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INNOVATION INDUSTRY DAYS (I2D)

ARTIFICIAL INTELLIGENCE AND AUTONOMY

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22 September 2026

FOCUS AREA

AI and Autonomy



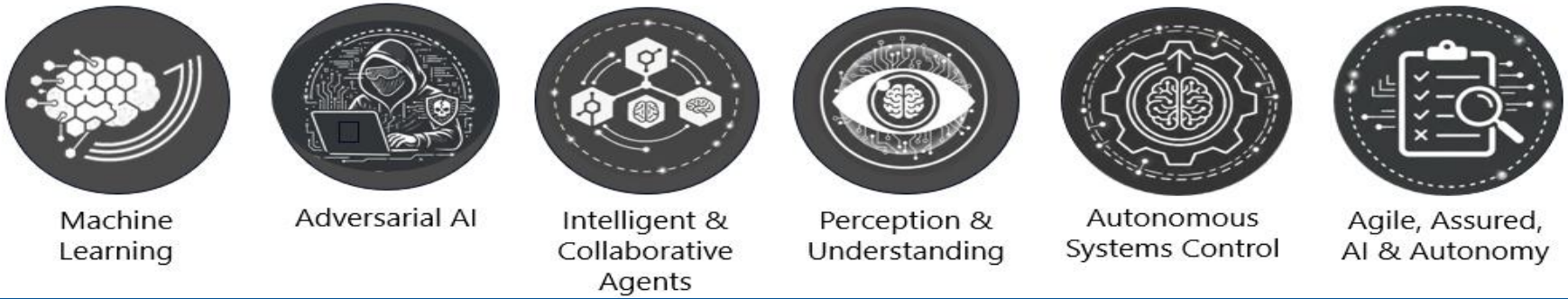
DESCRIPTION

Develop fundamental algorithms, software, and intelligent agents that can perform tasks typically requiring human intelligence (such as perception, reasoning, and learning) that enhance naval decision-making, planning, and mission execution for operational effectiveness and fleet readiness. It includes, but is not limited to, creating capabilities that can assist with naval missions requiring agile, assured, autonomous systems, intelligent surveillance systems, and decision support systems.

OBJECTIVE

- Provide intelligent real-time perception, detection, analysis, collaboration, and control to improve resilience for enhanced naval planning and operations in uncertain dynamic environments by adapting to new situations and strategies.
- Achieve automated understanding of complex naval environments for applications such as surveillance and robot perception.
- Provide confidence that the AI models are providing reliable information.
- Deliver capabilities to autonomous systems enhancing robustness, mission duration, and scalability to the Fleet at all levels of execution.
- Enhance ability to detect and mitigate adversarial attack, enable attack/counterattack, including executing or disrupting detect-to-engage sequences

AI & Autonomy Research Areas



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STRATEGIC ALIGNMENT

AI and Autonomy

GUIDANCE

Secretary of War, Artificial Intelligence Strategy for the Department of War, JAN 2026
"*We must internalize that **Military AI is going to be a race for the foreseeable future**, and therefore speed wins... We must accept that the risks of not moving fast enough outweigh the risks of imperfect alignment.*"

