

# **Test and Evaluation of Autonomous Ground Robots**

## Panel Members:

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with an introduction by:

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**ATEC**



# The AGV Test Perspective

NDIA Ground Robotics Capabilities Conference and Exhibition

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*Army Proven  
Battle Ready*

# Purpose

To describe the capabilities the US Army Aberdeen Test Center (ATC) currently possesses to test today's Autonomous Ground Vehicles (AGVs) and to identify what must occur for ATC to test the next generation of higher autonomy.

# Testing

- ATEC has conducted over 100 robotic tests over 15 years
- Generation 0 - Teleoperated Systems
  - Test requirements dependent on system specifications vice the mission the system is intended to fulfill
  - Currently set test methodologies – evolved over time
- Next Generation – Semi-Autonomy and Beyond
  - Software intensive systems
  - Pose additional test complications (perception, detection, reasoning)

# Safety Releases vs Safety Confirmations

- Safety Releases specify constraints required to ensure Soldier safety when using experimental equipment at a specific place during a limited time period
- Safety Confirmations indicate overall safety of the system and identify hazards not adequately controlled/mitigated, lists technical or operational limitations, and highlights safety problems that require further investigation/testing

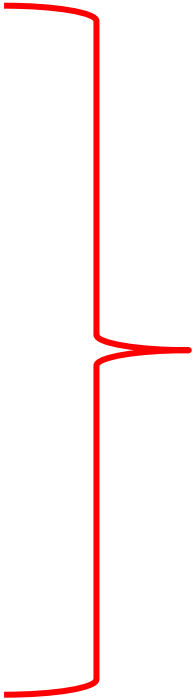
**TESTING FOR OUR ULTIMATE CUSTOMER  
– THE WARFIGHTER**

# AGV Use

- AGVs inherently present catastrophic risks.
  - Can be documented and controlled only to the extent they're understood and proven
- Need to develop Safety Releases to enable closer and more realistic Soldier interaction with SUT
- Need to develop Safety Confirmations with lower Risk Assessment Codes (RACs)

# What's the Problem?

- Fundamental Design Documentation
  - Software/Hardware Architecture
- System/Subsystem Test Data
  - DTP/Final Report
- Verified & Validated Models



All have not been made available

With these, the test community can tailor final verification test events



# What's the Solution?

- Prepare contracts to allow the sharing of software and system design documentation
- Developers establish a system safety plan IAW MIL-STD-882D and software safety engineering program using JSSSEH as general guidance
  - ID, document and track all system and sub-system level hazards; create closed loop hazard tracking database
  - Determine software influence on above hazards

# What ATC Provides

System Development	Formal Testing	Analysis
Customer Testing	Technical Testing Performance, Endurance, RAM, RSV, Mobility	Data Reduction
Documentation Review Detailed Test Plans	Safety Testing Software, System Safety, Fault Isolation, Troubleshooting	Data Analysis
Embedded Instrumentation	Facilities Automotive Courses, Climatic, EMI, C4, Weapons Accuracy, Sensor Tech	Test Incident Reports Data quality, scoring support
“On Location” Test Observation	“On Location” Test Execution	
	Test Methodology Development	

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# BACK-UP SLIDES

# REFERENCES

- AR 385-16 “System Safety Engineering and Management”
- AR 73-1
- AR 700-142
- AR 385-10
- DA PAM 73-1
- JSSSEH
- MIL-STD-882

		HAZARD PROBABILITY				
		FREQUENT	PROBABLE	OCCASIONAL	REMOTE	IMPROBABLE
SPECIFIC INDIVIDUAL ITEM		Likely to occur frequently	Will occur several times in the life of the item	Likely to occur sometime in the life of the item	Unlikely but possible to occur in the life of an item	So unlikely it can be assumed the occurrence may not be experienced
FLEET OR INVENTORY		Continuously experienced	Will occur frequently	Will occur several times	Unlikely but can reasonably be expected to occur	Unlikely to occur but possible
		A	B	C	D	E
HAZARD SEVERITY	<b>CATASTROPHIC I</b> May cause death or system loss	HIGH	HIGH	HIGH	SERIOUS	MEDIUM
	<b>CRITICAL II</b> May cause severe injury, severe occupational illness, or major system damage	HIGH	HIGH	SERIOUS	MEDIUM	MEDIUM
	<b>MARGINAL III</b> May cause minor injury, minor occupational illness, or minor system damage	SERIOUS	SERIOUS	MEDIUM	MEDIUM	MEDIUM
	<b>NEGLIGIBLE IV</b> May cause less than minor injury, occupational illness, or system damage	MEDIUM	MEDIUM	LOW	LOW	LOW

# ASTERS

## Objectives & Challenges

- ASTERS will assess the current state of:
  - Emerging AGV Technologies
  - Emerging AGV Requirements
  - Current test (DT/OT) and evaluation capabilities
- Challenges
  - Effective T&E
  - Unique considerations of AGVs through T&E

# Methodology/Process

Requirements  
Analysis &  
Development

Emerging AGV  
Technologies

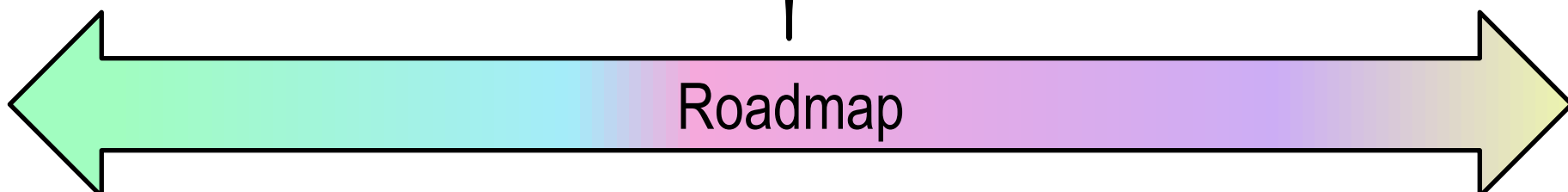
Assess Current  
AGV T&E  
Capabilities

Identify T&E  
Gaps

Solutions to T&E  
Gaps

Definition of  
Autonomy

Test Matrices





# Deliverables

