Air Force Civil Engineer Robotic Applications

Steve Bailey, GS-13, DAF

Research Engineer

Air Force Civil Engineer Center

Requirements, R&D, and Acquisition Division

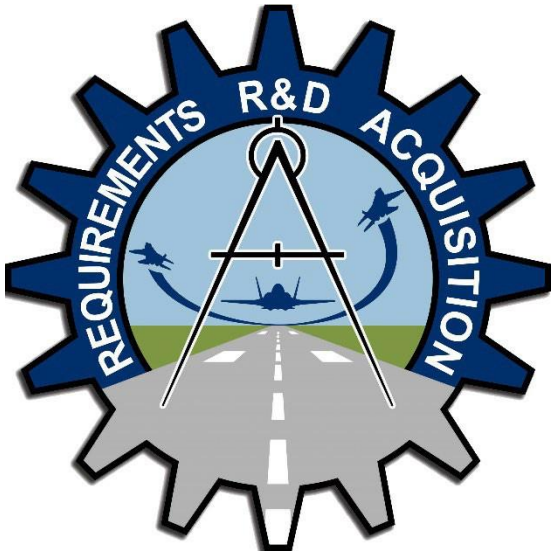
Overview

- Airbase Acquisition Branch (CXAE)
- Airfield Damage Repair (ADR) Processes
- Robotics and Unmanned Systems
- Small Unmanned Aerial Systems
- Robotics and Autonomous Systems Roadmap
- Takeaways
- Questions

Airbase Technologies Branch

Acquisition: develop, evaluate, and field technology

- Develop (RDT&E) and field new technology/prototypes
- Provide CE unique test & evaluation facilities/ranges
- Evaluate commercially available technology/equipment (COTS)
- Modify existing equipment
- Procure and sustain material solutions
- Provide expert technical advice and reach back support
- Focused on 6 primary technical areas that encompass the entire scope of airbase technology needs



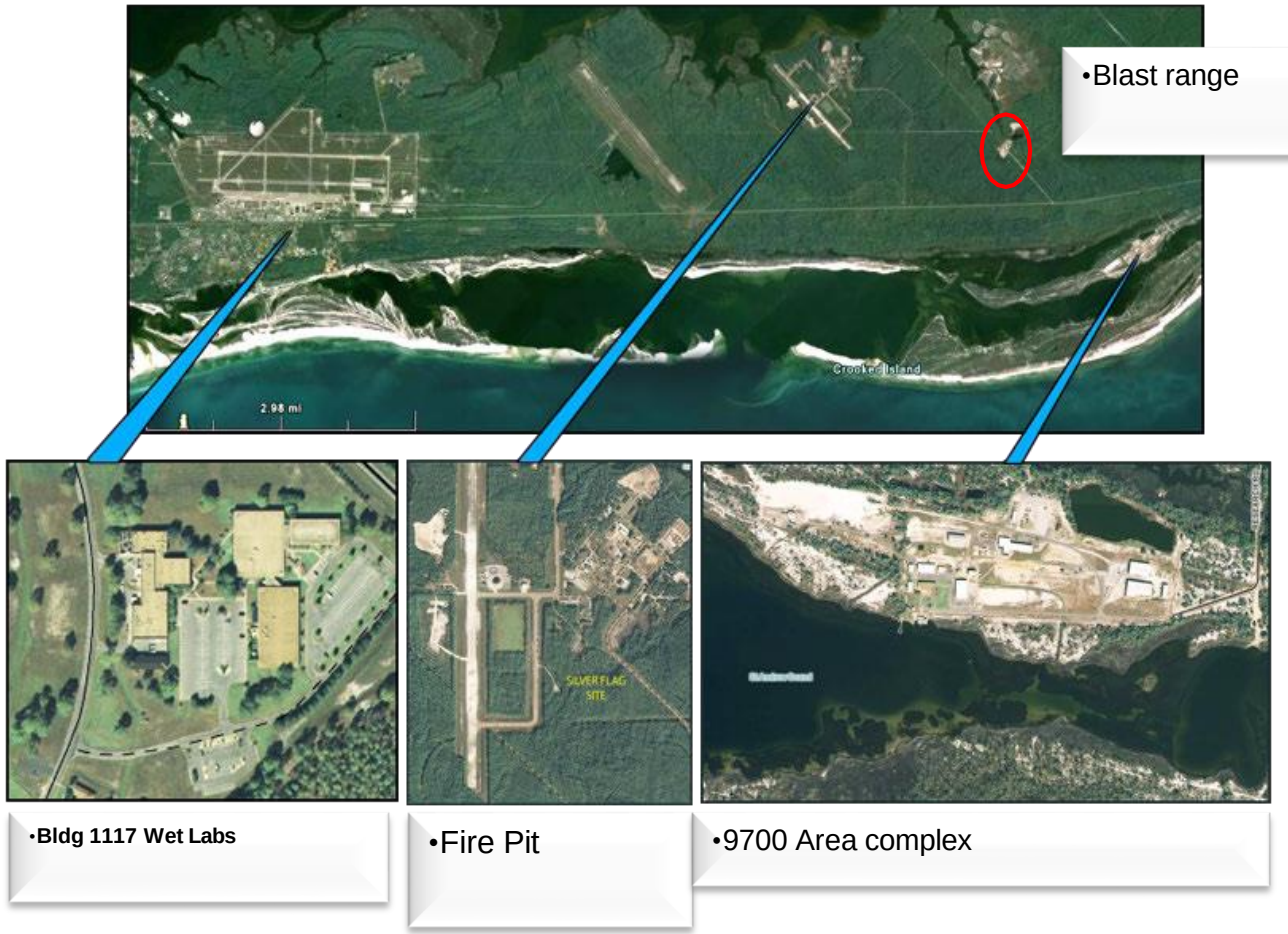
"Air bases are a determining factor in the success of air operations. The two-legged stool of men and planes would topple over without this equally important third leg." General of the Air Force Henry H. *"Hap"* Arnold