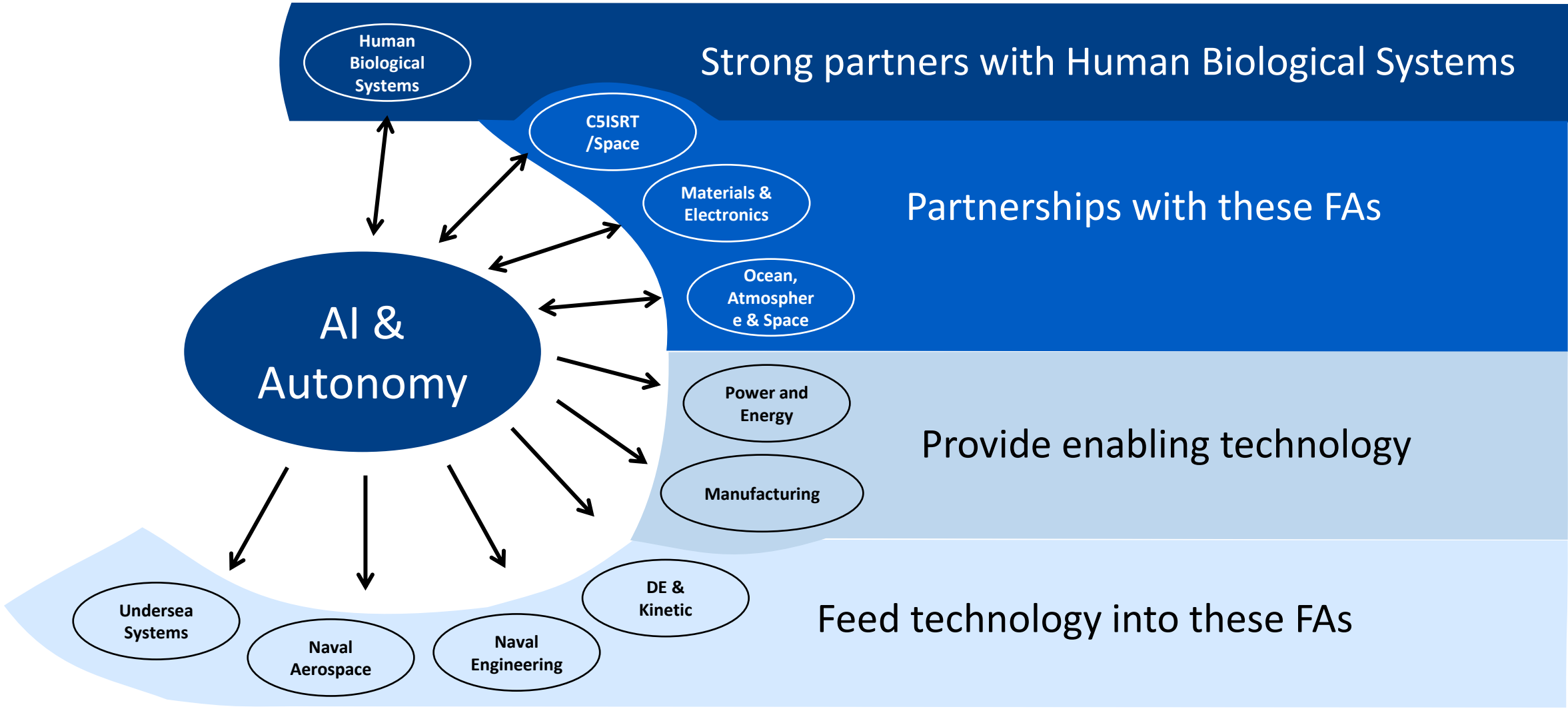
Secretary of the Navy (Acting), DON Strategy to Weaponize Data and AI
***"Strengthen industry partnerships.** Accelerate speed to value by partnering with industry leaders who can **help the DON adopt state-of-the-art data and AI solutions tailored to its needs**.*"



2026 CNO Fighting Instructions
"*Denial and striking forces are the offensive body of the Fleet**, enabled by the lethal combination of Robotic Autonomous Systems**, distributed long-range fires, naval aviation, undersea dominance, and large-magazine vessels.*"

USMC Deputy Commandant for Information, USMC Artificial Intelligence Strategy, JUL 2024
***"**On the digital battlefield, from receipt of mission to the execution of tactical tasks, **AI is an enabler for faster decision making and success.**"*

INTERNAL PARTNERSHIPS



Collaboration Amongst the FAs Enables Force-Wide Cross-Cutting Capabilities

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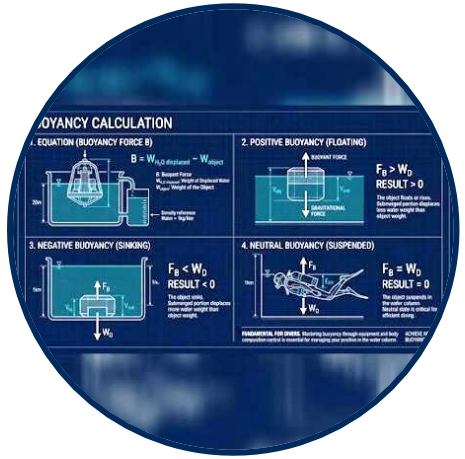
RESEARCH AREA

Machine Learning (ML)



DESCRIPTION

Develop foundational capabilities, including classical methods, deep learning, generative AI, and data-driven approaches, for dynamic, uncertain environments, including at the edge.



