NVESD S&T for Maneuver Support

Night Vision

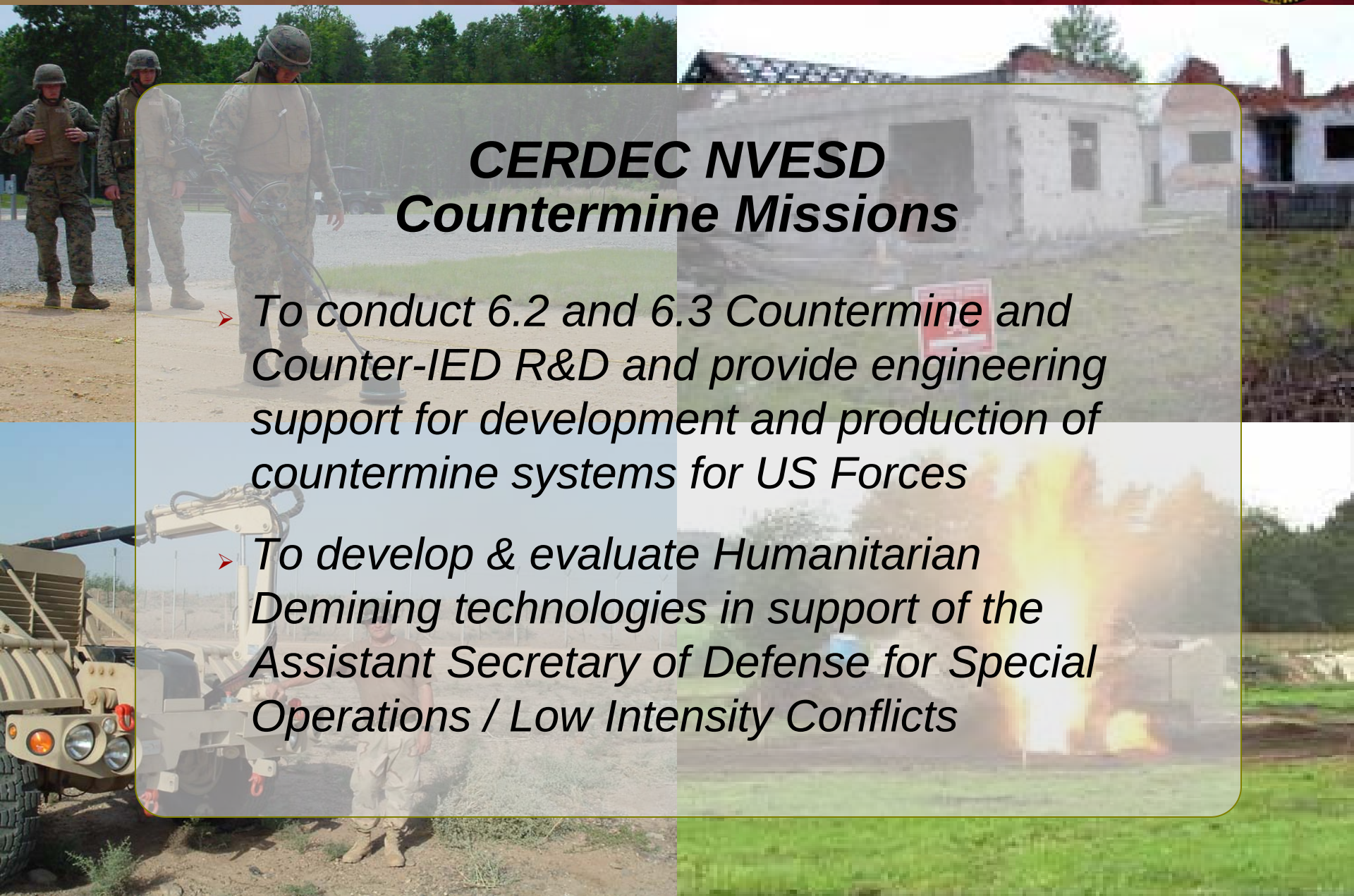
Night Vision & Electronic Sensors Directorate

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Dr. Donald A. Reago, Jr.
Principal Deputy for Technology and Countermine
US Army CERDEC NVESD

