



Naval Postgraduate School
Foundation

NAVAL POSTGRADUATE SCHOOL IMPACT

Ongoing Research & Solution Development



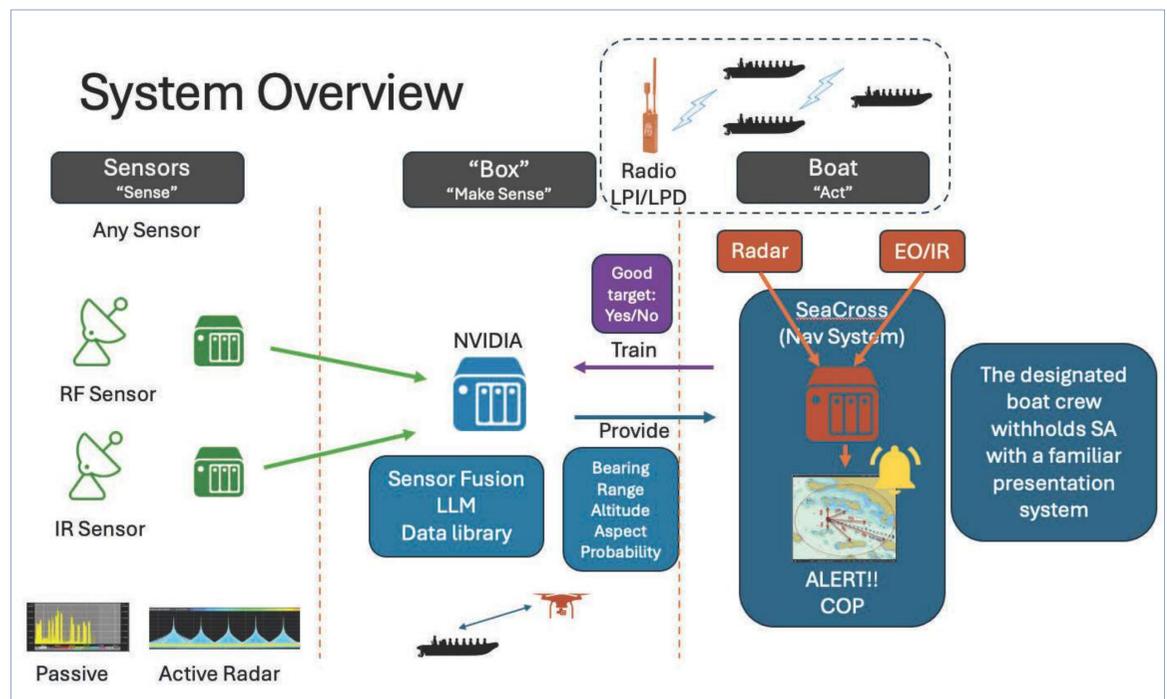
Passive cUAS System Supporting Maritime SOF Operations

SOF maritime insertion missions face increasing threats from small drones, which are challenging to detect passively. These drones can compromise mission security, expose operators, and disrupt operational tempo.

THE PROJECT

We developed a small-form-factor, standalone, omnidirectional counter-UAS suite designed to detect Class-1 UAS threats. The system integrates passive EO/IR, RF, acoustic sensors, an LPI/LPD radar with an onboard fusion engine linked to a navigation GUI. AI algorithms fuse multi-sensor data, refine real-time models, and update threat libraries as adversary tactics evolve.

Operating autonomously, it correlates cues in real time, flags threats on a map display, and incorporates operator feedback and updates global model post-mission. All sensing and processing remain onboard—no external networking—while strict SWaP demands are met using existing power sources. The architecture is vendor-agnostic and modular.



Autonomous detection and alerting – no need for EW SMEs in the boat.



Sensor agnostic – the user can integrate sensors according to their needs.



Non-proprietary – enables continuous frontline iteration.



Seven companies are involved in the project.



Reduced cost relative to current cUAS systems.



Operator feedback updates model

COLLABORATORS

NPS Departments: Physics, Defense Analysis, Information Sciences, Systems Engineering, Office of Research & Innovation



The appearance of external organization logos does not constitute endorsement of other organizations or their products and services by the Naval Postgraduate School, the Department of the Navy, or the Department of Defense.

DELIVERING IMPACT

This AI-driven system integrates seamlessly with existing platforms to elevate domain awareness and accelerate threat response in denied or constrained environments. It reduces detection latency, improves detection accuracy, and enables rapid geolocation for evasion—raising survivability by providing a Common Operating Picture. Together, these effects enhance the operational effectiveness of SOF missions in modern contested spaces.



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Sponsor:
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QuantumLeap: Simulate. Predict. Deploy. Digital Twins for Quantum Sensing

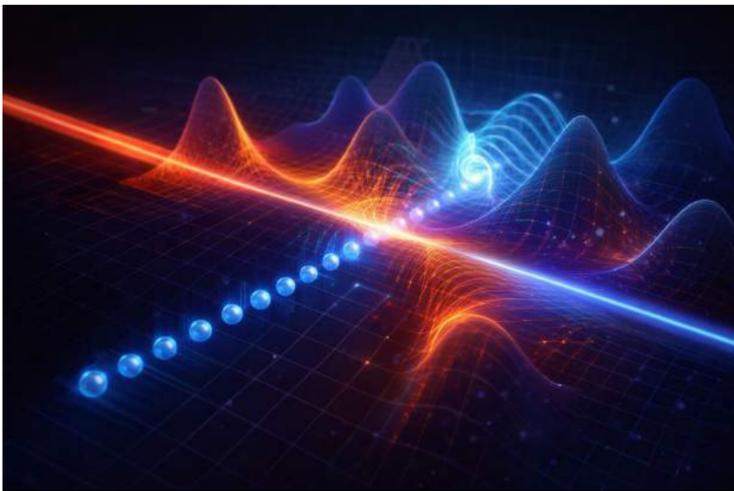
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THE CHALLENGE

Designing and validating quantum sensors has historically been slow, hardware-intensive, and narrowly constrained by what can be physically built and tested. This limits exploration of new sensor architectures, atomic species, and operational concepts, particularly for defense applications that must operate in dynamic, contested environments.

THE PROJECT

QuantumLeap is a Naval Postgraduate School initiative to build a community-standard digital twin platform for quantum sensing. By combining high-fidelity physics modeling with AI and accelerated computing, the platform connects theory, simulation, and experimental validation into a unified framework. Researchers can simulate complex quantum system behavior, predict performance under real-world conditions, and reduce risk before physical deployment.



SEEKING

- Funding
- Research Partnerships
- Data Sharing

DELIVERING IMPACT

QuantumLeap shifts quantum sensor development from isolated, artisanal efforts to a scalable, networked capability. The platform accelerates transition from concept to operational use, enables collaboration across government, academia, and industry, and positions NPS as a central hub for advancing quantum sensing aligned with naval and joint operational needs.