Your Success is Our Mission!

AFCEC/CXAE Capability Areas

Facilities Overview

- 4 compounds, 20 facilities, 143 acres of T&E ranges
- 250,000+ sq ft of laboratories and industrial facilities
- 100+ RDT&E vehicles
- $25M+/- equipment
- 12 miles between facilities
- Defense Research & Engineering Network
- Silver Flag Exercise Site
- SUAS Operations - Restricted airspace
- Amphibious—open water access



Airfield Damage Repair (ADR) Processes

Robotics & Unmanned Systems

Unmanned systems & technologies to support the full range of CE Missions

- Agile Combat Support
- Airfield Damage Repair & UXO Response
- EOD Robotics & Technologies
- Fire & Emergency Services
- Robotics for Airbase Operations & Support

Remote Mass Mechanical Clearance

Drive By Wire Applique

Load Cart

Tele-operated Genie Telehandler

Explosive Ordnance Disposal Robotics

Modified NIST evaluations for AF requirements

Small EOD robot selection completed 2015

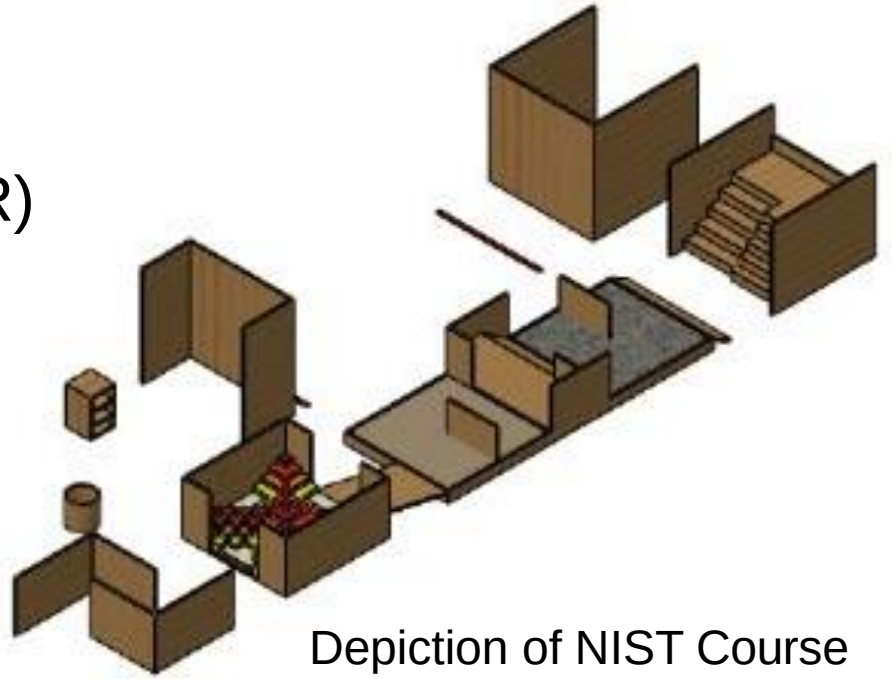
- Selected the Micro Tactical Ground Robot (MTGR)

