Mine Warfare S&T
Program Overview

Jason Stack, Ph.D.
Team Lead, MIW & Ocean Engineering Programs
Office of Naval Research

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Overview

Presentation Outline

- ONR & MIW Overview and Strategy
- MIW Applied Research (D&I) Program
- Currently Executing Efforts
  - FNC Program
- Future Directions

MIW S&T Investment Strategy

WHY we Invest

- **MCM Goals**
  - Decrease the tactical timeline
  - Minimize risk to operating forces
- **Mining Goal**: Enable on-demand battlespace shaping

HOW we Know Where To Invest

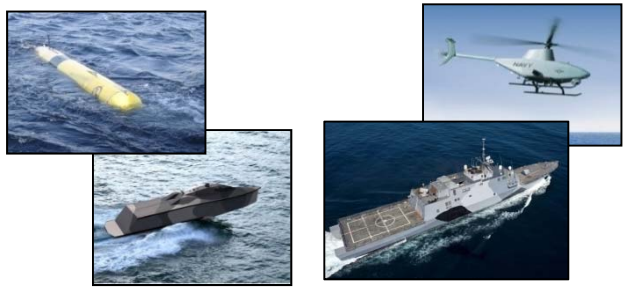
- Support Naval S&T Strategic Plan
- Address TOG-approved Capability Gaps—Informed by MIWIP IPCLs
- Community & stakeholder engagement (e.g., wargames, visits, analyses, etc.)

WHAT we Seek to Achieve with our Investments

- Linear DTE sequence
- Slower & manpower intensive

Transformation of MIW

- Offboard Unmanned Systems
- Distributed and Netted
- Autonomy & Automation



- Parallel / single-pass DTE
- Faster & less risk

MIW Applied Research

Mine / Obstacle Detection

- Sensors, signal processing, and ATR
- Phenomenology, modeling, and prediction
- Cooperative behaviors and autonomy
- Performance estimation

Mine / Obstacle Neutralization

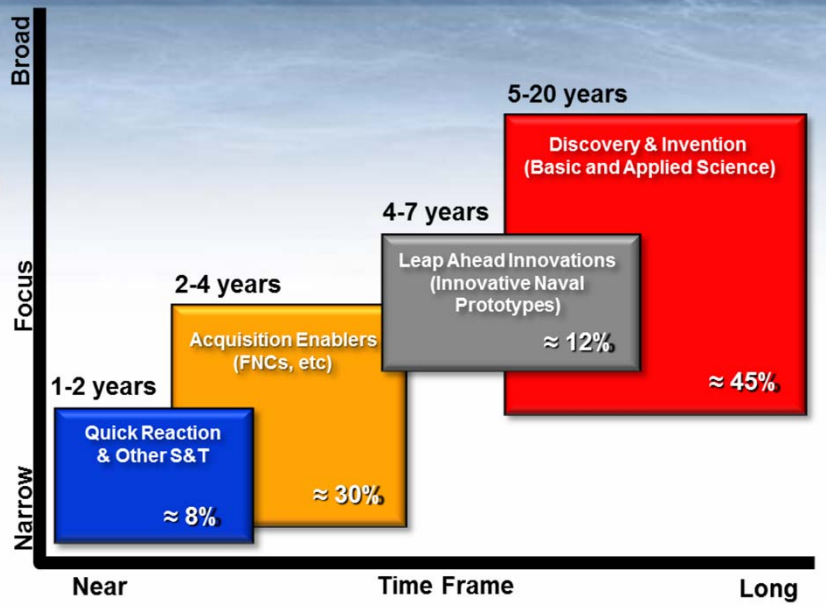
- Minesweeping for modern mines
- Neutralization enablers
- Mine burial (processes & prediction)
- Mine burial effects (lethality & susceptibility)

Mine Technology

- Remote control concepts, advanced D&L
- Modernized minefield theory

Special Warfare / EOD

- Sensors, robotics, and neutralization (e.g., no/low collateral damage)
- Diver technologies



- MIW D&I is from the red box above
- Each bullet at left represents an investment ***portfolio*** (i.e., not a single project)

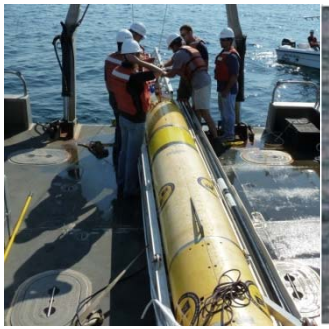
FNC Program
Advanced Sonar Technology

Advanced UUV sensors for high clearance rate MCM

- Sensor fusion to reduce false alarms
- Long range buried mine detection
- Volume mine hunting capability
- Confined area search capability for UUVs
- VSW mine hunting, including buried