The NPS CIRPAS Airborne Research Facility

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THE CHALLENGE

Naval and Marine Corps operations depend on accurate understanding of atmospheric and oceanic conditions, particularly in maritime and littoral environments. Environmental effects directly impact sensing, communications, navigation, and weapons performance, but existing models, and military/scientific systems, require real-world data for validation.

THE PROJECT

The NPS CIRPAS Airborne Research Facility provides a dedicated, manned airborne research capability to support atmospheric and oceanographic research, and RDT&E of military/scientific systems for the Department of Defense, the Naval Postgraduate School, and the broader research community.

The facility operates a specially modified Twin Otter aircraft equipped with a comprehensive suite of scientific instrumentation designed to study the marine boundary layer, sea surface conditions, aerosols, clouds, and radiative properties.

CIRPAS supports research, development, testing, and evaluation of military and scientific systems by providing flight operations, instrumentation integration, and in-house engineering and certification support. The aircraft enables data collection from near the sea surface up to high altitude, supporting experiments that cannot be replicated through ground-based or simulated environments alone.



NPS Airborne Research Facility 'CIRPAS' Overview

What we do:

The NPS CIRPAS Airborne Research Facility conducts and supports airborne scientific research for:

- Office of Naval Research (ONR)
- DOD (Navy, Marines, Army, Air Force)
- The broader scientific research community
 - (NASA, NSF, UC-Berkeley, U. of Arizona, Caltech, etc.).



Technical capability:

We provide:

- Manned research aircraft
- A suite of airborne scientific instrumentation
- Scientific/flight/logistical support

for projects focused mainly on atmospheric and oceanographic science, and RDT&E of military/scientific systems.

Facility Instrumentation



Nose: Temperature, Dew Point, Pressure (Static, Dynamic Sideslip Attack angle), GPS/INS, IR Temperature, Liquid Water Content, Aerosol Inlet

Fuselage: Solar/IR radiometers



Wings: CAPS, PCASP, CDP
Hard points and pods for 'research' or 'guest' instruments



Cabin: Nephelometer, Sootphotometer, CPCs, UFPCP, Data System Racks for 'Research' and 'Guest' Instruments. Satcom system



NPS-CIRPAS Aircraft Overview Twin Otter DHC-6-300 (UV-18A)



- Research Capacity: 1500 lbs (aircraft is unpressurized)
- Research Power (DC): 5600 W at 28 VDC
- Research Power (AC): 4000 W 115 VAC 60 Hz
- Speed: 100-140 kts
- Minimum Altitude: 100 ft over the ocean with good visibility
- Practical Ceiling: 18,000 ft
- Duration: 3-5 hours

SEEKING

- Research Partnerships
- Prototyping and Experimentation
- Education Partnerships
- Funding Opportunities

DELIVERING IMPACT

CIRPAS delivers critical airborne observations that improve environmental modeling and support evaluation and testing of electromagnetic, electro-optical, and high-energy laser systems. The facility enables real-world testing that strengthens confidence in operational predictions and accelerates transition from research to use.



Next Generation Underwater Breathing Apparatus (UBA) for Naval Special Operations (Navy EOD)

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THE CHALLENGE

Navy Explosive Ordnance Disposal, Naval Special Warfare, Navy Divers, and the U.S. Marine Corps continue to rely on the MK 16 Mod 1 Underwater Breathing Apparatus, a system fielded in the 1990s. While reliable, the MK 16 Mod 1 no longer meets the demands of modern mine countermeasure and special operations missions. Current operational environments require divers to operate with minimal acoustic and magnetic signatures while integrating more closely with Remotely Operated Vehicles and other unmanned systems. The lack of modern sensing, adaptability, and modularity limits mission effectiveness and increases operational risk in contested undersea environments.

THE PROJECT

This project explores the development of a next-generation Underwater Breathing Apparatus to replace the MK 16 Mod 1 through a make, make-or-modify, or buy analysis. The effort evaluates a modular, multi-service UBA design that incorporates modern materials, embedded sensing, and intelligent gas management to support evolving underwater mission profiles. The project also examines how increased use of Remotely Operated Vehicles may reduce depth requirements and enable new diver-ROV operational concepts, informing future tactics, techniques, and procedures.



Underwater EOD (UWEOD)

Mission:

- (1) Rapidly develop and deliver AI-powered technologically advanced material solutions to the globally dispersed Expeditionary MCM force
- (2) Reduce MCM & MHD timelines for forward deployed forces
- (3) Facilitate reduced risk to operational assets through properly planning, executing and evaluating tactical employment of UW systems.

Systems:

- Diver Safety and Life Support (DSL5)
- Underwater EOD (UWEOD) Systems
- Unmanned Undersea Vehicles (UUV) Systems
- Marine Mammal Systems (MMS)
- Sustainment for Naval EOD Forces UW Tools and Equipment

Resource Sponsors: OPNAV N95, N97
Requirement Owner: OPNAV N95

ACAT IV:

- MK 18 Mod 2 Inc I UUV
- MK 18 Mod 2 Inc II UUV
- MK 18 Mod 4 Viperfish (ECP to Mod 2)

AAP:

- MK 18 Mod 1 UUV
- MK 18 Mod 3 Lionfish (ECP to Mod 1)
- MESR Increment I
- MMUBA (Multi-Mission Underwater Breathing Apparatus)
- Strident

Other:

- MMS (MK 7/MK 5) – Care & Feeding
- MK 20/21 EOD Response Remotely Operated Vehicle (ROV)

Images: MK 18 Mod 1, MK 18 Mod 2, Lionfish, Viperfish, MK 20 & MK 21 Response ROV, MESR, MK 5 & MK 7 MMS, Multi-Mission UBA Candidates, STRIDENT

SEEKING

- Seeking
- Funding Opportunities
- Prototyping and Experimentation
- Research Partnerships
- Data Access and Sharing
- Education Partnerships

DELIVERING IMPACT

This research supports a modernized, multi-service UBA that enhances diver safety, stealth, and operational effectiveness. By reducing magnetic and acoustic signatures and integrating real-time health and system monitoring, the proposed approach improves survivability and mission success in mine countermeasure and special operations missions. The project also enables improved human-machine teaming by aligning diver capabilities with increased ROV use, reducing risk while preserving critical human decision-making underwater. Long term, the effort supports greater interoperability, reduced maintenance burden, and improved readiness across Navy and Marine Corps undersea forces.



Data Science @ NPS

Rapid Capability Development Supporting NATO & Ukraine

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By integrating operational lessons learned in the Ukraine-Russian conflict and advanced analytical methods into multinational training, education, and decision support, the U.S. military can enhance decision-making in degraded, ambiguous environments and translate observation into operational advantage.

THE PROJECT

NPS Operations Research student team developed an **interactive decision-support tool** for near-real-time analysis of enemy asset location and operational patterns.