Base support EOD robot selection completed 2021

- Selected L3Harris T7 Robotic System

L3Harris T7

MTGR



Depiction of NIST Course

Unmanned Ground Systems

Tele-operated and semi-autonomous ground systems to perform Civil Engineer Operations: EOD, airfield repair, firefighting, emergency management

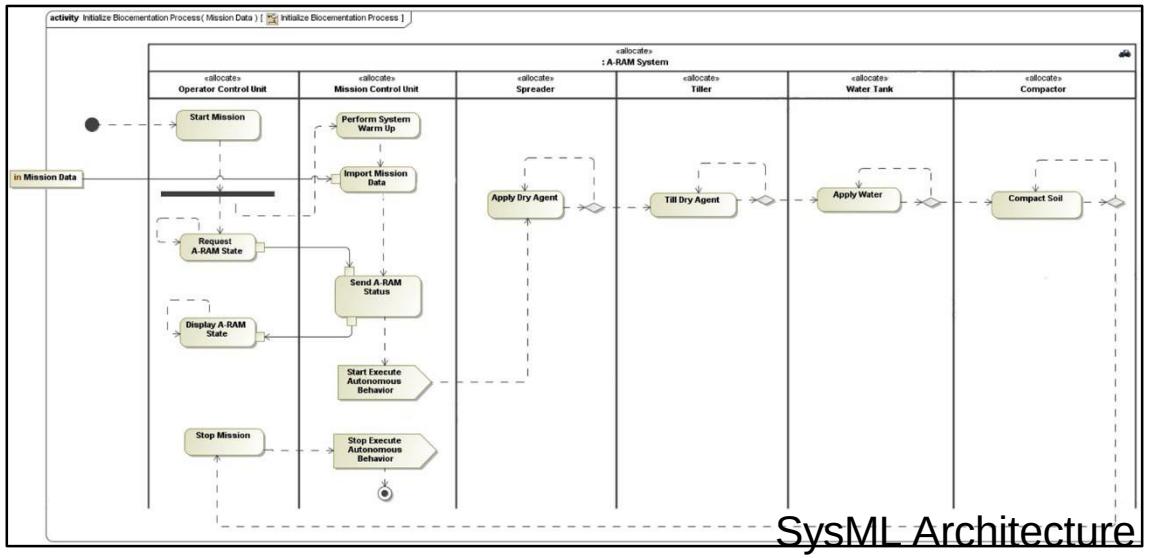
- **Test, evaluate and integrate appliques for USAF platforms**

In-Seat (RADR-T)