Approved for Public Release

NVESD Mission

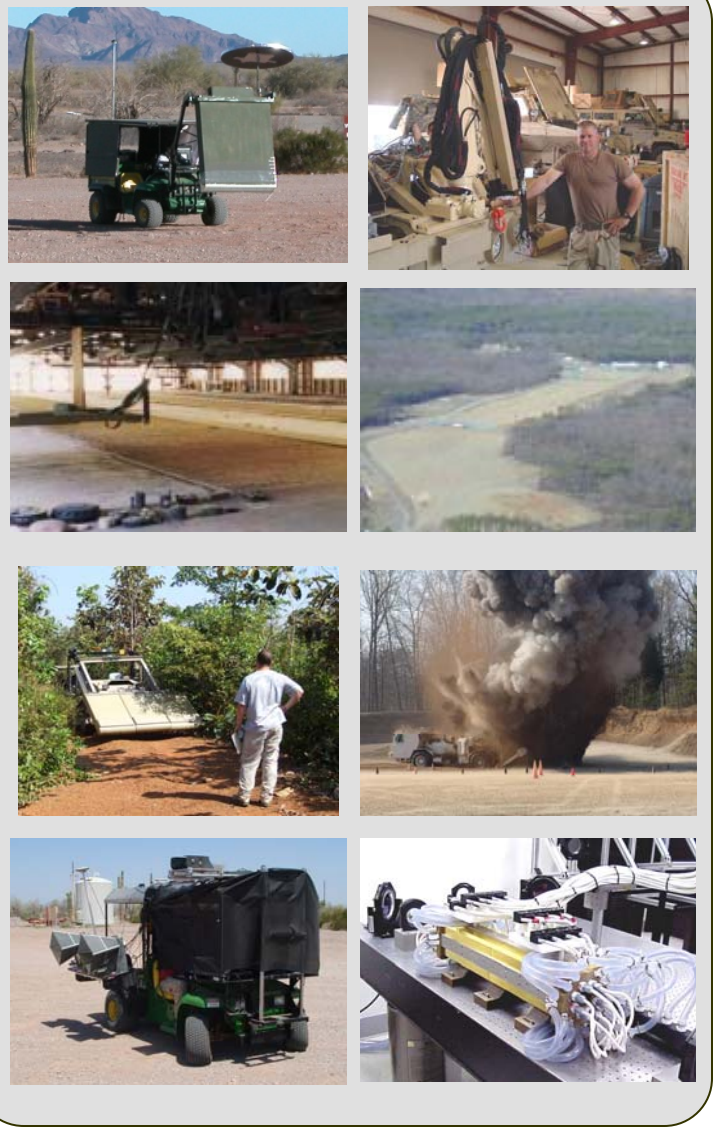


CERDEC NVESD
Countermine Missions

- *To conduct 6.2 and 6.3 Countermine and Counter-IED R&D and provide engineering support for development and production of countermine systems for US Forces*
- *To develop & evaluate Humanitarian Demining technologies in support of the Assistant Secretary of Defense for Special Operations / Low Intensity Conflicts*

NVESD Roles

- As an Army R&D directorate, NVESD takes on many roles:
  - Develops new components and prototype systems (TRL 3-6)—in house & contract
  - Supports university research that is targeted to our system needs (UMR, Duke, U Fla, etc.)
  - Maintains technical expertise in our mission areas—in house labs & field experimentation
  - Supports PMs (PM Countermine & EOD) in the development of new systems for the warfighter (e.g. GSTAMIDS, ASTAMIDS, AN/PSS-14)
  - Provides “honest broker” analysis and support
  - Develops and supports quick reaction capabilities to assist the warfighter



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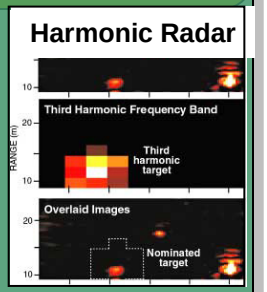
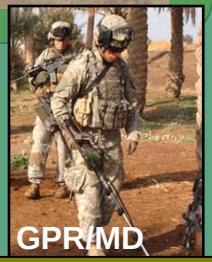
NVESD Technology Development for Detection of Explosive Devices