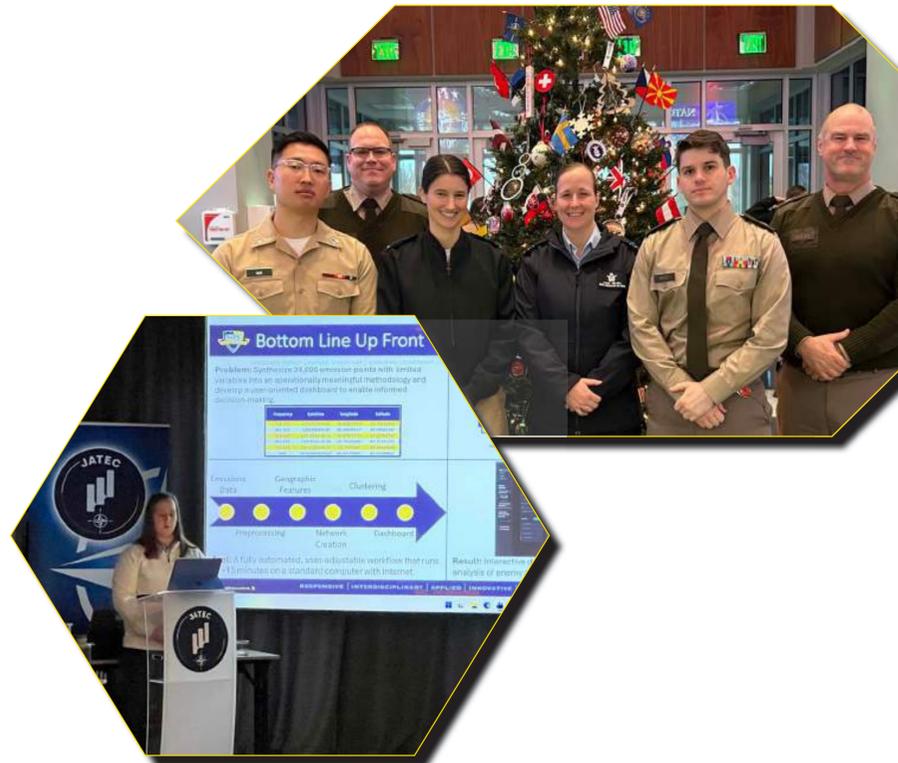
FASTCAT (Frequency-based Algorithm for Spatial and Temporal Clustering Analysis with Thresholds) uses machine learning, in combination with geohashing and a novel clustering algorithm, to reveal relationships and uncover insights.

» **Briefed final analytical findings to Supreme Allied Commander Transformation (SACT)** at NATO Allied Command Transformation (ACT)

» **Presented at Joint Analysis, Training, and Education Centre (JATEC)'s workshop:** "Enhancing Analytical Processes through Modern Information Technology, Artificial Intelligence, and Machine Learning Solutions"

SEEKING

» Students & Interns



COLLABORATORS

NPS students and faculty from Operations Research (OR) Dept. & Data Science and Analytics Group (DSAG)



DELIVERING IMPACT

NPS delivered the tool and underlying source code to NATO and Ukraine counterparts. It is now directly supporting operations in the ongoing Russian-Ukrainian conflict. The work demonstrates how applied defense analytics developed at NPS are on par with industry-best data-driven decision-making tools and inform multinational operational challenges, assessment processes, and analytic modernization efforts.



Optimizing Synthetic Data Training for High Energy Laser Targeting

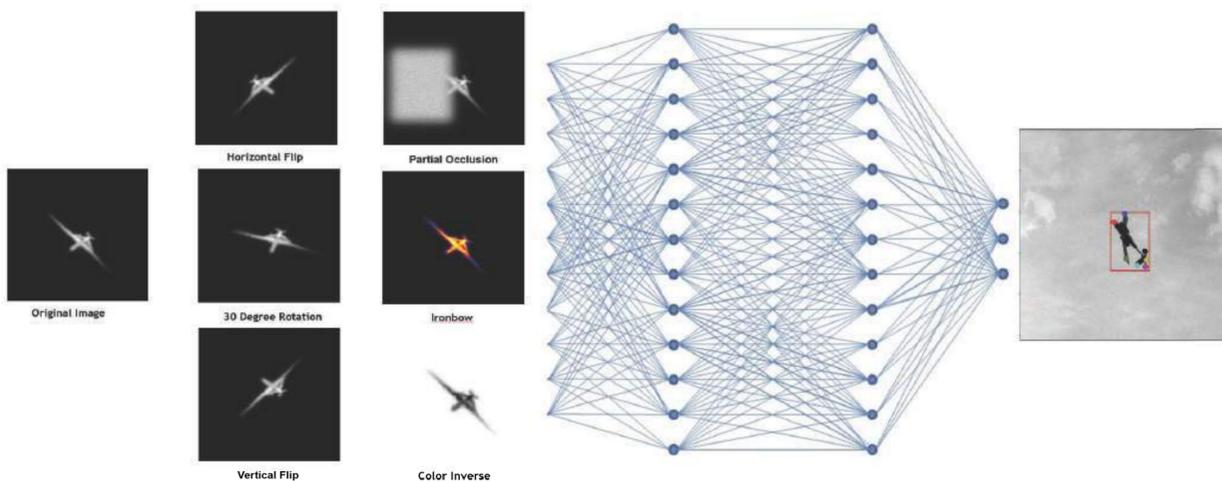
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THE CHALLENGE

High Energy Laser systems rely on computer vision to detect, track, and engage airborne threats. In operational settings, large, high-quality training datasets are rarely available. Limited real-world data, combined with sensor noise and degraded imagery, reduces model accuracy and reliability for precision targeting.

THE PROJECT

This project evaluates deep learning approaches for UAV keypoint detection and pose estimation using synthetic data and aggressive data augmentation. Multiple neural network architectures are trained on a limited dataset that is expanded through augmentation techniques such as blur, noise, compression artifacts, and targeted occlusions. Distributed GPU training enables rapid scaling and evaluation of models designed to improve robustness under realistic sensing conditions.



SEEKING

- Research Partnerships
- Data Access and Sharing

DELIVERING IMPACT

This work demonstrates how synthetic data and augmentation can produce accurate, resilient computer vision models with limited real-world training data. The results support more reliable High Energy Laser targeting in degraded environments and reduce data collection requirements for operational systems.



Critical Thinking & Strategic Foresight in the AI Era

THE CENTRALITY OF HUMAN-MACHINE COLLABORATION AND TEAMING

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As we progress further into the AI Era, the centrality of human machine collaboration and teaming becomes increasingly important to warfighters and warfighting. This includes understanding the potentials and limits of AI, and when and where AI can augment human thinking.

