Presented to:
NSRC Industry Day

Agenda
- Penn State Research
- Applied Research Laboratory

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Mission - Penn State is a multi-campus public land-grant university that improves the lives of the people of Pennsylvania, the nation, and the world through integrated, high-quality programs in teaching, research, and service.

- 19,300 Academic and Staff
- 70,100 Undergraduate Students
- 8,400 Graduate Students
- Degrees Awarded (2006-2007)
  - 13,216 (Baccalaureate)
  - 2,104 (Masters)
  - 685 Doctoral
- Major Research University
Penn State Research is ...
As a DoD designated University-Affiliated Research Center (UARC) ARL Penn State…

“…maintains a special long-term strategic relationship with DoD.”

Characteristics of this relationship include:

- Responsive to evolving needs
- Comprehensive knowledge of needs and problems
- Access to information and proprietary data
- Corporate knowledge and technical memory
- Objectivity and independence from commercial interests
- Quick response capability
- Current operational experience
- Freedom from real and perceived conflicts of interest
Applied Research Laboratory
- Locations and Offsite Activities

Keyport Naval Facility
Keyport, WA

Penn State
Electro-Optics S&T Center
Kittanning, PA

ARL Penn State
State College, PA

Distributed Engineering Center
Penn State Fayette Campus

Washington Office
Washington, DC

ARL Tampa
Tampa, FL

ARL KEY
Key West, FL

ARL Hawaii
Oahu, HI

Navigation Research & Development Center
Warminster, PA
Submarine Propulsors
- SSN637 Class Hybrid
- SSN699 Class LA Hybrid
- SSN766 (Mod 25) Hybrid
- SSN720 Superjet/Suprelite
- SSN21 (Seawolf) Class
* Virginia Class
Advanced SEAL Delivery System (ASDS)

Surface Ship Propulsors
- FF 1051 HVD
- CGI ICUP
- CG16 HVD
- DD-21 Pod (Blue Team)

UUV Propulsors
- 21” UUV TVPJ / LMRS / ADUUV
- 38” Seahorse

Torpedo Propulsors
- Mk-50
- Mk-48
- Mk-48 TPU
- Anti-torpedo Torpedo

* Collaboration with NSWC-CD
Applied Research Laboratory
- Anti-Torpedo Torpedo

The Problem

Wake homing torpedo

Anti-Torpedo Torpedo Hardware
Applied Research Laboratory
- Materials and Manufacturing

- **LASCOR**: Laser Corrugated lightweight structural panels installed on the USS Mt. Whitney, saved 20,000 lbs.

- **Seawolf**
  Precision inspections and acoustic diagnostics and prognostics

- **Propulsor Hull Improvement Program (PHIP)**

- **Advanced Seal Delivery System (ASDS)**
  Composite Propeller, Stator

- **Expeditionary fighting vehicle (EFV) Troop Ramp Door**

- **Production Modeling Tools – VCS, CVN-21**

- **DDG 1000 Hull/Superstructure Joint**

- **Laser Processing and Repair facilities established in Navy depots:**
  - NUWC Keyport (torpedo repair)
The Communications and Navigation Office at ARL serves as a research center of excellence in communication technologies, information fusion and processing, navigation science, and visualization in response to naval needs.

In fulfillment of this mission, the Communications and Navigation Office ...

- Performs basic and applied research, exploratory development, and advanced development in support of program sponsors

- Champions the transfer of advanced technologies to naval acquisition programs and fleet operations as well as to other government agencies and the private sector
RADIANT GEMSTONE – Enabling Technologies in Support of National-Tactical Information Operations. Specifically, Develop Technologies to Support the Following Operations:
- Target Tracking
- Indications and Warning

USS Annapolis
Mediterranean Field Test – September 2005

HSV-X1
WESTPAC Field Test – June 2006

Tiger Shark UAV
CONUS Field Test – July 2008

USS Montpelier
Greece (15 Apr 2008) returning from Harry S, Truman Strike Group
Applied Research Laboratory
- High Fidelity M&S/HW in-the-loop
Basic Research

Applied Research

Exponential Tapered Slot Array
Tactical Matched Field Processing – Develop a self-contained single aperture urban geolocation system to support Tagging, Tracking, and Localization of tactical threat emitters. Program will leverage technologies developed on previous research programs:

- Antenna beamforming
- Multipath fingerprinting
- Emitter geolocation
“Smart” Antenna Array – Develop and demonstrate a smart antenna array that can eliminate interference entering the sidelobes by controlling the induced currents of selected elements using materials with electro-optically controllable properties. This program will leverage technologies developed previously for the Navy:

- Genetic Optimization Algorithms
- Electro-optically controllable materials
Small group interaction with integrated COP
- Multi-user touch and gesture activated display surface
- Geospatial visualization and data correlation
- Real-time data feeds
  - Force laydown and status
  - Target tracks
  - Intelligence
  - Weather
Effectively optimized for specific missions and users
- MDA, CN, HD, GWOT

Providing intelligence, operations, and support personnel a means to effectively interact with a horizontally integrated Common Operational Picture (COP)
Problem Statement

• **Objective** – Spatial and temporal characterization of complex social networks by sensing devices that are ubiquitous for:
  - Indications and warning,
  - Event prediction; and
  - Focused sensor/analyst cueing.

• **Research Goal** - Integrate recent technology advances in immersive visualization, sensing of complex social networks, and dynamic modeling of complex social system into an overall system.
Summary of Research

Key Enablers:

- Force Directed Layout using Immersive Visualization
- Derivation of Complex Social Networks using Sensor Data
- Complex Social Network Predictive Classifiers
Figure 1: Al-Qaeda in Afghanistan (purple) has significant links to a large number of other extremist organizations, including Hamas (yellow)
Highlighted are the cell structures inherent in a terrorist network. This represents a group of individuals that are reported together, but rarely with others. FDL captures temporal aspects of networks.
ARL Penn State has a 63-year proud legacy of delivering advanced technology and R&D products to the national defense.

The UARC designation captures our trusted agent status and the strategic relationship that exists between Penn State and the DoD.

Our “track record” is based upon a first principles research approach and integral relationship within Penn State.

ARL fulfills a key role in developing a cadre of engineers and scientists needed for the industry and DoD workforce.

We are working on programs that are critical to current forces and their future capabilities.

**ARL welcomes the opportunity to help solve hard problems of National Importance.**