Electromagnetic

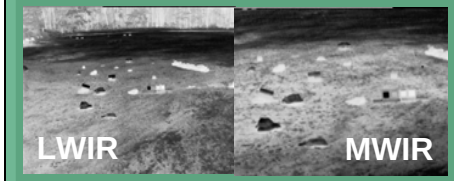
Down Looking GPRs



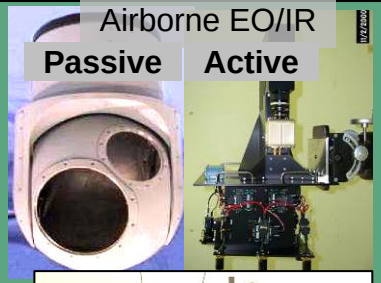
Metal Detectors

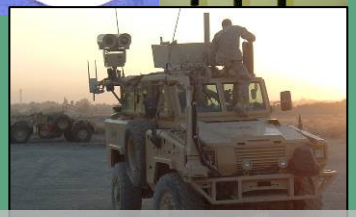


Electro-optical and Infrared



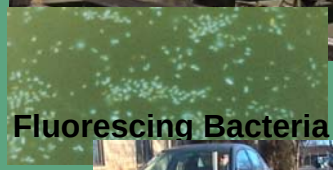
Hyper-spectral, Reststrahlen & Multi-spectral LWIR





Route Clearance Camera

Explosive Specific Techniques



IMS

Expertise Across the Spectrum – Flexibility to adjust to Changing Threat Transitions to PM Countermine/PM IED Defeat

Current Operations

War Support is Priority #1

NVESD Employees In The Field Supporting OIF/OEF

Interrogation Arm

Purpose: Provide medium mine-resistant vehicles a stand-off tool to detect and/or interrogate suspicious off-route targets

RG-31 arm training in theater

Crane mounted on HMMWV testbed

NVESD Engineers training soldiers in theater on the use of the Husky arm

Current configurations:

- **All systems equipped with components necessary to permit remote operation inside a protected vehicle cab**

Testbed capability:

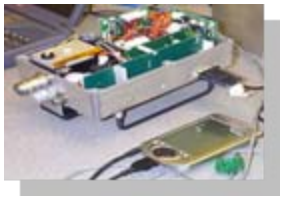
- **Testbed configuration on HMMWV used to integrate and evaluate additional sensors in standoff mode**

Lightweight system to minimize impact to cross-country capability of medium mine-resistant vehicles

One of the Top 10 Army's Greatest Inventions for 2007

Nomadics Fido Technology: Product of NVESD Sensors for Explosive Detection ATO

The Nomadics Fido XT sensor is capable of detecting trace amounts of the most common Explosive Related Compounds (ERCs)



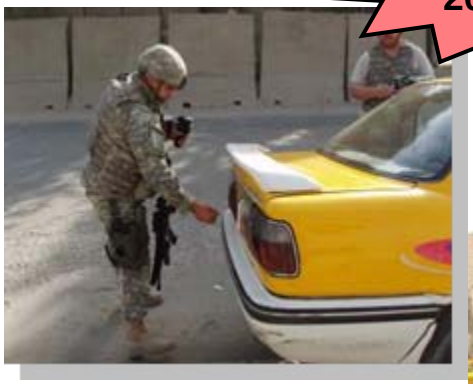
Early Versions of Fido Sensor

NVESD Developed Fido X and XT versions

Selected Army's Greatest Invention 2005-2006

Applications:

Iraqi Soldier utilizing Fido for personnel screening prior to Mosque entry.
Photo from
NY Times article



Vehicle Inspection

Personnel screening

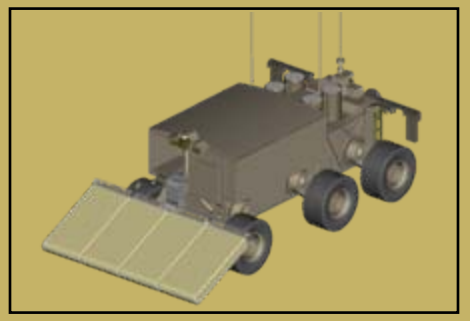
Applications include personnel/facility screening, IED confirmation, and VBIED inspection