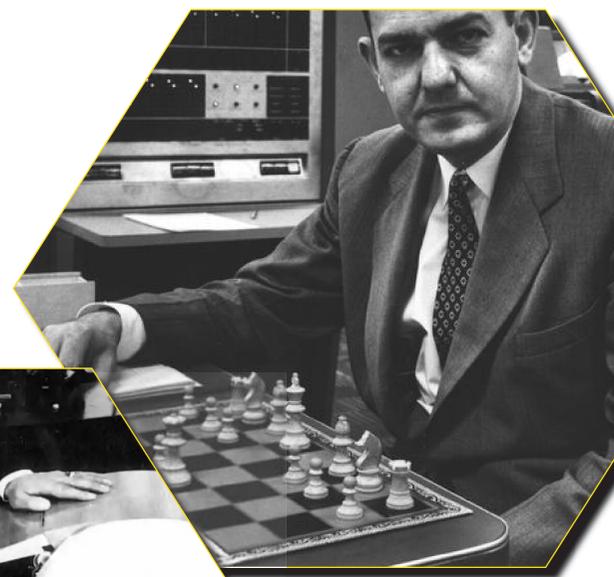
THE PROJECT

This project will develop an interdisciplinary understanding of human-machine teaming and collaboration through hypothesis and experiment/analysis, in order to shed light on when and where to use AI in warfighting decision making.

Deliverable: teachable lessons and workshops on strategic foresight

SEEKING

- » Funding Opportunities
- » Research Partnership
- » Students & Interns



Take the NPS Short Course:

Critical Thinking for Human-Machine Collaboration & Teaming

Provided by the NPS Office of Warfare Studies & the NPS AI Task Force

Learn more & register: Contact meaugier@nps.edu & rgpugh@nps.edu

DELIVERING IMPACT

The effort develops military and civilian leaders who can critically evaluate, employ, and augment AI within warfighting organizations, which will accelerate effective adoption while preserving human judgment, accountability, and operational advantage.



REGENERATIVE GRAZING OPEN AIR LAB (R-GOAL)

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R-GOAL addresses a core readiness challenge: the rising fuel loads, soil degradation, and high vegetation-management costs that reduce training-land availability and increase wildfire and safety risks across DoW installations.

THE PROJECT

By applying Adaptive Multi-Paddock (AMP) grazing, R-GOAL provides a **low-cost, operationally flexible land-management system** that improves soil function, reduces fuel loads, enhances visibility and maneuver conditions, and decreases reliance on mowing and prescribed fire—all while maintaining zero interference with training through real-time coordination with Range Control.

The project **trains a veteran workforce capable of managing DoW lands** using modern regenerative methods.

- » Virtual fencing collars for precise herd control.
- » Remote sensing and geospatial monitoring to track ecological and readiness metrics.
- » Operational cost-modeling tools to quantify savings and performance gains.
- » Mobile water systems that enable implementation across diverse terrain.

SEEKING

- » Education Partnership
- » Research Partnership
- » Students & Interns
- » Funding & Scaling Support



**Proof of Concept:
Camp San Luis Obispo**

Supported by the DoW, USDA, & National Resource Conservation Service

DELIVERING IMPACT

R-GOAL positions the DoW to modernize its land stewardship, reduce costs, improve safety, and build enduring ecological resilience that supports both current and future training demands—directly strengthening the Dept. of War’s ability to train at scale and tempo. This repeatable, data-driven land-management model can be deployed across installations, supported by a trained veteran workforce.



MODULAR, AI-ENABLED WARGAMING INTERFACE

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Wargaming is central to how the Dept. of War explores future conflict and informs high-stakes decisions, yet most wargaming infrastructure remains bespoke, labor-intensive & difficult to adapt. While AI, simulation, analytics & autonomy have advanced rapidly, the interfaces that allow us to use these capabilities together have not. The bottleneck is orchestration: how humans, AI systems, and simulations interact during real decision-making.

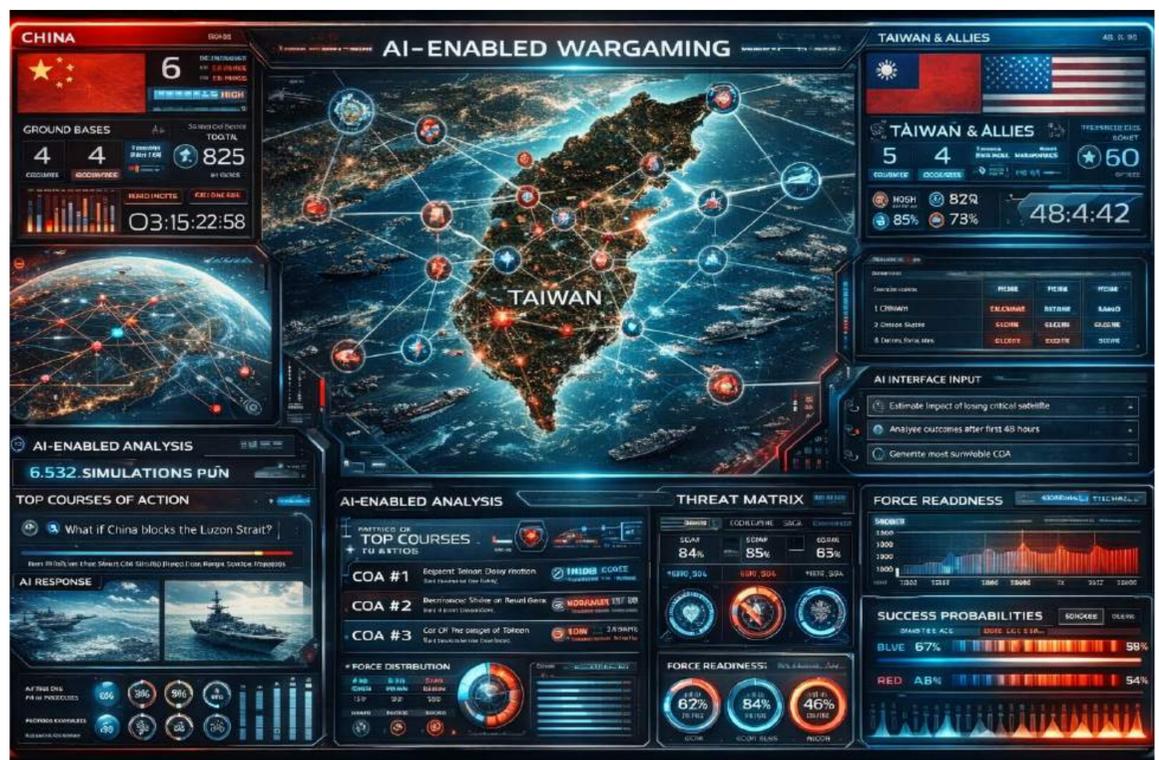
THE PROJECT

This project develops a modular, AI-enabled wargaming interface that sits above existing models, simulations and data sources, **focusing on the decision interaction layer**. This shared decision infrastructure requires industry and government to build it together.

