



Technology Innovation for Naval Warfighting

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Distribution Statement A: Approved for public release

O F F I C E O F N A V A L R E S E A R C H



Office of Naval Research Global

MISSION

Obtain, coordinate & make available
worldwide scientific information



VISION

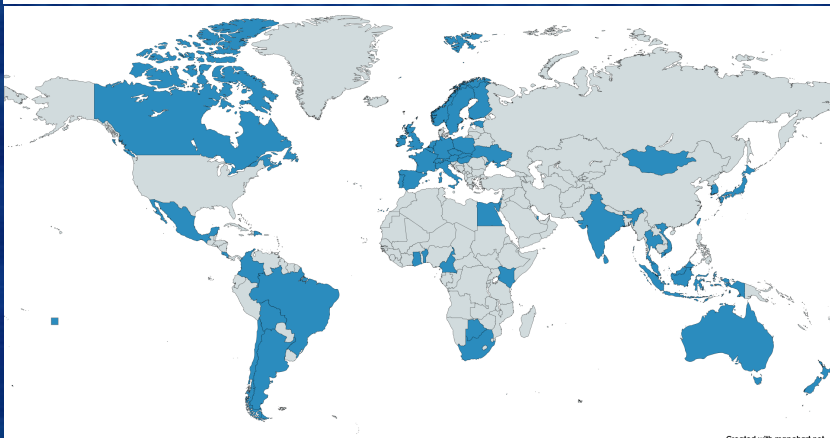
Be the partner of choice for
S&T leaders



Connecting 4000+ People

> 1000 Partners

Engagement in 54+ Countries



Departments

INTERNATIONAL SCIENCE

INTERNATIONAL ENGAGEMENT

SCIENCE ADVISOR PROGRAM

EXPERIMENTATION AND ANALYSIS

FOREIGN COMPARATIVE TEST

TECH SOLUTIONS

LONDON TECH BRIDGE

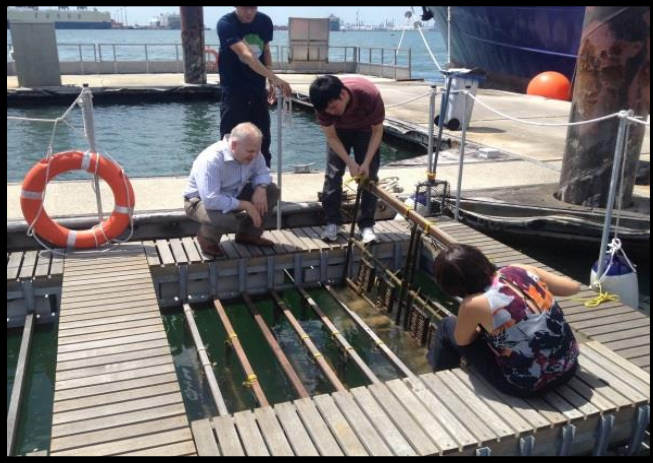
Naval Research Enterprise (NRE)



Global Presence



Trusted Partnerships



International Science

24 Science Directors deployed in seven sites worldwide to find the best science and connect it to the Naval Research and Development Establishment

ACADEMIA AND LABS



Science Advisors

25 Science Advisors embedded in Navy and Marine Corps HQ staffs to connect the warfighter to the Naval Research and Development Establishment

DEPT OF NAVY FLEET & FORCE



International Engagement

Developing and maintaining US Navy military to military science & technology relationships with international partners

S&T MILITARY TO MILITARY

Trusted Partnerships



Experimentation & Analysis

Explore new technology capability limitations, develop operational concept possibilities and analyze science and technology.

FLEET/FORCE



TechSolutions

Rapid-response science and technology program focused on producing prototype solutions to problems submitted by Sailors and Marines.

SAILORS AND MARINES



Foreign Comparative Test

Identify and test foreign capabilities and technologies for enhanced warfighter lethality, effectiveness, readiness and protection.