Technologies:

- Integrated Forward Looking Sonar and Dual Frequency SAS
- Long Range LFBB Sonar
- VSW Acoustic Color – Imaging Sonar



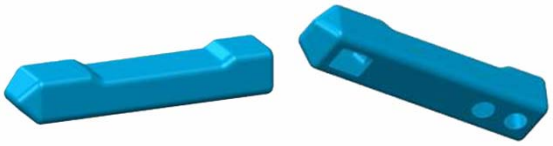
FY15/FY16 Demonstration - FY16 /FY17 Transitions PMS 406 and 408

FNC Program

Compact Modular Sensor & Processing Suite (CMSS)

Compact suite of sensors for single pass detection and real-time classification of drifting and moored mines

- Reduces false alarm rate (FAR)
- Eliminates post mission analysis (PMA)
- In-situ characterization of the environment



Pods for Fire Scout MQ-8C and MH-60S

Technologies:

- Advanced 2D and 3D LIDAR
- Multi-spectral Imaging (MSI) and LWIR
- Synthetic Aperture Radar (SAR)
- Target recognition / data fusion algorithms

Fire Scout MQ-8C

MH-60S

Transitions to ALMDS in FY18

FNC Program

Single Sortie Detect To Engage

Mine Countermeasure (MCM) detect-to-engage in a Single Sortie

- Accelerates the MCM timeline
- Reduces risk to the warfighter
- Reduces sailor workload

Automated UUV Deploy & Retrieve System

UUV Charge & Data Download

Technologies:

Technologies for an Advanced Expendable Mine Neutralizer

- USV-based launch and recovery of multiple UUVs for search, identification, and neutralization
- Automated UUV charging, data extraction, information processing, and re-planning
- Low-cost, expendable UUV for reacquisition & mine neutralization
- Architecture, autonomy, and automation to enable USV-UUV cooperation and overall system supervision by remote operator

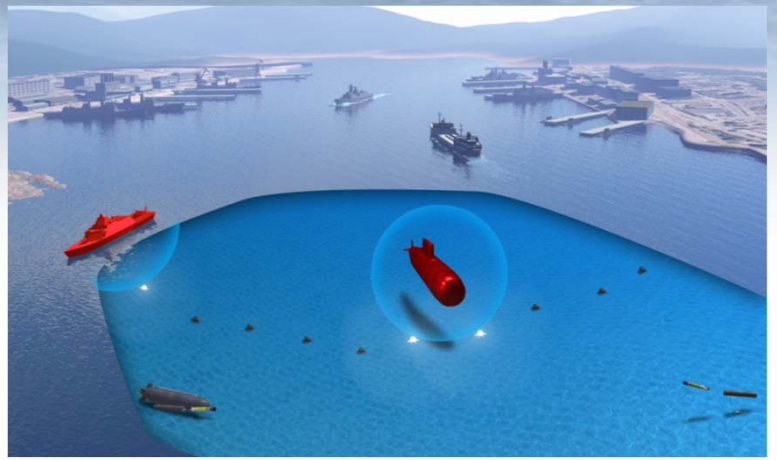
FY16 Initial Demo - FY17 Full demo - FY 18 Transitions PMS 495, 406 and 408

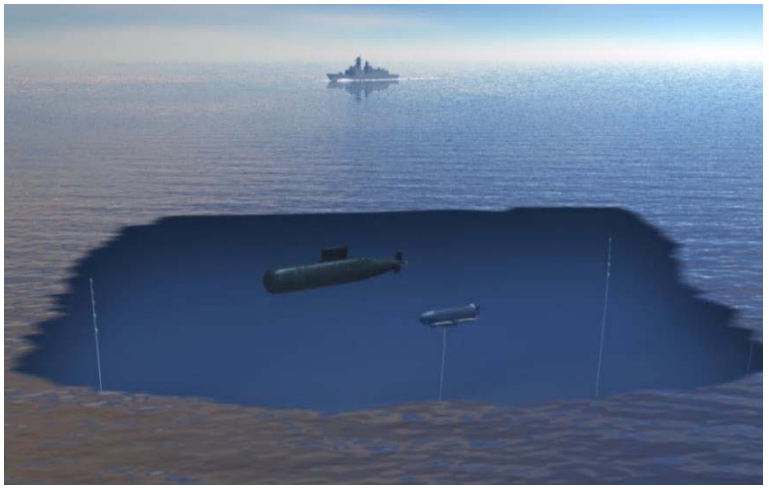
FNC Program

Advanced Undersea Weapons System

Unmanned sensors, weapons and communications nodes

A cost effective battle space shaping system that provides a tactically flexible asymmetric capability to deter and restrict the mobility and access of adversary forces