CORE OBJECTIVES

- Develop fast, accurate ML for naval environments and missions
- Improve ML model predictions for uncertain, unknown environments
- Develop ML model predictions that self-correct, self-improve
- Produce accurate integrated physics models with ML

TECHNICAL ROADMAP

Machine Learning (ML)

Fast, Accurate ML Including Non-Traditional Modalities

Seamless Integration of Domain Knowledge with ML

1-5 yrs

Develop accurate ML methods for limited data and reduce model training time, including non-traditional modalities (e.g. acoustic and signals data)

Increase accuracy by integrating domain knowledge, including physical models, with learning systems across different domains

5-10 yrs

Expand ML model prediction across different DON domains

Develop ML that can function effectively in distributed and dynamic unseen, operational environments

10+ years

Develop ML model predictions that can learn without human supervision, that can self-correct, self-improve and learn from each other

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Deliver integrated fast, ML approaches for specialized naval domains in disconnected, tactical environments

Delivering ML capabilities for specialized naval domains, with the confidence necessary to take military actions

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TECHNICAL CHALLENGES

Machine Learning (ML)

Learning From Limited Naval Data

- Demonstrate new algorithms that can learn from a fraction of data used to train current ML algorithms but have the same performance as models that are trained on large amounts of data

Measuring Uncertainty of Predictions

- Demonstrate methods that quantify the uncertainty of predictions made by ML algorithms for naval environments

Delivering Autonomous, Adaptive ML

- Demonstrate unsupervised, self-correcting, fast-learning algorithms and architectures that work with limited naval data
- Demonstrate accurate ML algorithms/architectures that are deployed on real time, edge platforms in contested environments.
- Demonstrate algorithms that cross correlate across multiple non-traditional modalities that capture uncertainty and improve real-time information for warfighting decision making

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RESEARCH AREA

Adversarial AI and Autonomy



DESCRIPTION

Understand and develop AI and autonomous system software that is robust to adversarial attacks, data manipulation and deceptive information, and develop the ability to counter attacks while securing an offensive advantage.



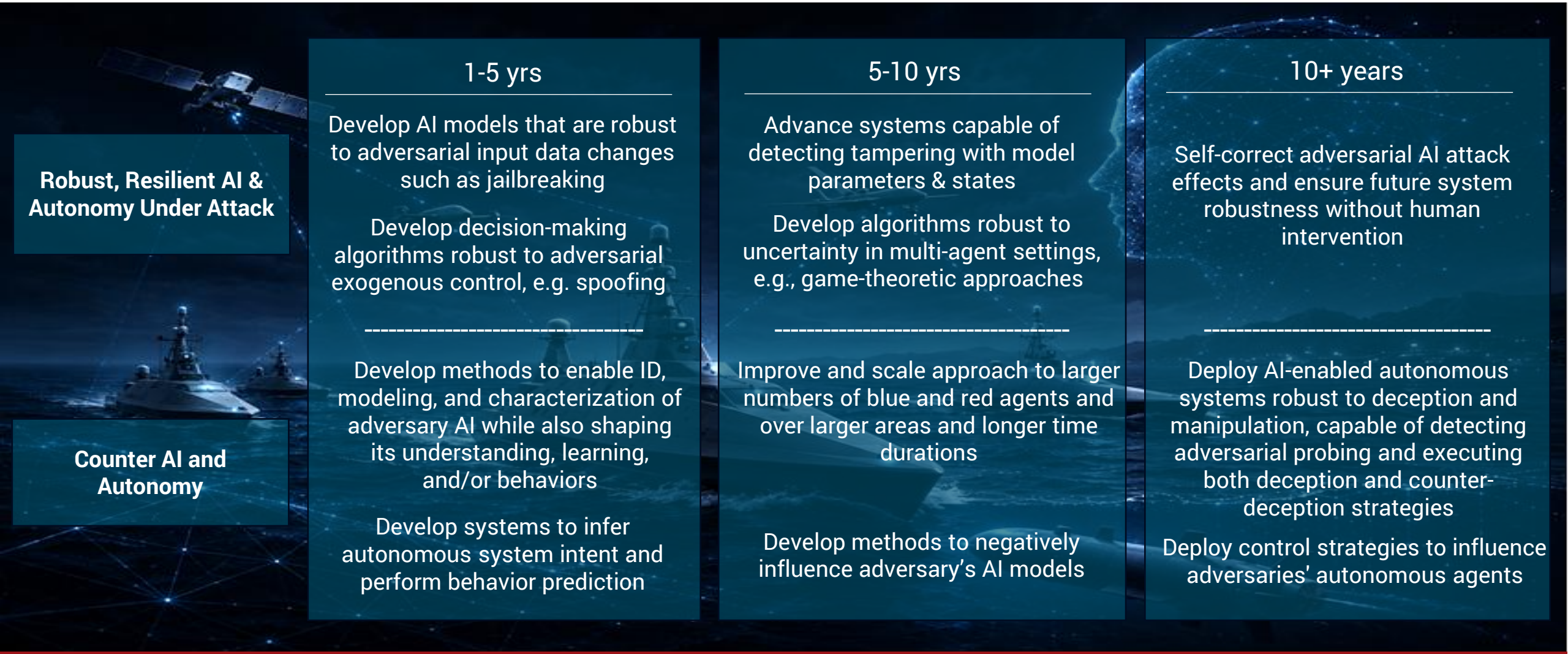
CORE OBJECTIVES

- Develop tools for protecting AI systems and negatively affecting adversary's AI systems
- Enable identification, modeling, characterization, and prediction of adversary AI/autonomy
- Develop and execute in real-time countering approaches including both direct intervention and more indirect methods such as deception