INTERNATIONAL DEFENSE



International Science

Global Technology Awareness (GTA) Visits

Attend international events & visit international institutions to discover cutting edge S&T

Visiting Scientist Program (VSP)

Support travel of foreign scientists to the US to socialize new S&T ideas or findings with the NRE

Collaborative Science Program (CSP)

Support international workshops & conferences of Naval interest

International Research Grant

Fund innovative international S&T & connect researchers to ONR programs and US researchers

Global-X Challenge

Seek potentially game-changing multidisciplinary technology concepts from international research teams

Science Directors

- Identify disruptive S&T
- Initiate and manage grants
- Link international scientists with NRE
- Provide global presence
- Expand network of global innovators and technologists



Collaboration tools

Small early investments can lead to significant results

DISCOVER & CONNECT

A world map where countries are colored either blue or light gray. Blue countries include Canada, Mexico, Brazil, Argentina, Chile, Peru, Colombia, Venezuela, Ecuador, Bolivia, Paraguay, Uruguay, Cuba, Haiti, Dominican Republic, Puerto Rico, Greenland, Iceland, Norway, Sweden, Finland, Denmark, Germany, Poland, Czech Republic, Slovakia, Austria, Hungary, Switzerland, Italy, France, Spain, Portugal, Greece, Turkey, India, Pakistan, Bangladesh, Sri Lanka, Nepal, Bhutan, Myanmar, Thailand, Laos, Cambodia, Vietnam, Philippines, Malaysia, Singapore, Indonesia, Brunei, Timor-Leste, Australia, New Zealand, Japan, South Korea, North Korea, China, Mongolia, Kazakhstan, Kyrgyzstan, Uzbekistan, Turkmenistan, Georgia, Armenia, Azerbaijan, Belarus, Ukraine, Russia, and others. Light gray countries include the United States, Canada's northern territories, Alaska, Hawaii, Mexico's southern states, Central American countries, Caribbean islands, most African countries, Middle Eastern countries, Iran, Afghanistan, Tajikistan, China's Xinjiang and Tibet regions, and others. The map illustrates the global reach of the research grants, covering all continents except Antarctica.

0 liaison visits across
4 countries

6 Visiting Scientists from
9 countries

2 Supported workshops
25 countries

48 New International Research Grants
(48 Institutions in 24 Countries)

- ## 48 New International Research Grants (48 Institutions in 24 Countries)

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Sample S&T Focus Areas

WARFARE



Warfighter Performance

- Biotechnology / Bioengineering
- Cognitive / Neural Sciences
- Training Technologies
- Health Protection



Expeditionary and Irregular Warfare

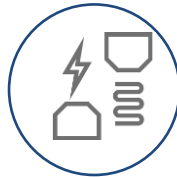
- Situational Awareness
- Decision Making
- Mobility / Logistics
- Soldier Protection



Autonomy and Unmanned Systems

- Robotics
- Machine Learning / AI
- Perception
- Human Machine Interface

POWER



Power Projection and Integrated Defense

- Directed Energy
- Energetic Materials



Power and Energy

- Renewable Energy
- Propulsion
- Power Control
- Thermal Management
- Hypersonics

ADDITIONAL FOCUS AREAS



Electromagnetic Maneuver Warfare

- EM Propagation & Waveforms
- Sensors and Electronics
- Optical Systems



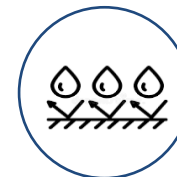
Information Dominance / Cyber

- Communications / Information Technology
- Computer Science
- Mathematics / Data Analytics
- Quantum Science



Access to Maritime Battlespace

- Ocean/Atmospheric Sciences
- Underwater Acoustics
- Ocean Sensing



Platform Design and Survivability

- Air/Surface/Subsurface Vehicles
- Materials
- Corrosion / Biofouling
- Manufacturing Technologies

<https://www.nre.navy.mil/our-research/onr-technology-and-research>

2024 Global-X Challenge

MULTI-NATIONAL CHALLENGE



\$750K
9 Months AWARD

To encourage multi-disciplinary science and technology partnership in naval-relevant topics.

3 CHALLENGE TOPICS

Subsea Object Detection and ID (Underwater & Seabed)

Detect objects of any material and scale; Objects may be moving or stationary, wholly immersed within the water or seabed, or on the seabed surface; ID will occur at near real-time; Operate in all salinity and in high turbidity

Personal Expeditionary Power & Energy

Power density >1000 W/kg & energy density >=5000 Wh/kg; Man-portable; Low Hazard; Long-life, quick charge, reusable and recyclable; May be weight bearing and incorporated into structures

High Latitude High Bandwidth Communications

Enables voice and 5MBPS data communications in the air, on land, ice and sea surface in latitudes above 60°; Operates with low power at -55°C at >25km range in minimum visibility conditions