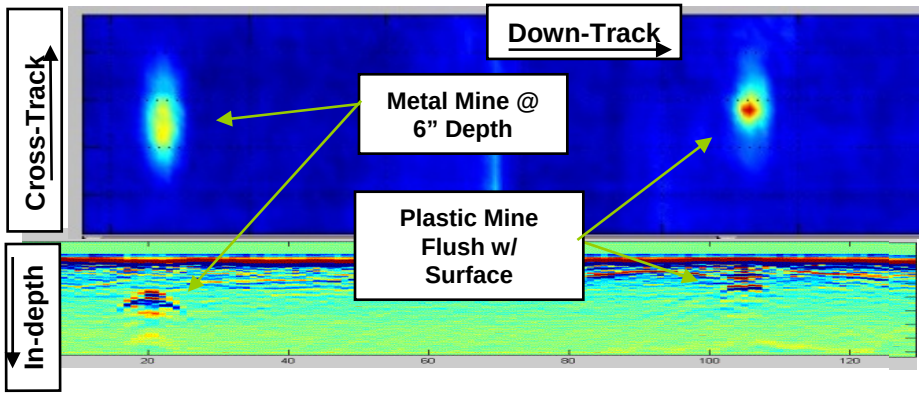
Near Term Innovations

Down Looking Mine Detection Hosted on Unmanned Ground Vehicle

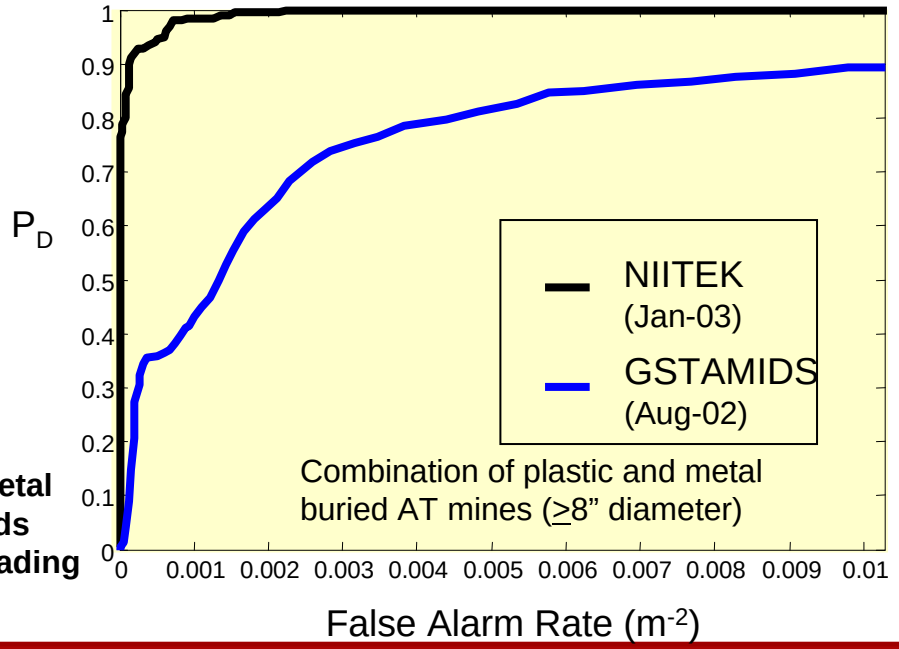
Breakthrough in Vehicle-Mounted GPR

Wichmann/NIITEK





- **Near perfect Pd for AT mines in initial blind tests (> .95)**
- **Order of magnitude reduction in FAR (.0005/m^2) for plastic & metal cased AT mines buried at varying depths in dirt and gravel roads**
- **Off route capability will be tested but can expect higher FAR leading to slower ROA at choke points**

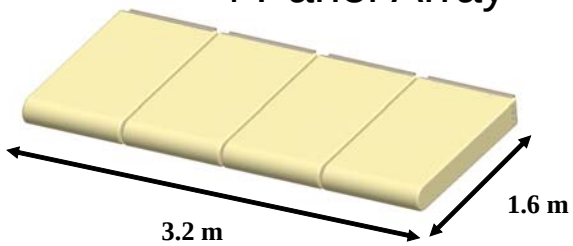


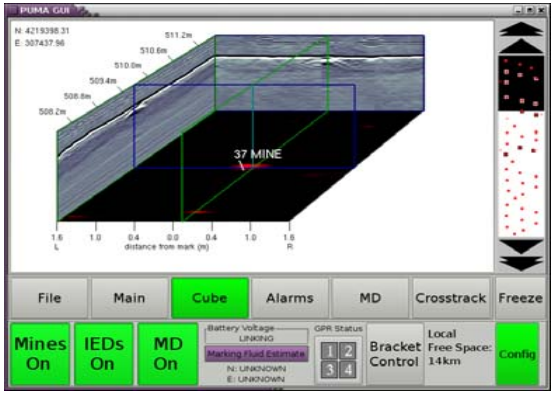
First practical wideband radar for rapid sub-soil imaging of plastic and metal cased mines. Radar search speed has been increased to 15 km/hr.

