Machine Learning, Reasoning and Intelligence

AT A GLANCE

WHAT IS IT?
Basic and applied research to develop principles of machine intelligence and efficient computational methods for building versatile smart agents (cyber and physical, individuals and teams) that can perform missions autonomously with minimal human supervision in all environments and be able to collaborate seamlessly with people and other agents.

HOW DOES IT WORK?
Research is focused on developing tractable methods for creating the “building blocks” of intelligence, namely, knowledge bases, machine learning, reasoning, planning and intelligent architectures that allow seamless integration of these blocks and developing methods for autonomous perception with particular emphasis on scene understanding from imagery. The goal is developing knowledge-rich methods that are general and portable across application domains, efficient and robust to uncertain and partial information, and provide performance guarantees that enable self-assessment to build trust.

WHAT WILL IT ACCOMPLISH?
Intelligent, versatile, mission-aware agents that function autonomously in all environments and collaborate seamlessly with humans and other agents, performing such tasks as persistent surveillance of maritime domain.

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The goal of this program is to develop principles and tractable computational methods for building intelligent agents (cyber and physical) that can function autonomously in uncertain, dynamic, open-world and unstructured environments with minimal supervision and collaborate seamlessly with other agents and warfighters.

Focus areas include:
- Elements of intelligence: Of particular interest are building knowledge bases from diverse sources, representing and organizing knowledge; learning complex concepts; reasoning with uncertain, incomplete and contradictory information; self-assessment; planning in large partially known environments; and intelligent architectures that seamlessly integrate these capabilities for decision making.
- Teams of agents and humans: Develop computational methods for building collaborating teams of autonomous agents with decentralized decision making; develop computational models of human behavior and decision making for use by agents collaborating with warfighters.
- Scene understanding and perception: Methods for reconstructing 3-D scenes; recognizing objects, activities and events; inferring intentions from images and video; and describing images and video. Of particular interest are developing visual representations, building visual knowledge bases optimized for inference and developing methods for integrating reasoning with high-level knowledge and image data.

Research Challenges and Opportunities:
- Building knowledge bases, machine learning, reasoning, planning and architecture for seamless integration of these modules.
- Decentralized decision making for cooperative teams of autonomous agents.
- Computational models of human behavior and decision making for use by autonomous agents.
- Scene understanding from image/video for persistent surveillance, autonomous perception and managing large visual databases.