Technologies:

- Tactical Positioning and Fire Control
- Remote Command and Control (RECO)
- Autonomous Threat Discrimination & Localization

FY17 Initial Demo - FY18 Full demo - FY 18 Transitions PMS 495 and 406

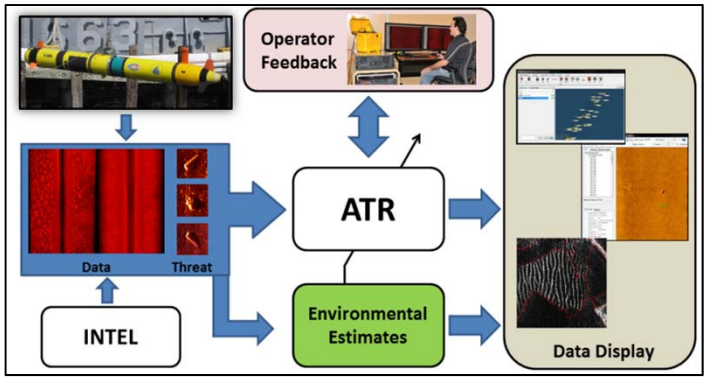
FNC Program
Automation of UxV-Based MCM

Improved MCM planning tools & Automatic Target Recognition

- Automated MCM planning/re-planning
- Accelerated sensor data analysis
- Squadron-level performance estimation

Technologies:

- Capability to plan/re-plan to desired risk
- Common operating picture for diverse MCM assets
- Dynamic asset rescheduling & deconfliction
- In-situ MCM sensor performance prediction
- Environmentally adaptive ATR algorithms



FY19 Initial Demo – FY20 Full demo – FY20 Transitions PMS 495 and 408

FNC Program

Autonomous USVs for MIW

Technical Description

1. Autonomous avoidance of fixed and moving hazards
2. Magnetic mine influence system for use on Unmanned Surface Vehicles (USVs).
3. Automated underway refueling system for USVs and RMMV.

S&T Focus

- ONR "CARACaS" perception and route planning autonomy components
- Magnetic influence sweep payload for USVs with greater magnetic dipole moment per weight than currently possible
- Underway refueling and data transfer system capable of operating with no personnel on-board platform to be refueled.

Warfighter Payoff

- Improvements in area clearance rate via continuation of USV operations during comms dropouts and in SS-3; greater magnetic dipole moment and reduced refueling timelines
- Enables use of low-bandwidth comms and reduces human operator workload

FY21 Transition to PMS 406

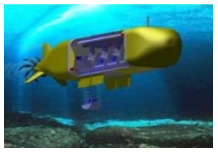
Future Directions

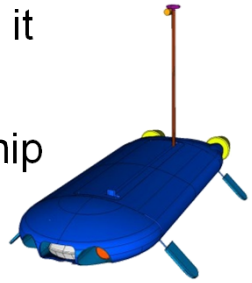
Mission Area Drivers

1. Many-sortie missions: Fully autonomous intra-sortie but heavy, rich human-machine between-sortie interactions
2. Long-duration missions: Multiple missions & goals per sortie; sortie time >> a priori environment and threat estimates and > system reliability & typical survivability profile

Future Capability Areas

- Systems of systems
  - MCM: e.g., USVs launching & recovering UUVs and coordinating with UAVs to decrease the tactical timeline
  - Environmental characterization: Make more organic & more automated
- Trust
  - Individual: Will operators use it
  - Institutional: Will establishment field it
- Novel Platforms (non-torpedo shaped)
  - Optimize platform-payload relationship
- Modularity, reconfigurability, endurance

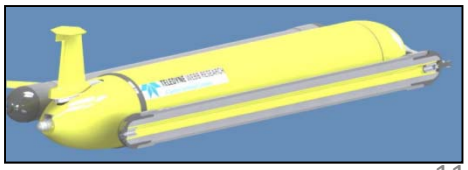




Future Technology Areas

Key Foci: Autonomy, automation, & systems of systems)

- Performance estimation
- Environmental adaptation
- Interactive perception
- Temporally non-myopic planning / re-planning
- Warfare domain-specific doctrine modernization (i.e., today's doctrine relies fully on SMEs to instantiate)



Questions

It is not the strongest nor the most intelligent that survives.
It is the one that is the most adaptable to change.

—Charles Darwin