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TECHNICAL ROADMAP

Adversarial AI and Autonomy



	1-5 yrs	5-10 yrs	10+ years
Robust, Resilient AI & Autonomy Under Attack	Develop AI models that are robust to adversarial input data changes such as jailbreaking Develop decision-making algorithms robust to adversarial exogenous control, e.g. spoofing	Advance systems capable of detecting tampering with model parameters & states Develop algorithms robust to uncertainty in multi-agent settings, e.g., game-theoretic approaches	Self-correct adversarial AI attack effects and ensure future system robustness without human intervention
Counter AI and Autonomy	Develop methods to enable ID, modeling, and characterization of adversary AI while also shaping its understanding, learning, and/or behaviors Develop systems to infer autonomous system intent and perform behavior prediction	Improve and scale approach to larger numbers of blue and red agents and over larger areas and longer time durations Develop methods to negatively influence adversary's AI models	Deploy AI-enabled autonomous systems robust to deception and manipulation, capable of detecting adversarial probing and executing both deception and counter-deception strategies Deploy control strategies to influence adversaries' autonomous agents

Ensuring naval dominance in AI and Autonomy by hardening our systems and countering our adversaries

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TECHNICAL CHALLENGES

Adversarial AI and Autonomy

Robust AI Models

- Assess robustness of AI models and detect vulnerabilities
- Demonstrate and mitigate tampering with model parameters and states

Formal Modeling of Potential Adversarial Behavior

- Demonstrate methods to formally model adversarial behavior that has not been previously observed but would be non-trivial to defeat

Robust Multi-Agent Adversarial Decision Making

- Demonstrate approaches to multi-agent game-theoretic decision making in environments where uncertainty is pervasive and the adversary may have information advantage

Counter Deception and Fighting Back

- Demonstrate autonomous systems that are robust to deception over short and long durations
- Demonstrate approach to counter adversaries' autonomous agents

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RESEARCH AREA

Intelligent and Collaborative Agents



DESCRIPTION

Develop large-scale and robust reasoning, planning, and decision-making methods from centralized to decentralized systems, allowing achievement of complex goals in dynamic and uncertain environmental conditions, denied or degraded communications, and with partial and imperfect information.