NIITEK (Wichmann) GPR – State of the Art GPR*

- Wide bandwidth
- Significantly reduces system related clutter
  - Resistive V dipole
    - Voltage reflected from open end of antenna is small
    - RCS of antenna is small – reduces ground reverberations
    - Secondary ground bounce outside time gate
- Directive beam
  - Reduces clutter to target ratio
  - Low side lobes reduces direct coupling and extraneous scattering
- Best demonstrated shallow target detection performance
- Numerous field tests
  - YPG
  - AP Hill, VA
  - ATC
  - UK
- Deployment to Africa & Cambodia (Humanitarian Demining)

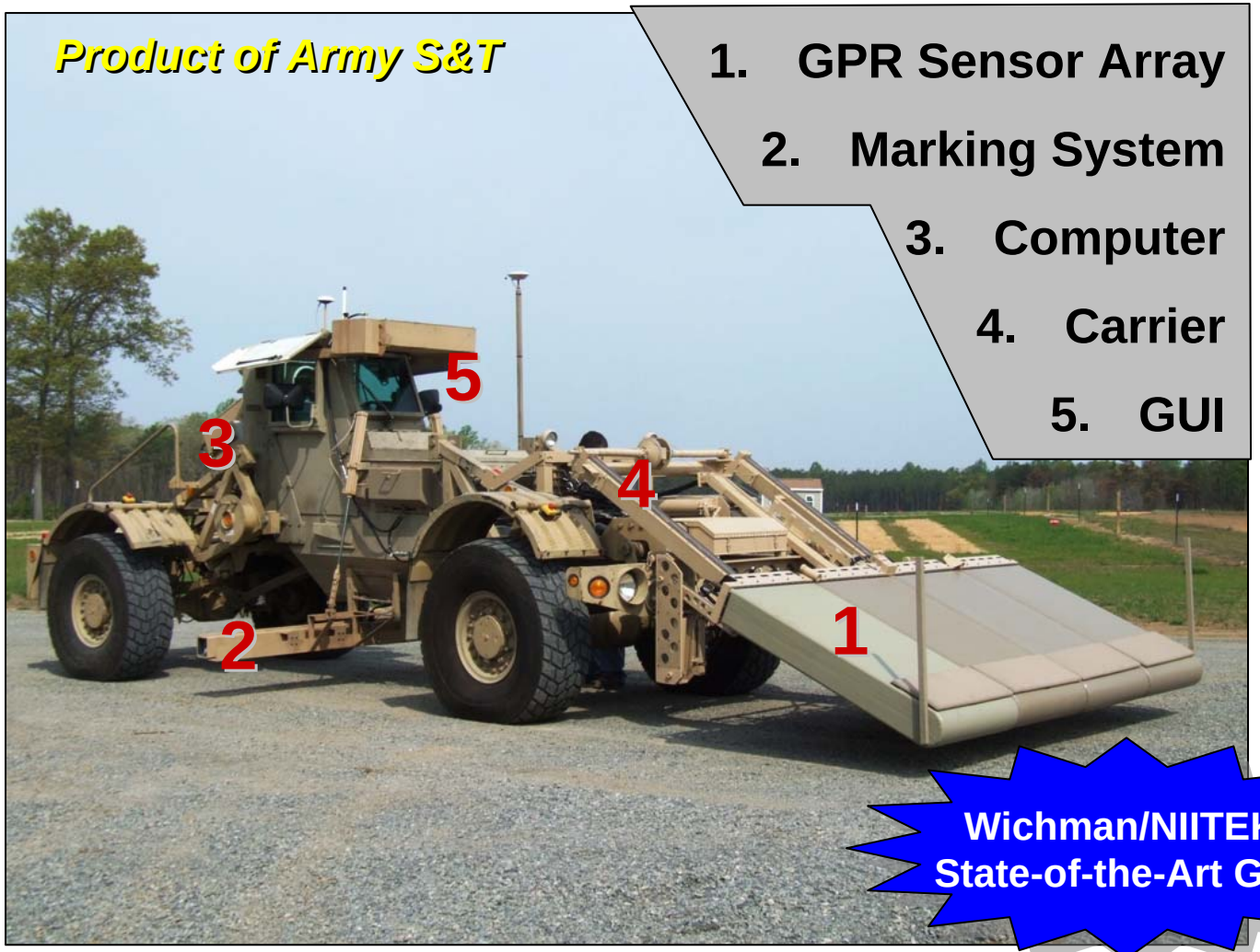
4 Panel Array





*** JASON Mine Detection Study, pp. 13-15, Final Brief, 2003**

Husky Mounted Detection System (HMDS) Kit Components

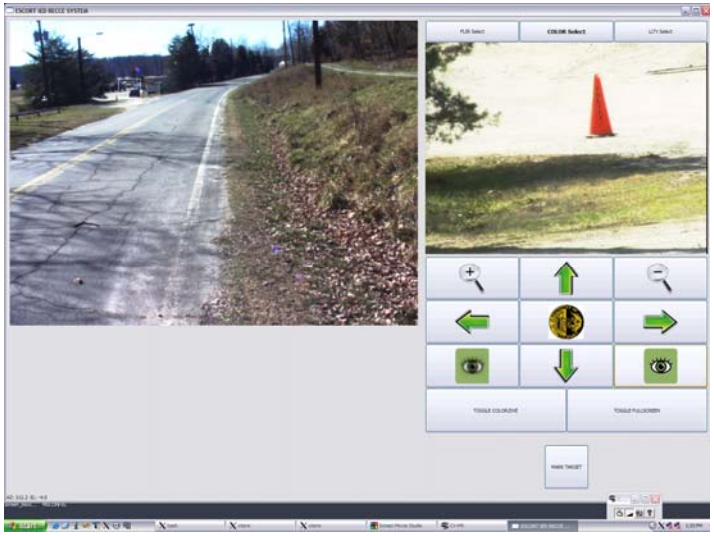


HMDS Operation

NVESD Multi-Sensor EO/IR GUI

- **Unique Graphical User Interface (GUI) provides new capability for on-the-move detection by combining the strengths of existing DVE and high mag, stabilized sensors**