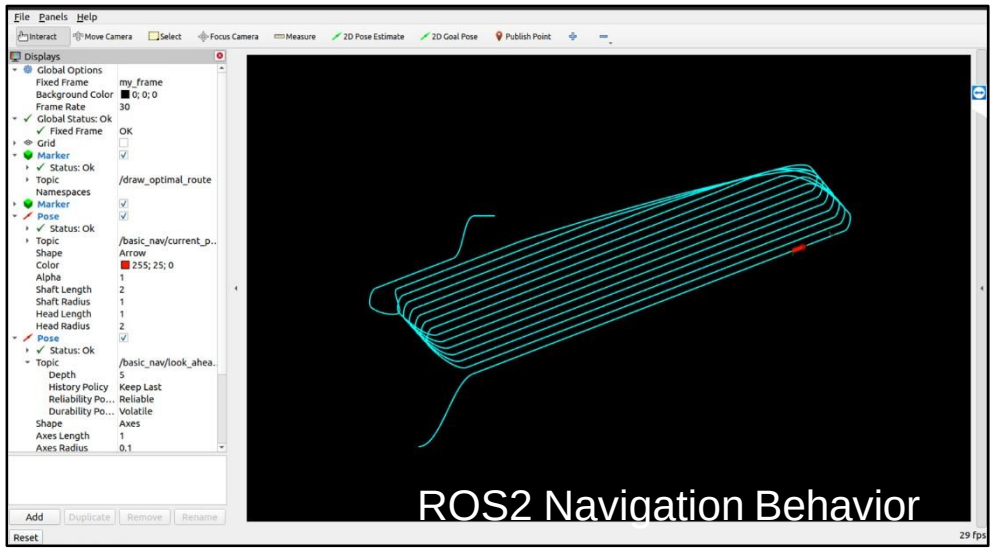
In-Seat (RADR-A)

Drive by wire (OTONOS)