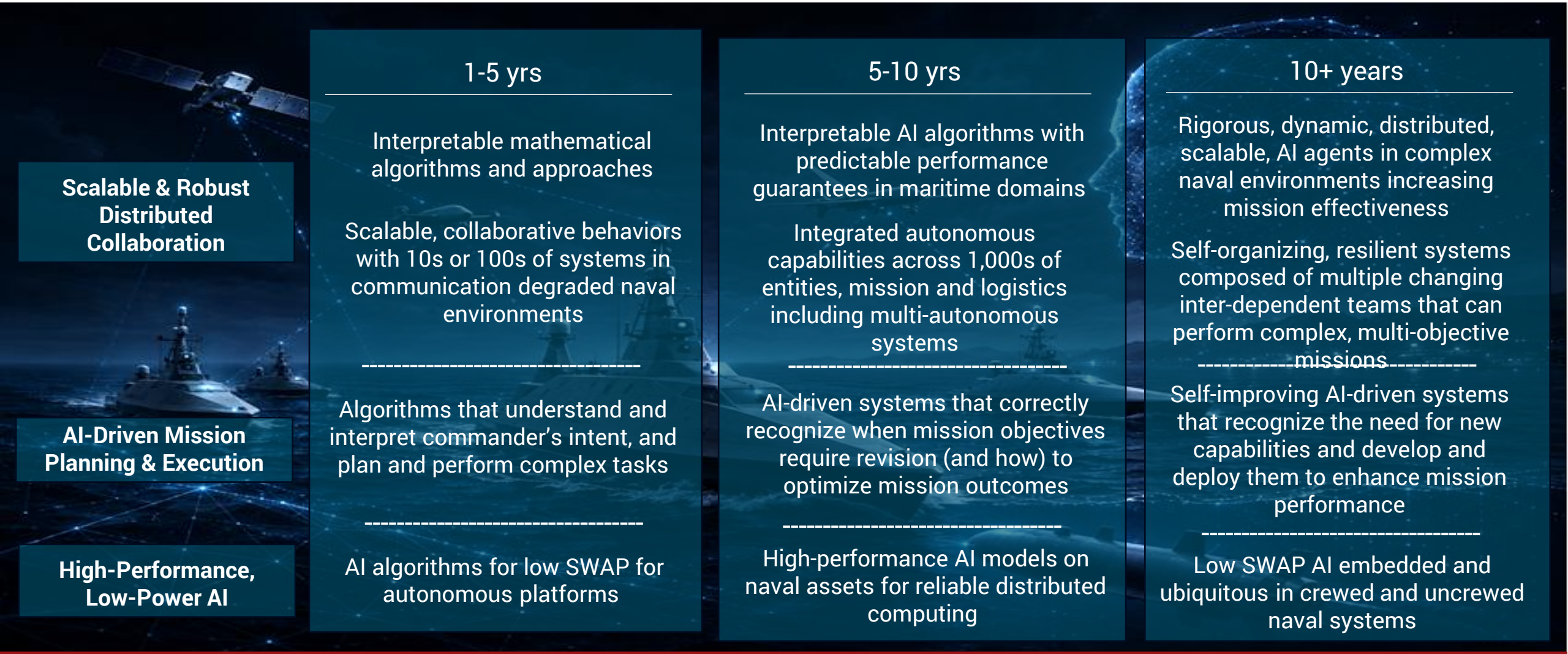
CORE OBJECTIVES

- Develop efficient AI algorithms, with rigorous guarantees, to enable real-time cooperative operations with multi-agent systems in naval environments
- Develop and scale up robust, dynamic, decentralized, distributed autonomous agents
- Develop and deploy approaches to achieve AI-driven mission planning and mission execution with dynamic environments and changing objectives
- Develop high performance, low power AI algorithms and software to enable edge computing for sensing and control in intelligent UxVs in all domains

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TECHNICAL ROADMAP

Intelligent and Collaborative Agents



	1-5 yrs	5-10 yrs	10+ years
Scalable & Robust Distributed Collaboration	Interpretable mathematical algorithms and approaches Scalable, collaborative behaviors with 10s or 100s of systems in communication degraded naval environments	Interpretable AI algorithms with predictable performance guarantees in maritime domains Integrated autonomous capabilities across 1,000s of entities, mission and logistics including multi-autonomous systems	Rigorous, dynamic, distributed, scalable, AI agents in complex naval environments increasing mission effectiveness Self-organizing, resilient systems composed of multiple changing inter-dependent teams that can perform complex, multi-objective missions
AI-Driven Mission Planning & Execution	Algorithms that understand and interpret commander's intent, and plan and perform complex tasks	AI-driven systems that correctly recognize when mission objectives require revision (and how) to optimize mission outcomes	Self-improving AI-driven systems that recognize the need for new capabilities and develop and deploy them to enhance mission performance
High-Performance, Low-Power AI	AI algorithms for low SWAP for autonomous platforms	High-performance AI models on naval assets for reliable distributed computing	Low SWAP AI embedded and ubiquitous in crewed and uncrewed naval systems

Establishing an asymmetric naval advantage with resilient, distributed, intelligent agents capable of operating in any environment

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TECHNICAL CHALLENGES

Intelligent and Collaborative Agents

Interpretable, Intelligent, Collaborative Agents

- Demonstrate agents that monitor the maritime domain (i.e., surface, air, underwater) under adverse conditions, recommend tactical response options, and task assets

Next-Generation Autonomy for Unmanned Maritime Vehicles (UMVs)

- Demonstrate agents that perform complex tasks with little to no human intervention in dynamic, unstructured, uncertain, and harsh maritime environments, support diverse missions and tasks, and enable many heterogeneous UMVs to cooperate autonomously for extended periods of time with no communication between them and their human operators

AI for Optimal Mission Effectiveness

- Demonstrate agents that act at a high level of autonomy in open mission environments (e.g., reason about their resource allocations, dynamically determine which mission objectives to pursue)

Low-SWAP AI for Naval platforms

- Demonstrate and quantify improvement of low SWAP AI on naval autonomous platforms to handle sensing and control with minimal human involvement

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RESEARCH AREA

Perception and Understanding



DESCRIPTION

Autonomous system and AI algorithm ability to perceive and understand naval-relevant environments and entities, using multi-modal sensing. The focus is on unique naval modalities and signals over a broad range of temporal and spatial scales that enable rapid actions across the naval and joint force.