- » The interface structures how intent is expressed, how AI contributes analysis and options as an advisor, how simulations evaluate consequences, and how decisions and outcomes are captured for replay and learning.
- » The interface supports many different wargames while preserving human authority, vendor independence and flexibility as technologies evolve.

SEEKING

- » Targeted funding for prototype development and pilots
- » Light-touch integration with existing data, tools or simulations
- » Collaborative experimentation in a pre-competitive environment



DELIVERING IMPACT

An AI-enabled wargaming interface improves decision quality by making human-AI interaction explicit, repeatable, and analyzable. It enables faster exploration of alternatives, earlier exposure of failure modes, and better capture of decisions and outcomes across games.



Neural Network-Based Compression of Wide Area SVP Profiles

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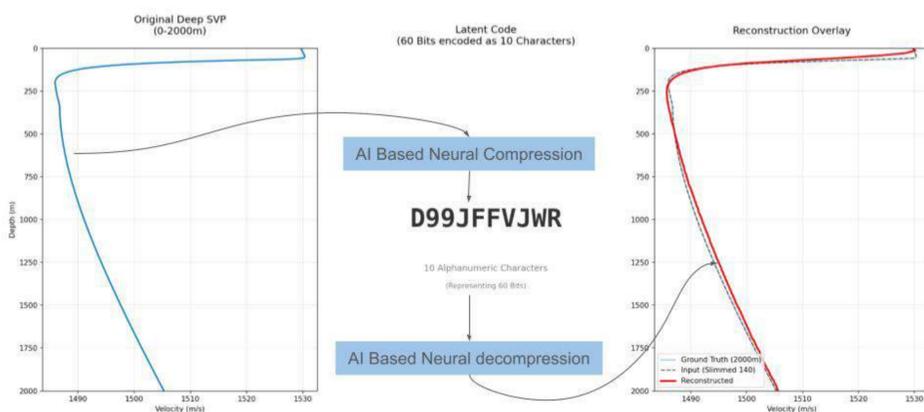
THE CHALLENGE

Submarine communications are severely bandwidth-limited, making it difficult to transmit large oceanographic datasets without exposing platforms or disrupting operations. Existing methods do not efficiently compress wide-area sound velocity profile data for transmission over extremely constrained broadcast channels.

THE PROJECT

This project develops a neural network-based compression approach that reduces wide-area sound velocity profile data to extremely small message sizes while preserving operationally useful information.

Synthetic datasets are generated to train and evaluate the model, with initial success demonstrated on single profiles and ongoing expansion to wide-area representations.



Initial Results - 98.66% compression, 1.6 m/s AVG Error

SEEKING

- Data Access and Sharing
- Prototyping and Experimentation

DELIVERING IMPACT

This work enables more efficient transmission of oceanographic information to submarines while minimizing bandwidth use.

Improved access to sound velocity data supports better undersea navigation, sensing, and operational decision-making without increasing communications risk.



IMPACT OF AI ON MORAL REASONING AND ETHICAL LEADERSHIP

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Heightened operational readiness, increased retention, better mental health, and fewer harmful behaviors exhibited by subordinate personnel is related to leaders who adhere to core values and moral principles.

THE PROJECT

This research seeks to develop an AI-enabled tool to augment the moral reasoning of military leaders. Such a tool would be tailored to encourage development through the mechanisms of change outlined in Social Learning Theory, including self-management, self-reflection, post-conventional schema activation, and mastery experiences.

This research seeks to answer:

1. Can an AI enabled tool improve the moral reasoning of military leaders?
2. How do military leaders interact with AI enabled tools to improve moral reasoning?

Answers can inform future military training, ethical sensemaking and decision-making of operational leaders, and ethical decision rehearsal in operational planning.

SEEKING

- » Education Partnership
- » Research Partnership
- » Funding Opportunities
- » Prototyping & Experimentation



COLLABORATORS

UtahStateUniversity®

DELIVERING IMPACT

This effort enhances readiness and command effectiveness by strengthening ethical judgment and decision quality across accession, operational planning and command-level leadership. An AI-enabled capability supports moral reasoning development, ethical scenario rehearsal and structured reflection, enabling leaders to anticipate second- and third-order consequences, mitigate cognitive bias and make sound decisions in high-tempo, contested environments.



Mission-Agile User Authentication and Access Control for 5G Networks

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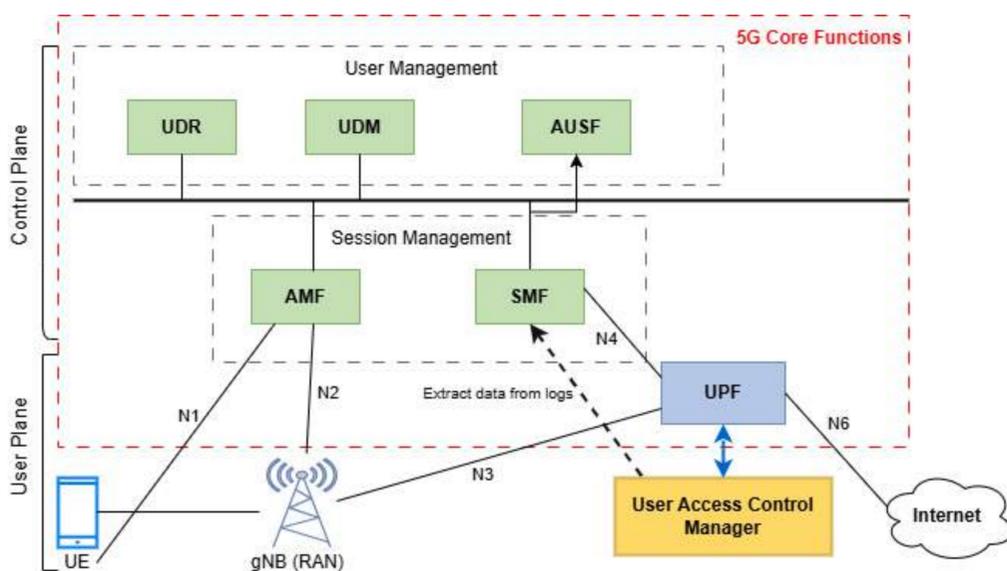
THE CHALLENGE

Military operators of 5G networks must support group-based user authentication and access control, beyond SIM or eSIM, to meet highly dynamic, mission-specific security requirements. Current 5G user authentication solutions require tight, time-consuming integration of enterprise security services with 5G core functions, and they do not address enforcement in the user plane.

THE PROJECT

This project designs and prototypes a vendoragnostic, rapidly deployable 5G User Access Control Manager

- Require no installation of special software on devices by using the web interface
- Minimize control plane overhead by diverting user authentication traffic to user plane
- Reduce dependency on core control functions by leveraging UPF programmability



SEEKING

- Research Partnerships
- Data Access and Sharing

DELIVERING IMPACT

This work enables mission-agile user authentication and access control for tactical 5G networks. By supporting adaptive groupbased user authentication, user plane enforcement, and rapid revocation, the approach reduces risk from compromised devices and improves containment speed during operations. The solution remains compatible with commercial and coalition 5G deployments while strengthening security for defense missions.