- **GUI allows full use of both sensors simultaneously.**
  - DVE's WFOV provides excellent situational awareness, but low magnification limits C-IED activity to short range.
  - Higher magnification sensors provide excellent overwatch & longer range detection, but soda straw effect limits useful on-the-move-situational awareness
- **Touchscreen GUI provides easy operator control of both sensors -- best method to point high magnification sensors to regions of interest while on-the-move.**
- **NVESD solved the technical problems with DVE-to-high mag pointing in a moving vehicle**
- **Now working on automation of cueing (in house and with UMR)**

Operation on the Move



GUI only requires ruggedized PC, upgraded display & simple video camera for easy integration with existing sensors.

GUI Operation

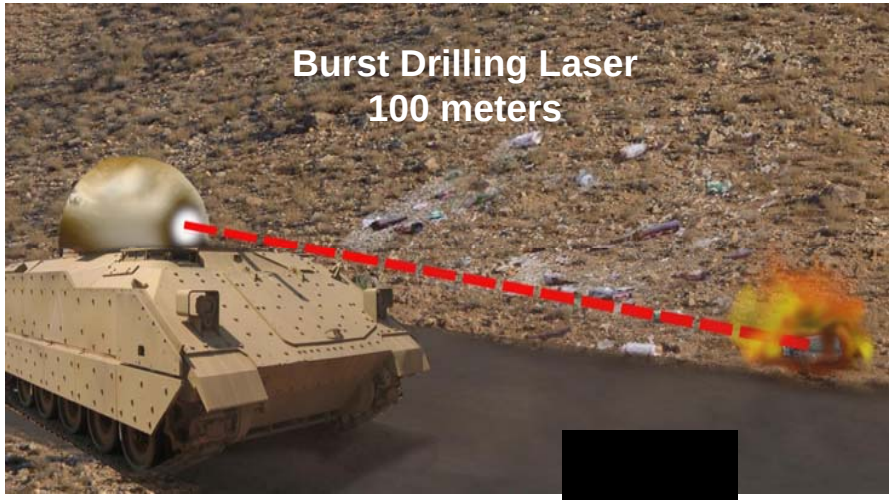
Advanced Technology

NVESD Countermine/CIED ATOs

Army S&T Advanced Technology Objectives (ATOs) form the core of our mission specific research and development portfolio