CORE OBJECTIVES

- Enhance perception and understanding for operations in highly dynamic, noisy, and high-variance environments
- Support decisions in uncertain environments with unseen conditions, such as the choice between wide area exploration or exploitation
- Provide multi-modal active sensing and knowledge acquisition for own-system decisions

TECHNICAL ROADMAP

Perception and Understanding

	1-5 yrs	5-10 yrs	10+ years
Perception for Planning and Decision-Making	Reliable object/environment recognition under non-ideal conditions using multi-modal sensing	Activity recognition using multi-modal data, ability to communicate data to support planning and decision-making	Ability to infer plans/intentions of human and autonomous actors
Own-System Understanding and Improvement	Research methods for system self-understanding	Develop perception and self-understanding for autonomous systems including assessment of state/status, performance, proficiency, and mission progress	Deploy systems able to extend or learn new perceptual representations, semantic classes, etc. in stride
Reliable, Enduring, Knowledge-Sharing Systems	Very low-SWAP methods for long duration missions with minimal energy use in support of control, navigation, planning and learning in naval environments	Autonomous perception with formal guarantees, a high degree of robustness in dynamic environments, and graceful degradation in unexpected conditions.	Deploy heterogenous maritime autonomous systems to transfer learning and experiences across environments, different spatiotemporal dynamics and different system architectures with limited comms

Achieving autonomous battlespace understanding to improve naval decision making

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TECHNICAL CHALLENGES

Perception and Understanding

Dynamic Naval Environment Understanding

- Demonstrate understanding of naval relevant environments over a broad range of temporal and spatial scales, including operations in highly dynamic environments, such as coastal areas, with both regular cycles of natural changes at different time scales and unexpected events that may cause significant change

Contextual Understanding and Alignment

- Demonstrate rich understanding of the environment from the high to intermediate levels (e.g., semantic and non-metric information) to low-levels (e.g., more direct sensor data products) to support balancing of goals and achieve mission objectives

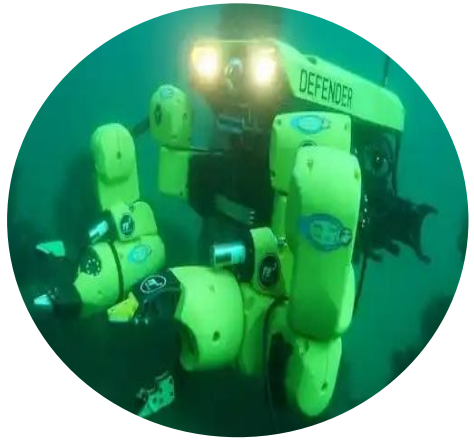
Knowledge-Sharing Systems

- Demonstrate semantic knowledge transfer on heterogeneous autonomous systems with limited communications across large time scales

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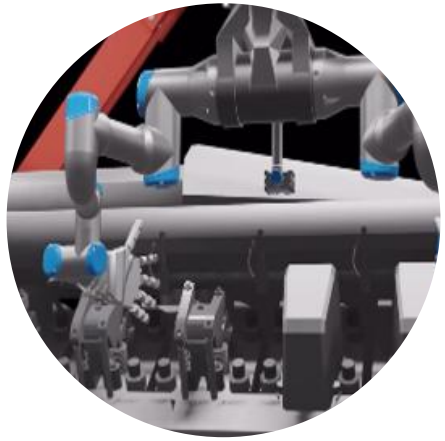
RESEARCH AREA

Autonomous Systems Control



DESCRIPTION

Software and cyber-physical control that enable systems to execute plans and maintain stable operations in any conditions across time and space. Including robust robotic mobility and manipulation capabilities that address unique naval needs (e.g. uncontrolled shipboard environments, battlespaces).