Four-Leg Power Conditioning System

WITH INCREASED POWER QUALITY AND POWER DENSITY FOR TRANSPORTATION ELECTRIFICATION AND MICROGRID APPLICATIONS

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The U.S. military needs reliable, robust electrical power — whether at a permanent base, a forward operating location, or on the move — to support modern warfighting platforms and increase resiliency and security of mission-critical systems.

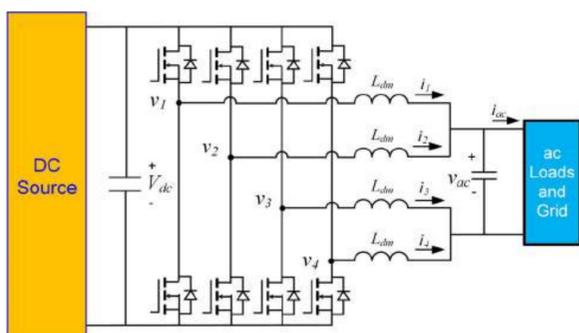
THE PROJECT

This invention reduces leakage currents in microgrid applications to increase energy security. A cost saving potential exists, as power electronics is getting cheaper while magnetic materials for passive filters are still expensive.

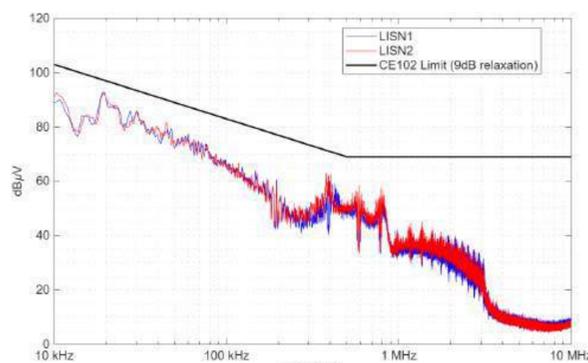
This novel power conditioning system has the potential to increase the power electronics power density, which is critical for transportation electrification including directed energy.

» Experimentally validated in a lab

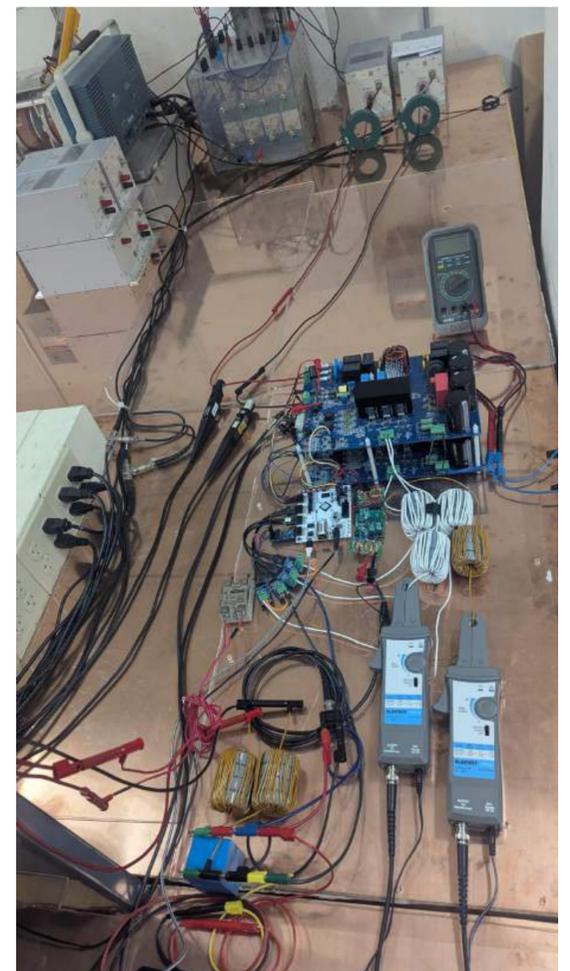
» Patent pending



Novel Single-Phase Converter



Experimental EMI w/o CM Choke



SPONSOR



CONTRIBUTORS

NPS Electrical Engineering students

COLLABORATORS



Baylor University

DELIVERING IMPACT

The technology can increase power density, which is critical for shipboard power, and increase power quality and power security for land-based applications such as microgrids.



Digital Twin of Resilient Energy Systems

REALIZING PROACTIVE MAINTENANCE & PREDICTIVE LOAD SHAVING ON MILITARY FACILITIES

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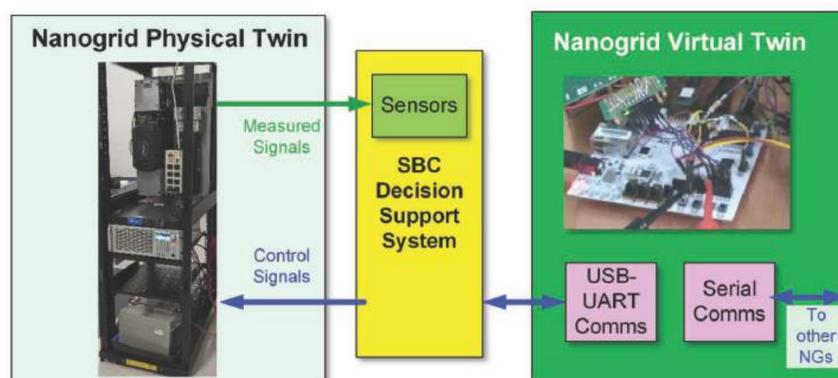
NPS MICROGRID INNOVATION RESEARCH CENTER

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The U.S. Navy is deploying energy systems, such as microgrids, to increase energy security and energy dominance. As the Joint Force increases its use of AI, digital twins for energy security and dominance will become increasingly important for decisive advantage and installation security.

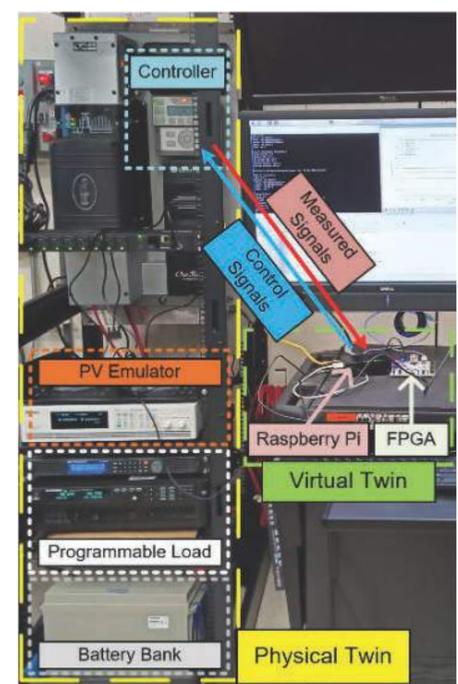
THE PROJECT

Our novel Digital Twin (DT) platform features **low-cost implementation** and potentially fast deployment time, **adaptable and vendor-agnostic** virtual twin (VT) of energy systems implemented on FPGAs, physical twin (PT) with **commercial off the shelf (COTS) hardware**, and single board computer (SBC) for bidirectional communication with PT and ML/AI.