Significant Dates and Times

Event	Date	Time
White Paper Submission Date	3 Apr 2024	23:59 Eastern Daylight Time (EDT)
Notification of White Paper Valuation*	29 Apr 2024	17:00 EDT
In-Person Teaming Workshop**	16-17 May 2024	
Full Proposal Submission	3 Jun 2024	23:59 EDT
Notification of Selection: Full Proposals *	21 Jun 2024	17:00 EDT
Grant Awards *	14 Jul 2024	17:00 EDT

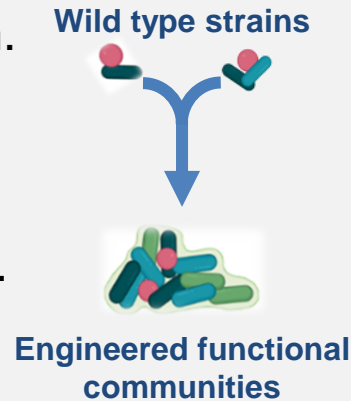
* These are approximate dates

**By invitation

Engineered Biofilms with Modular Functionality for Persistent and Survivable Naval Platforms

Technical Objectives:

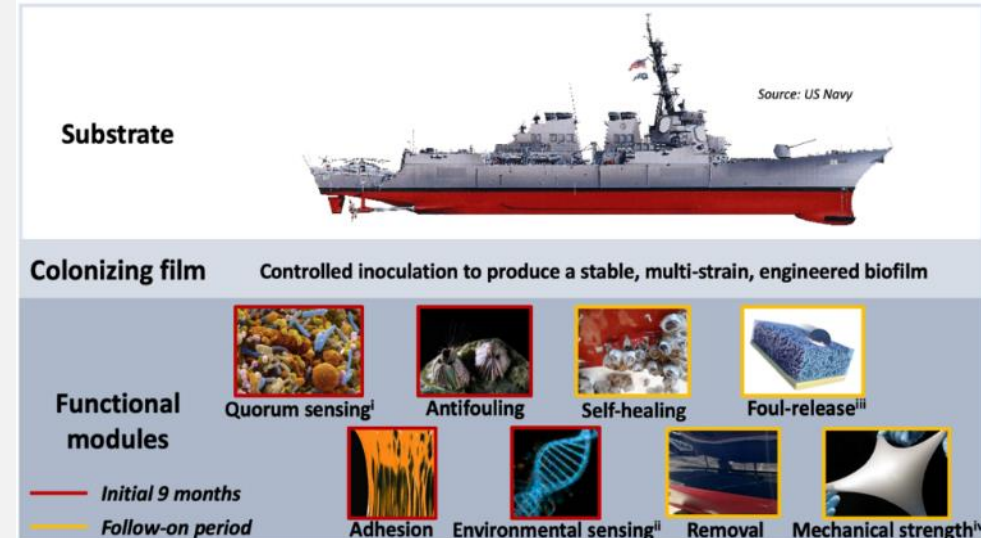
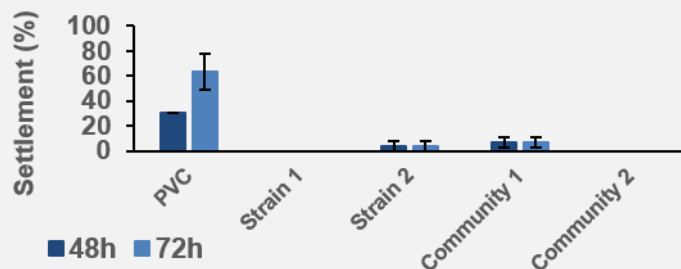
- 1) Engineer a stable, synthetic biofilm.
- 2) Obtain control of the biofilm using precise genetic manipulation.
- 3) Develop functional modules to control film invasion and biofouling.
- 4) Evaluate the film as an environmental sensor.



Potential Impact: Replace traditional synthetic hull coatings and associated maintenance regimes.

Approach: Artificial bacterial communities were assembled from wild-type strains by selecting for **1)** community compatibility and **2)** enhanced biofilm formation.

Demonstration: Two strains and two communities effectively prevented barnacle settlement over 72h.



(Image credits: i) Matcher et al. 2018. *Estuarine, Coastal and Shelf Science* 200:224-233. ii) New Scientist. iii) Wyss Institute, Harvard University. iv) Carnegie Mellon University.)