- Component Development (6.2)
  - Standoff Mine/IED Defeat
  - Sensors for Explosive Detection
  - Standoff Explosive Detection
- Advanced Development (6.3)
  - In Road Mine/Threat Detection
  - Standoff Threat Detection and Neutralization for Route Clearance

Standoff Mine/Threat Defeat Technology (6.2)



Purpose:

Develop ability to pre-detonate/defeat mines/threats at 100m standoff using novel high power long pulse drilling laser technologies, & by improving the accuracy, lethality, & current standoff of a penetrator payload which will be used with fielded launcher system

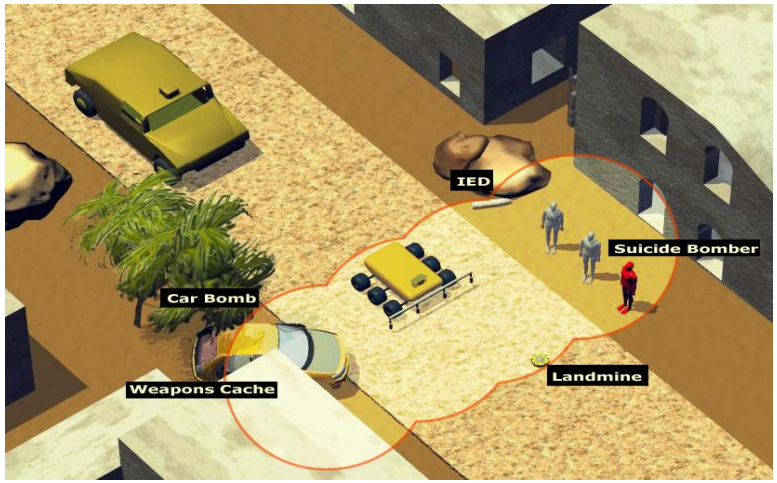
Payoff:

- Force protection and increased Warfighter assured/enhanced mobility and survivability with reduced collateral damage thru accurate point defeat and higher OPTEMPO in threat/mines areas
- Modular defeat solutions for unmanned and manned platforms
- Reduce overall logistical burden through use of regenerable power drilling laser technology
- Regenerable drilling laser technique does not waste assets on false alarms

Novel Techniques for Precision Neutralization

Sensors for Explosive Detection (6.2)

Program Other than ATO (POTATO)



Detection of explosives from threats in ***urban/route clearance missions***

Technology Transition of Fido

Integrated Nomadics Fido XT on iRobot Packbot EOD variant

Purpose:

- *Provide short range standoff capability to detect explosives which is the only constant amongst the various related threats, mines & other threats in high clutter urban environments and along route clearance scenarios*
- *Program will support the user with survivability, increased optempo and improved mobility*

Product:

- *Explosive signature database of threats, landmines and other threats*
- *Brassboard prototype spectroscopic and/or polymer-based sensors* - use in urban areas
- *Models and algorithms to improve sensor response and enhance detection*

Payoff:

- *Detection/confirmation of threats, mine, Car and suicide bombers & weapons cache in complex* urban environment *and on-routes*
- *Survivability, optempo, improved mobility*

FY08 focus will enhance Fido with additional sensor channels and improved detection algorithms.

New Program: Standoff Explosive Detection Technology (6.2)

Program duration: FY08-11

Purpose:

- Pursue ground based detection and confirmation technologies of explosives from standoff distances
- Provide a reliable solution for standoff detection of threats, surface mines & bomb-making facilities in real-time
- Development will focus on emerging non-contact sensing techniques to attain standoff range