SEEKING

- » Funding Opportunities
- » Prototyping & Experimentation
- » Research Partnership
- » Tech Transfer



COLLABORATORS

A team of NPS students and faculty from Electrical and Computer Engineering, Systems Engineering, Operations Research, & Energy Academic Group



DELIVERING IMPACT

The technology and approach addresses Navy-specific requirements and goals. Digital Twins of microgrids and other energy systems used by the Joint Force can help facility managers assess future threats, optimize operations, increase efficiency and energy assurance, and implement proactive maintenance.



Ontology for Trusted Neuro-symbolic Systems

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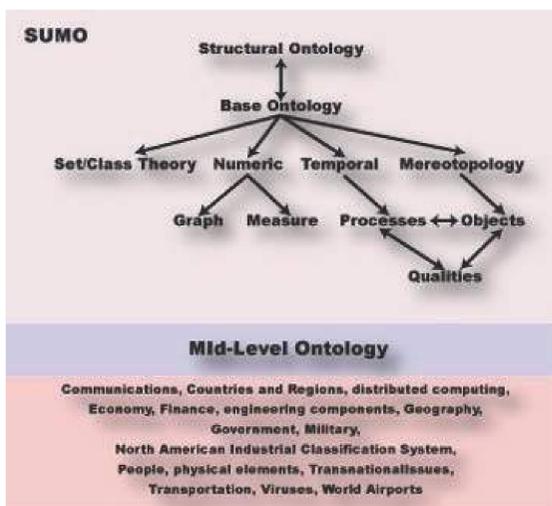
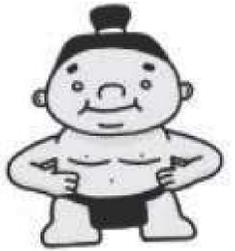
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THE CHALLENGE

Schemas and data models lack computable definitions for their terms, preventing automation from finding inconsistencies in data. High consequence systems need deterministic, trustworthy explanations.

THE PROJECT

- Provide a “dictionary for computers to read” – a library of concepts with definitions in formal logic that a computer can be used to verify correctness and answer questions.
- Use reasoning in mathematical logic to provide verification of data
- Create trusted and explainable AI through use of automated theorem proving tools from formal mathematics



SUGGESTED UPPER MERGED ONTOLOGY (SUMO)

A comprehensive ontology of 20,000 concepts and 100,000 human-authored formal logic statements created over 25 years of effort covering general concepts of time, space and human action as well as dozens of domains including geography, economics, military vehicles and processes, computers and networking and many others. Visit www.ontologyportal.org.

APPLICATIONS

- Theory of Mind for autonomous robots
- Data integration for simulation
- Data integration for equipment signatures
- Verifiable cyber resource planning
- Trusted autonomous vehicle reasoning with COLREGs and ROEs
- Language to logic translation for document curation
- Computable definitions for cryptographic primitives and protocols
- Cyber-physical reasoning under rules of engagement

SEEKING

- Research Partnerships
- Prototyping and Experimentation
- Data Access and Sharing
- Education Partnerships
- Students and Interns

TRUSTED AI CERTIFICATE AT NPS:

- Three course sequence of logic, ontology, language understanding
- Students and professionals can employ and contribute to the ontology after completion

DELIVERING IMPACT

- Verifiable data and metadata for common understanding of data
- Explainable AI - proof of reasoning
- Data quality assurance through data definition library reuse
- “Cognitive Guardrails” to catch AI errors



Artificial Intelligence, Synthetic Reality, and Future Warfare

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THE CHALLENGE

Military applications of AI are limited by the ability of humans, organizations, and doctrine to absorb and employ these technologies. Operational advantage is often assumed rather than tested, creating risk that promising tools are misapplied, misunderstood, or fail to translate into real battlefield value.

THE PROJECT

This research examines how AI and synthetic reality interact with human perceptions of future warfare. This explores how technologies are placed into negative or highly unrealistic operational and strategic contexts, which can explain resistance to adoption by military organizations over time.

Get the People Off the Boat: Unmanned Is the Essence of Autonomy

The U.S. Navy faces many decisions about the best way to develop and employ autonomous vessels, especially those that can substitute for crewed surface ships and submarines.

By James Wirtz

September 2025 | Proceedings | Vol. 151/9/1,471

FEATURED ARTICLE | VIEW ISSUE

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Military Strategy Magazine / Volume 10, Issue 3 / Colin Gray, the RMA, and the Rise of Drone Warfare

Although the machine gun had the company in the hands of a small group. During the Franco-Prussian War machine gun, not with infantry form behind the front lines. Firing at long identifying where their plunging fire aim that rendered the mitrailleuse it subjected to its fire were especially c

Colin Gray, the RMA, and the Rise of Drone Warfare

James J. Wirtz - Naval Postgraduate School, Monterey



SEEKING

- Funding Opportunities
- Research Partnerships

DELIVERING IMPACT

The work helps senior leaders and planners distinguish between technological potential and operational utility. By identifying where human, organizational, and political factors constrain or distort AI adoption, the research supports more realistic force design, doctrine development, and experimentation strategies, reducing the risk of costly misalignment between technology and warfighting needs.