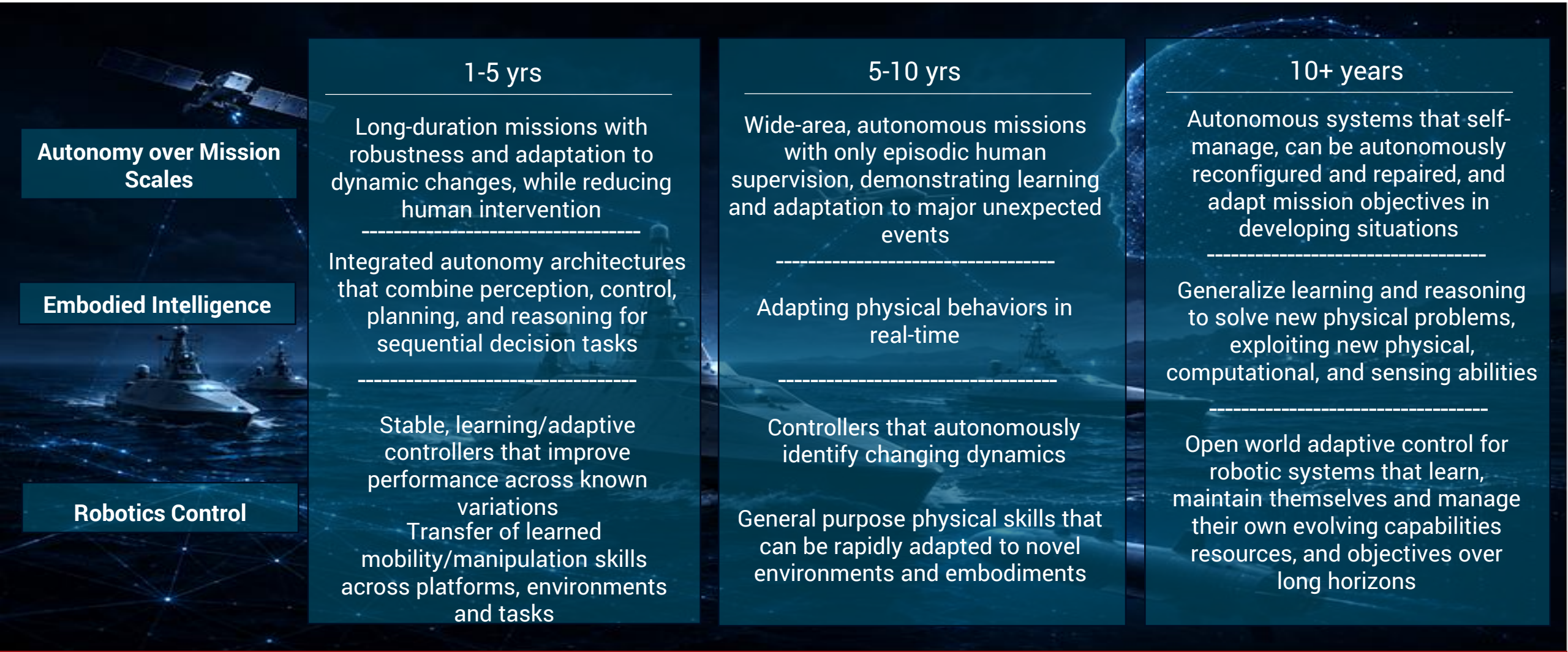


CORE OBJECTIVES

- Persistent and resilient autonomous control over large spatiotemporal scales and changing naval environments
- Algorithms for autonomous robotic manipulation in naval contexts
- Robust plan execution under uncertainty, including with degraded sensor inputs

TECHNICAL ROADMAP

Autonomous Systems Control



	1-5 yrs	5-10 yrs	10+ years
Autonomy over Mission Scales	Long-duration missions with robustness and adaptation to dynamic changes, while reducing human intervention	Wide-area, autonomous missions with only episodic human supervision, demonstrating learning and adaptation to major unexpected events	Autonomous systems that self-manage, can be autonomously reconfigured and repaired, and adapt mission objectives in developing situations
Embodied Intelligence	Integrated autonomy architectures that combine perception, control, planning, and reasoning for sequential decision tasks	Adapting physical behaviors in real-time	Generalize learning and reasoning to solve new physical problems, exploiting new physical, computational, and sensing abilities
Robotics Control	Stable, learning/adaptive controllers that improve performance across known variations Transfer of learned mobility/manipulation skills across platforms, environments and tasks	Controllers that autonomously identify changing dynamics General purpose physical skills that can be rapidly adapted to novel environments and embodiments	Open world adaptive control for robotic systems that learn, maintain themselves and manage their own evolving capabilities resources, and objectives over long horizons

Enabling autonomous systems capable of achieving naval objectives in uncertain and adversarial environments

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TECHNICAL CHALLENGES

Autonomous Systems Control

Long-Duration Autonomy

- Demonstrate robust long-duration autonomy during which many a priori assumptions may be become invalid with sparse contact with warfighters.(e.g., address cumulative uncertainty, changing environments, component degradation, resource constraints, and evolving mission objectives)