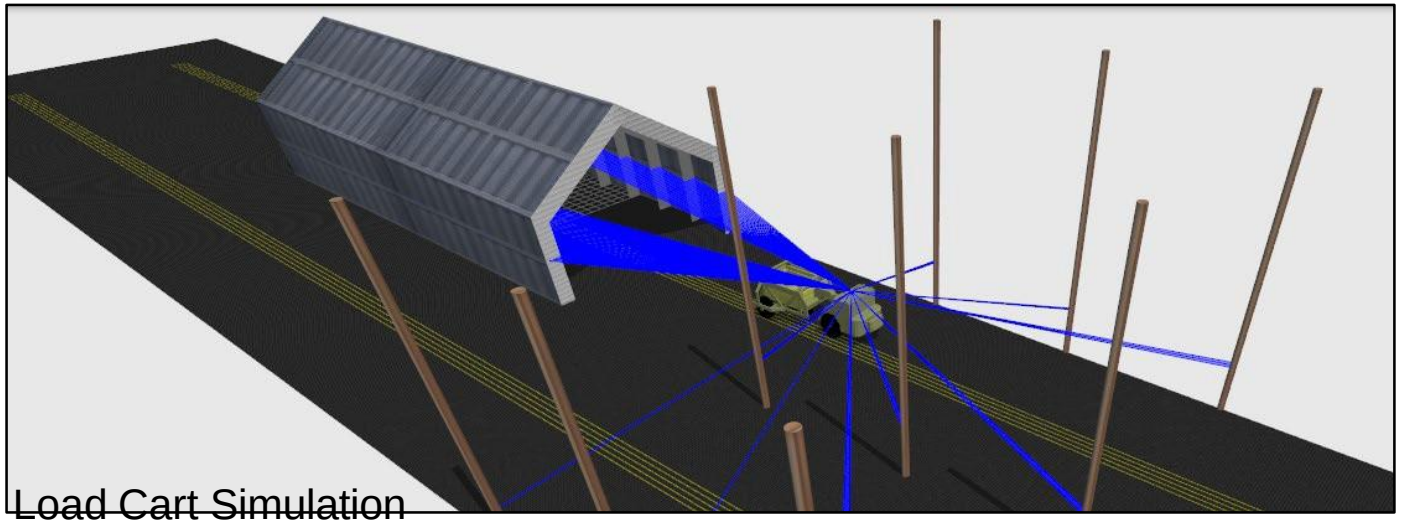
Digital Engineering & Autonomy

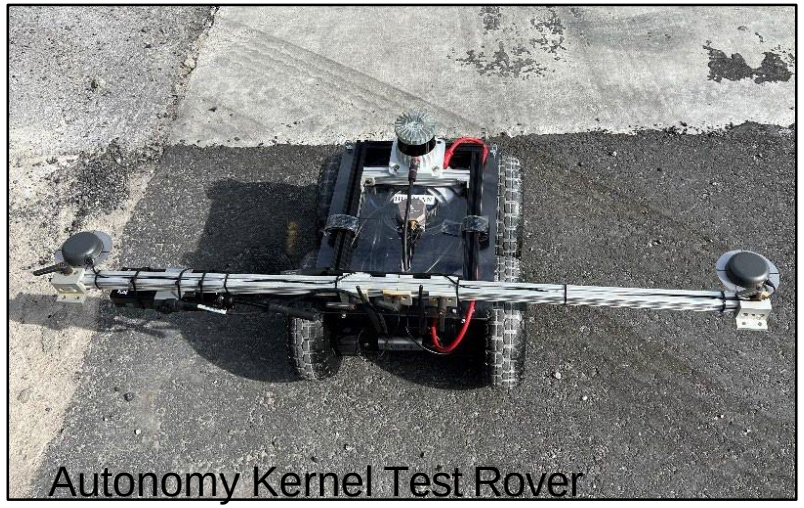


SysML Architecture



ROS2 Navigation Behavior


Load Cart Simulation


Autonomy Kernel Test Rover

Your Success is Our Mission!

Other Applications

Free personnel from *Dull*, *Dirty*, or *Dangerous* jobs

Your Success is Our Mission!

Small Unmanned Aerial Systems (SUAS)

- **Used for AF Missions**
  - Perimeter security
  - Force Protection
  - Surveying
  - Building Inspections
  - Many other uses
- **Teledyne FLIR Aeryon SkyRanger R60**
- **Teledyne FLIR SkyRaider R80**
- **DIU Blue UAS**
- **Future Capabilities?**

SkyRanger R60

Source: Defense Visual Information Distribution Service, photo by Smith, J

Vantage Robotics Vesper

Source: Defense Visual Information Distribution Service, photo by Smith, J

Robotics and Autonomous Systems Roadmap

	Short-Term (0-2 years)	Medium-Term (2-5 years)	Long-Term (5-10 years)
APOF	APOF ConOps	Auto APOF Loader	
RDA	RDA Draft FRD	RADAS v 0.7x	RADAS v 1.0
REHM	REHM FRD, AFTTP 3-32.5 V1	RADBO/REHM C3 Integration	SLAM Bot
ADR	ADR FRD/CONOPS/CDD	Robotic ADR Equipment	Next Gen RADBO Auto ADR
1.1. Sensing and Perception	Crater ID Surface UXO ID Development Subsurface UXO Locate	Subsurface UXO ID Development Surface UXO ID Maturation	Subsurface UXO ID Maturation Surface UXO ID Maturation
1.2. Mobility	GPS Degraded Navigation	Crater and Depression Avoidance UXO and Obstacle Avoidance	
1.3. Manipulation	Auto Pallet Handling	Coring, drilling, & boreholing Highly Dexterous Manipulation	
1.4. Human System Interaction	RMMC Applique APOF TAK IOC REHM TAK IOC	ADR Applique TAK Spiral	TAK Spiral
1.5. System-level Autonomy	Load Cart Autonomy Kernel A-RAM Autonomy Kernel	APOF Autonomy Kernel RMMC Autonomy Kernel	ADR Autonomy Kernel
1.6. Rapid CBRNE Mitigation	L-CBA S-CBA	Subsurface UXO Access	Subsurface UXO Mitigation
1.7. Systems Engineering	Robot M&S Environment T&E Interoperability DE Environment	Robot M&S Environment T&E DE Environment	Robot M&S Environment T&E DE Environment

Takeaways

- AFCEC is advancing robotics with developmental partners in many RDT&E projects
  - Robotics and Unmanned Systems, applique kits, platforms/sensors testing and software interface
- Multiple test/explosive ranges and facilities to evaluate systems “full operational capability” on-site
- Laboratories for controlled environmental testing
- Ability to support new robotics technology for AF enterprise missions
- Enabling the CE Warfighter to be more agile, flexible efficient and effective!

Questions?