Performers: N. Aldred, T. McGenity, B. McKew, M. Burmolle, C. Amador, D. Karig, M. Guell,

Institutions: University of Essex, Univ of Copenhagen, Clemson Univ, Universitat Pompeu Fabra

Countries: UK, US, DK, ES

Period of Performance: Oct 2020 – Apr 2022

ONRG Point of Contact: scott.a.walper.civ@us.navy.mil

Transition Partner: DARPA

Development of a Novel Underwater Muometric Positioning System (muPS)

2021 Global-X Challenge Area:

Positioning is challenging at high latitudes due to a dearth of visible satellites, and especially so underwater

Technical Objectives:

- (a) Development of the timing system for measurement validation
- (b) Integrate the detector and timing systems into a surface based detector system and a roving detector system (whose position is to be found)
- (c) Undertake testing of the combined systems

Approach:

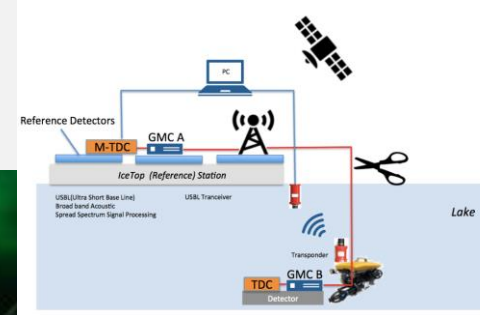
Develop a flexible, robust and deployable muPS system to be tested in a variety of environments.

Proof of Concept Demonstration:

- (a) Develop timing system for validation
- (b) Integrate the detector and timing systems
- (c) Conducted successful demonstrations in dense urban (Jan 2023), underground (Mar 2023) and high latitude underwater (Apr 2023) environments

Potential Impact:

GPS-like quality positioning at high latitudes



Performers:

C. Steer, L. Thompson; S. Miyamoto, H. Tanaka; M. Holma; L. Freitag; S. Steigerwald

Institutions:

Geoptic; NEC; Muon Solutions; Int'l virtual Muography Institute; Woods Hole Oceanographic Institute

Countries:

UK, JP, FI, US

Period of Performance: Oct 2021 – May 2023

ONRG Point of Contact: charles.r.eddy12.civ@us.navy.mil

Potential Transition Partner: Industry



USNAVSOUTH/FOURTHFLT Unmanned Campaign



CNO task to Commander, FOURTHFLT.

Mission

The USNAVSOUTH/FOURTHFLT Unmanned Campaign provides the Navy a theater to operationalize unmanned systems in a permissive environment, develop TTPs against near-peer competitors, refine manned-unmanned C2 infrastructure, and inform the CNO's hybrid fleet of the 2030's.

Beyond FY23 Initiatives

- Enhanced Maritime Domain Awareness: Persistent, integrated & distributed
- Combat Logistics: Unmanned logistic delivery
- Kill Chain Integration: Find – Fix – Battle Damage Assessment
- Partner Nation: Expanding activities with key partner Navies



Fleet Experiments



Unmanned Fires / Battle Damage Assessment (BDA)

1. USV – CUSV with Poniard rocket (PMS420 / South Korea)
2. UAS – Aerosonde targeting and BDA with Minotaur (PMA263 / PMA280)



Unmanned Contested Operations At-sea

1. UAS – FVR-90 acoustic detect-and-avoid (USCG RDC / ONR / NAVAIR)
2. UAS – FVR-90 intelligent, autonomous navigation computer vision (DIU)
3. UAS – Skyways intelligent, autonomous navigation computer vision (DIU)
4. UAS – Transwing autonomous computer vision (NAWCAD / DARPA)
5. USV – Logistics USV (OSD(R&E) / MCWL)
6. USV – OceanAero Triton (NSWC PCD)



Unmanned Target Following

1. UAS – Jump20 organic ISR detect-and-cue USV (Industry)
2. USV – CUSV autonomous target following (PMS420 / PMS406)



Survivability / Sustainment

1. Assured PNT with GPS jamming (NIWC Pacific / NAVAIR SBIR)
2. Low-profile target detection (NAVAIR SBIR)
3. ASSIST/VISION Autonomy enhanced force protection system (Industry)
4. Augmented reality combat repair using Starlink (PMA260 / COMFRC)