Embodied Intelligence

- Demonstrate intelligent physical systems that operate robustly in complex, unstructured, dynamic, harsh environments with uncertainty, limited resources, and a need to make fast decisions with limited information (e.g., some subset of tasks currently done by highly skilled sailors)

Robust Mobility And Manipulation

- Demonstrate robots that can maintain stability, contact, traction, balance, dexterity, and task performance despite uncertain terrain (including platforms), contact dynamics, and disturbances

Advanced Control Architectures

- Demonstrate a system that can be composed, modified, and reconfigured without redesigning the entire control system

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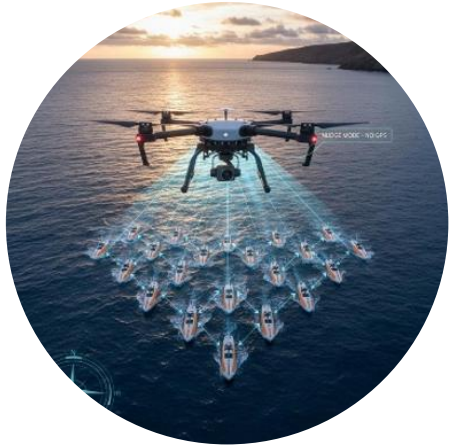
RESEARCH AREA

Agile, Assured AI and Autonomy



DESCRIPTION

Enable a lifecycle-spanning engineering framework that mathematically guarantees the safety, robustness, and operational trustworthiness of AI and autonomous systems operating in unpredictable, adversarial, and open-world naval environments while also supporting rapid adoption and upgrading of the latest advances in intelligent and autonomous systems.



CORE OBJECTIVES

- Enable rapid adoption of AI and Autonomy through the following efforts:
- Develop theory-based Verification and Validation (V&V), Systems Safety, and Test & Evaluation (T&E) tools to assess systems within naval environments, minimizing the sim-to-real gap
- Balance design-time, run-time, and life-time methods and processes, and highly automate methods to enable rapid and agile adoption
- Build tools and methodologies to support a naval-centric ecosystem focused on tactical activities
- Challenge AI-enabled autonomous systems under near-combat conditions

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TECHNICAL ROADMAP

Agile, Assured AI and Autonomy

	1-5 yrs	5-10 yrs	10+ years
Simulation Tools and Models	Models representing regions, environments, platforms, missions and doctrine established	Run-time assurance and life-cycle safety models for heterogeneous, multi-domain systems at scale (1000s of units)	AI behaviors, decision-making and interfaces accurately modeled. Dynamic reconfiguration of swarms demonstrated in virtual environments
Defining Scenarios and Standards	Develop models to easily be transferred between simulation environments Highly automated formal methods for specifying naval missions, constraints, and success metrics	Deployment of a standardized simulation environment, with testing scenarios, at every distribution level	Automate model generation for virtual environments based on real-world observations Autonomously share updated models across virtual environments in real time
Testing Methods and V&V	Methods to quantify performance, including uncertainty and safety margin assessments in the naval domain	On-demand upgrades to support ongoing deployments based on what is discovered in theater Develop virtual and live adversarial systems to test blue systems	A complete system Certification, Systems Safety, and Verification & Validation framework for distributed, learning-enabled autonomous systems including live tests Continuous and rapid evaluation of AI and autonomy

Reducing AI & Autonomy V&V timelines from months to hours for the future fleet

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TECHNICAL CHALLENGES

Agile, Assured AI and Autonomy

Safety of Intelligent Autonomous Systems

- Demonstrate method/tools to assure intelligent autonomous system safety while maintaining adequate safety margins over a whole life cycle, in naval environments

Highly Automated Verification and Validation of Naval Autonomous Systems

- Demonstrate methods and tools for the automated and scalable verification, validation, and assurance of embedded AI at both the individual component property level and at the system level for closed-loop intelligent autonomous systems

Adequate Virtual Test Environments

- Demonstrate a virtual test environment that can satisfactorily model and test swarm-scale interactions, environmental impacts on autonomous system performance, and AI-enabled decision-making by individual swarm entities in realistic scenarios

Large Numbers of Surrogate Platforms for Swarm Research

- Swarming algorithm research is impacted by low numbers of inexpensive surrogate vehicles for testing mathematical models in representative environments and scenarios (ground and water vehicles)

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QUESTIONS & ANSWERS

AI and Autonomy



Submit Questions

Questions for Industry

- What is missing from our roadmaps?
- Which of the briefed technical challenges have already been solved?
- How do we transfer ONR algorithms into industry systems?
- What metrics do you use to assess AI and Autonomy?
- How do you measure success in IRAD funds (go/no-go points for continued funding)?

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