Terry Tierney, TARDEC

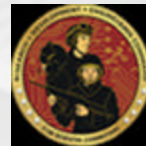
RUX06 Efforts: X5 (Field)

Soldiers: Each individual (12) completed the experiment.

General Structure: Soldiers teleoperated and waypoint planned a Talon using 2 dismounted control devices.

Primary Areas of Interest:

- NLOS versus LOS teleoperations control of small robots.
- Training
- Display scalability



# HRI Control Device Results

## *Preliminary Results for X5*

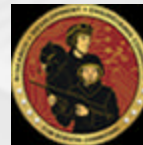
### Scalability

- Intuitive to use, little to no training required
- Dynamic configurability of interfaces important to support Soldier preferences, hardware form factors and redundancy
- Planning capability on dismounted devices is desirable



### Platform Control

- Smaller display form factor and soft joystick more practical for dismounted operations





# Live-Virtual-Constructive Overview

POCs: Robert Scott Smith, UAMBL  
Kaleb McDowell, Ph.D. ARL

RUX06 Efforts: X6 (Mixed), *Pilot (Motion Base)*

Soldiers: Soldiers (10) teamed to complete 5 trials for X6.

General Structure: An MCS platoon was attached to a RECON Troop. The MCS platoon conducted a tactical movement down a road (mixed), 5 simulated BLOS fires (virtual) on red force locations (constructive), and the lead vehicle identified civilians and hostiles located along the movement route (live). The hostiles were engaged virtually.

## Primary Areas of Interest:

- Document TTPs
- Concept Validation





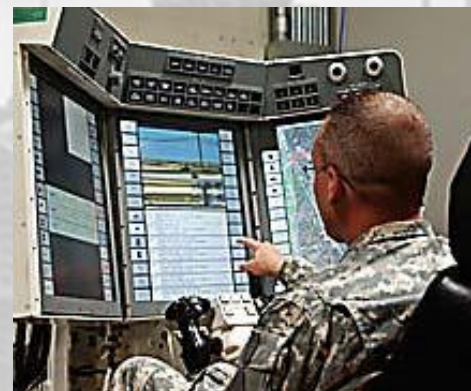
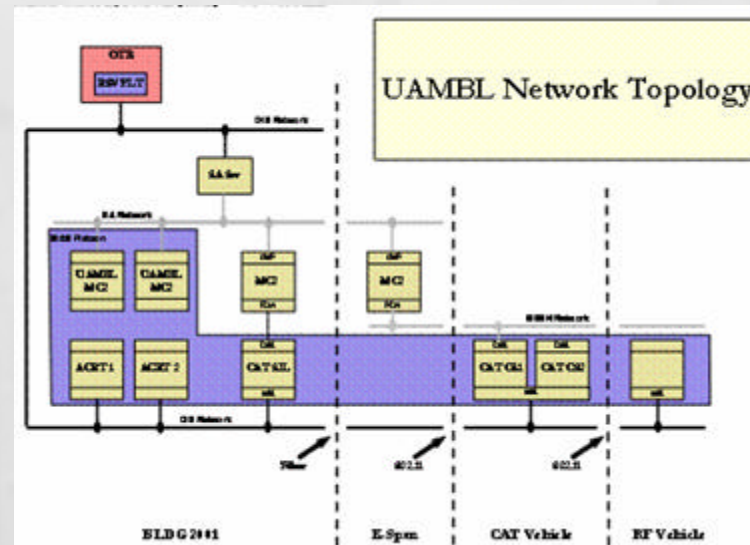
# Live-Virtual-Constructive Results

## *Preliminary Results for X6*

Autonomous movement reduced the MCS platoon's rate of march.

Validated manned-unmanned teaming concept between MCS and ARV-R.

Documented the BLOS fire distribution TTP of an MCS Platoon.



# Fire Control Overview

POC: Deborah A. Butler, AMRDEC

RUX06 Efforts: X4 (Simulation), X6 (*Mixed*)

Soldiers: Each individual (12) completed the experiment.

**General Structure:** Soldiers were trained to utilize the Crew Automation and integration Testbed (CAT) crew station to engage targets from their manned and unmanned assets using the FC-NET fire control system. The soldiers' ability to prioritize targets, select the appropriate asset and weapon for a specific threat, and engage targets was measured. This process was repeated with and without automated weapons pairing and target prioritization algorithms.

**Primary Areas of Interest:**

- Weapons pairing and target prioritization algorithms.



# Local Area Awareness Overview

POC: Kelvin Oie, Ph.D., ARL

RUX06 Efforts: X5 (Simulation), X2 (*Field*), X6 (*Mixed*), Pilot (*Motion Base*)

Soldiers: Individuals are completing the experiment this week.

General Structure: Soldiers scanned for people during a simulated ride through a virtual, urban environment.

Primary Areas of Interest:

- Scanning of continuous video versus static images during mobility operations.
- Impact of increased visual area and camera panning on scanning performance.





# 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.