AI Guardrail: Safeguarding AI-accelerated Warfighting Decisions

MR. BRIAN WOOD, BPWOOD@NPS.EDU

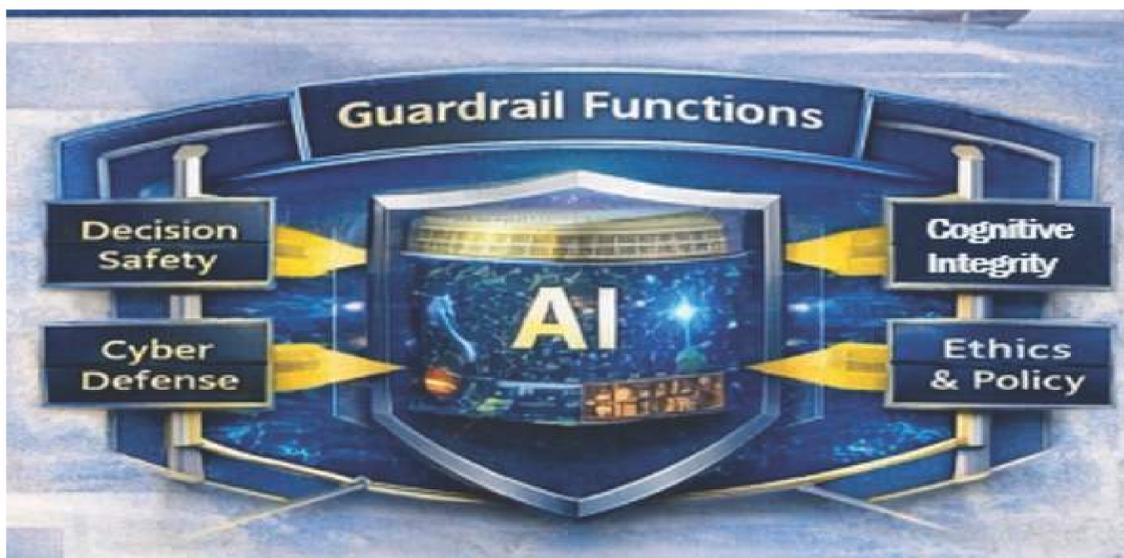
FACULTY ASSOCIATE RESEARCH, INFORMATION SCIENCES

THE CHALLENGE

As artificial intelligence is integrated into defense and aerospace systems, operational risk increases when AI behaves unpredictably, insecurely, or without clear accountability. Unconstrained or opaque AI can introduce cybersecurity vulnerabilities, unsafe decision acceleration, and ethical and safety failures that undermine mission trust and readiness.

THE PROJECT

AI-Guardrail develops an adaptive, real-time framework that constrains AI behavior while preserving operational utility. The project integrates open-source hardware and software with generative AI models to create a decision-support layer that enforces deterministic behavior, continuous monitoring, and policy-aware controls. The system detects and mitigates threats such as adversarial prompts, jailbreaks, phishing attempts, and data leakage, while maintaining transparent audit trails and certifiable decision pathways. Evaluation occurs through simulation and applied testing to ensure operational relevance.



SEEKING

- Funding opportunities
- Research partnerships

DELIVERING IMPACT

AI-Guardrail improves mission readiness by enabling safer, more trustworthy AI deployment in complex operational environments. By combining real-time threat detection, explainable decision pathways, and verification mechanisms, the framework reduces cyber and operational risk while accelerating responsible AI adoption. The approach directly supports testing, validation, and certification efforts, strengthening confidence in AI-enabled systems across defense applications.



Persistent Smart Acoustic Profiler

An energy-harvesting UUV for USW support



NAVAL
POSTGRADUATE
SCHOOL

PSAP: A different approach to acoustic and oceanographic data collection

- **Energy-harvesting** → unlimited endurance
- **Smart hydrophone** → onboard data processing in real time
- **Global 2-way comms** → critical data/info exchange from remote locations in real time



PSAP deployment off the Kona Coast HI



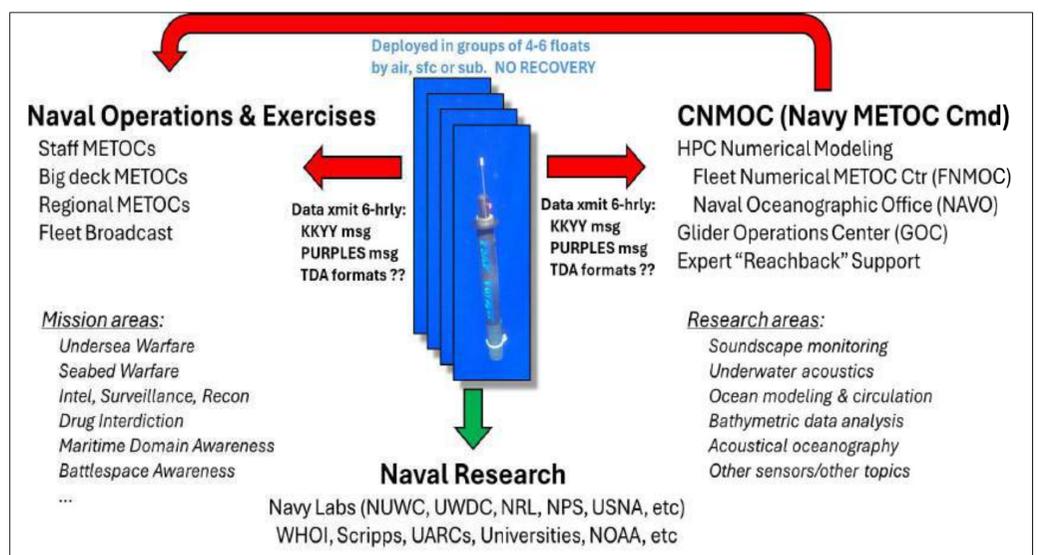
Deployed 11/06/2024 to present; >835 profiles; every 6-hrs

Cost Efficient (effort & dollars)

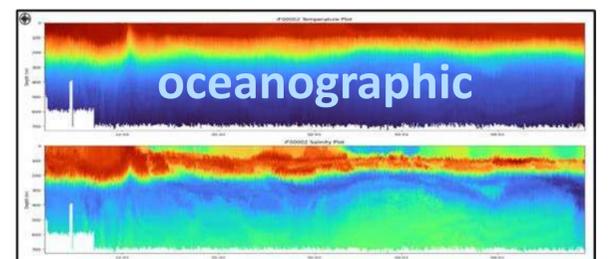
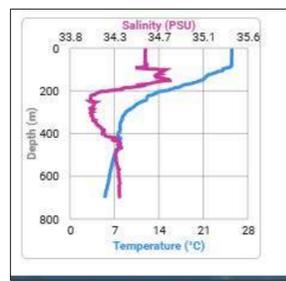
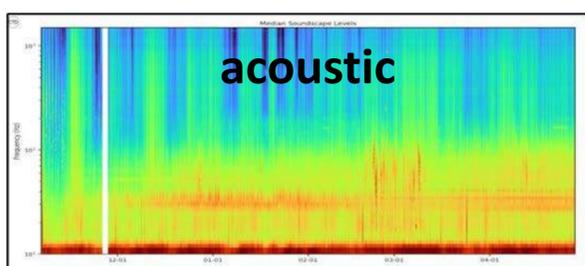
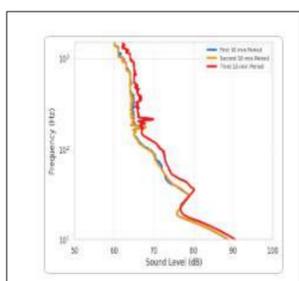
- **No recovery** required → deploy with no need for a support tail (major savings!)
- **No refreshing** batteries or data storage → continuous monitoring and higher security
- **No replacements** required → can redirect, relocate or recycle; but not expendable

Proposed CONOPS

- **Rapid response** → air-deploy like sonobuoy
- **Stealthy** → release at depth from undersea platforms
- **Stand-off** → Use ocean currents to guide into place
- **Research** → deploy without need for recovery vessel



Real-time Battlespace Intelligence directly to the Fleet Operators every 6-hours



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Consortium for Robotics and Unmanned
Systems Education and Research