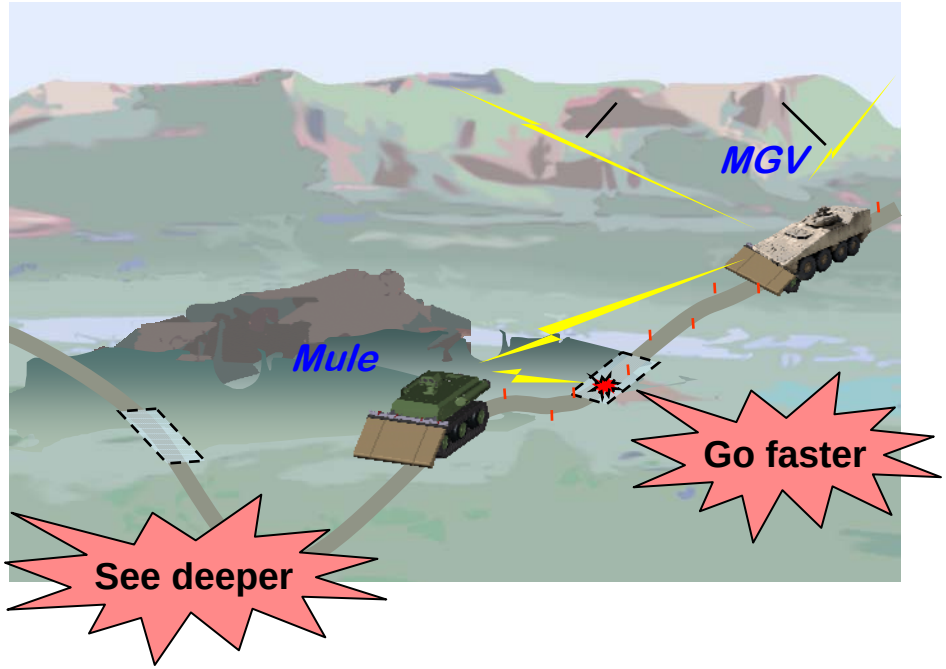
Payoff:

- Standoff explosive detection at safe distances, that provide a rate-of-advance meeting OPTEMPO requirements
- Higher probabilities of detection, and lower false alarm rates, for chemical specific sensors (TNT, DNT, RDX, PETN, HMEs, and other ERCs)

Current	Future
IMS with particle sampling 	**Robotic platform capability** 
Handheld Fido 	**Vehicular mounted system** 
Fido/Packbot 	

Program will focus on maturation of standoff techniques

In Road Threat/Mine Detection (6.3)



Downward looking sensor technology to address a broader spectrum of in road mine and threat threats

Purpose: Demonstrate advanced mine and threat detection capability to address a broader spectrum of in road threats (including deeply buried threats) and higher rates of advance

Product: TRL6 prototypes detection sensors for in road threat and mine threats for modular engineer platforms and FCS

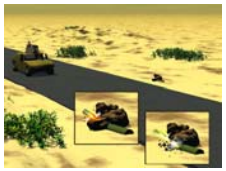
- Low Cost High Speed Metal Detector: Metal detector and signal processing to address inroad metallic threats at tactical speeds
- Advanced GPR For Deep and Shallow threats: Optimized down looking radar and algorithms for deeper threat detection and operation at tactical speeds
- Combined Vehicular GPR/Metal Detector Array: Modular, multimode array of down looking GPR and MD sensors to address a broad spectrum of in road threats

Payoff: Enhanced survivability of US vehicles and forces from in road threats (AT mines and deeply buried threats). Enables higher speed operations for FCS and higher rates of advance for route clearance teams in modular brigades

Standoff Threat Detection and Neutralization for Route Clearance (6.3)

Suite of Counter-threat Sensor and Neutralizer Technologies to Address Evolving Roadside Concerns

Forward Looking Radar



Precision Targeting Grenade

Advanced Radar and RF

Forward Looking EO/IR

Detection and neutralization technologies work together as a system of systems.

Purpose: *Demonstrate and mature threat/mine detection and neutralization capabilities for route clearance vehicles*

Product: *TRL6 prototypes of detection and neutralization technologies that provide effective standoff detection and neutralization of roadside threats*

- *Standoff forward looking sensors: multi-sensor suite includes forward looking radar, harmonic radar, thermal infrared (IR) sensors and other forward looking technologies*
- *Precision Grenade: collaborative effort with ARDEC to mature a shape charge penetrator round for the existing 40mm grenade launcher*
- *Effective system concepts for route clearance*

Payoff: *Enhanced survivability of US vehicles and forces from roadside threats. Higher rates of advance in route clearance.*

Summary

- NVESD serves as the Army's primary laboratory for the development of new countermine and counter-IED technologies (detection and neutralization) and provides engineering support for development and production of countermine systems for US Forces

NVESD Principles of Operation

- Maintain In-house Expertise
- Close Contact with Military User
- Partnership with Industry
- Open to New Technology from All Sources – Leverage DARPA, Other Labs
- Concern with Affordability

Champion the Right Technology for the Soldier