ONR's Science of Autonomy Program

The field of autonomy is crucial to the Department of the Navy's missions, both today and tomorrow. At present, autonomy helps minimize tasks that are dull, dirty and dangerous, as well as reduce manpower and resources. In the future, autonomy will offer the ability to execute mission tasks that would otherwise be unaffordable or impractical and offer persistent, pervasive and perceptive capabilities.

ONR's Science of Autonomy program addresses critical multidisciplinary autonomy challenges that cut across different ONR departments and warfighting areas/domains, including air, sea, undersea and ground. The program primarily invests in three areas: (1) advanced technology development—prototype problem-specific automated and autonomous systems; (2) applied research—domain-specific research; and (3) basic research—to foster broad and deep understanding and advancement in autonomy.

The program is focused on four interrelated areas: (1) human collaboration with autonomous systems; (2) perception and intelligent decision making; (3) scalable distributed collaboration; and (4) intelligent architectures. This multidisciplinary approach helps foster collaborations among researchers in various autonomous system domains that have traditionally been somewhat separated: air, sea, undersea and ground systems; control theory; computational intelligence; human factors; biology; economics; cognitive science/psychology; and neuroscience.

The vision for ONR's Science of Autonomy program is development of an autonomous system of systems for uses such as riverine warfare, urban operations, casualty care, mine warfare, missile defense, surface warfare, human/unmanned systems collaboration, persistent surveillance and strike, and oil platform defense. The idea is that autonomous behavior and the systems that incorporate it will be seen in many operating domains and used for many missions, on multiple platforms.

By making this vision a reality, ONR aims to bring about many future operational benefits, including:

- Providing new capabilities that expand the operational envelope of U.S. forces, provide force multiplication or replace existing capabilities with less expensive alternatives
- Achieving survivability of system capabilities
- Reducing the need to place personnel and high-value assets in high-threat areas
- Reducing manning and communications requirements
- Reducing training and logistics support requirements
- Reducing the cognitive load on warfighters and increasing throughput of operationally relevant information
- Enabling humans to focus on decision making and make better decisions faster than the adversary can endure.

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UNMANNED SYSTEMS AND AUTONOMY

ONR has all of its departments working on the Science of Autonomy program in some capacity. Examples of multidisciplinary research include:

- A control engineer working with a neuroscientist to develop spatial understanding approaches for autonomous systems that fit human semantic models and could be used to create UAV “wingmen” for dismounted Marines
- Biologists and engineers using models of social interactions in animal groups that allow individuals to access higher-order computational abilities at the collective level and make good decisions despite uncertainty
- Biologists, psychologists and engineers applying behavioral and cognitive models of predator-prey relationships to engineered systems for intelligence, surveillance and reconnaissance of large, complex areas by heterogeneous unmanned systems.

This cross-organization collaboration brings the top subject-matter experts from a diverse range of fields together, which is crucial to solving some of the key naval challenges that exist in the field of autonomy, including:

- Operations that take place in variable and uncertain environments with limited manning, communications and other resources
- Users with a wide range of skills and experience
- Platforms with highly limited and intermittent communications
- Complex missions executed with heterogeneous platforms and sensors, including significant differences in physical and sensing capabilities
- The need for:
  - Rapid and dynamic responses to user needs and changes in the operating space
  - Automation that can explain its capabilities to the user and reliably execute the required tasks in the required time.

ONR Departments

All six of ONR’s major departments, or “Codes,” are working on components of the Science of Autonomy Program.

Code 30:	Expeditionary Maneuver Warfare and Combating Terrorism
Code 31	Command, Control, Communications, Intelligence, Surveillance and Reconnaissance
Code 32	Ocean Battlespace Sensing
Code 33	Sea Warfare and Weapons
Code 34	Warfighter Performance
Code 35	Naval Air Warfare and Weapons

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