Cognition, Self-Reflection and Adaptable Robotic Behaviors

S&T Campaign: Sciences for Maneuver
Platform Intelligence

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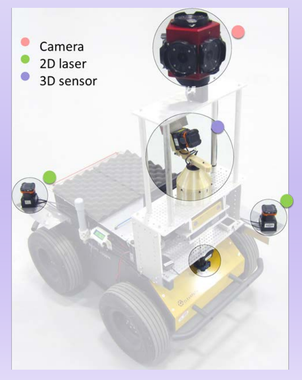
Research Objective

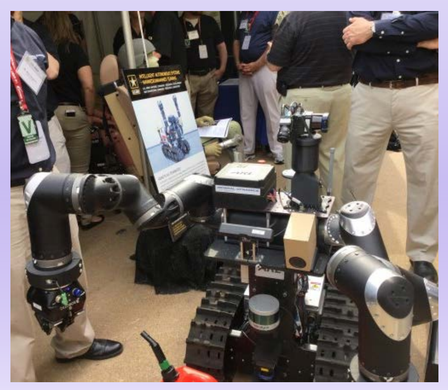
Provide autonomous robotic systems with the contextual understanding of perceived objects and the activities of the humans around them that would support scene interpretation, analogical reasoning and enable robots to become team members in military units

Our Robotic Assets

Indoor Platforms

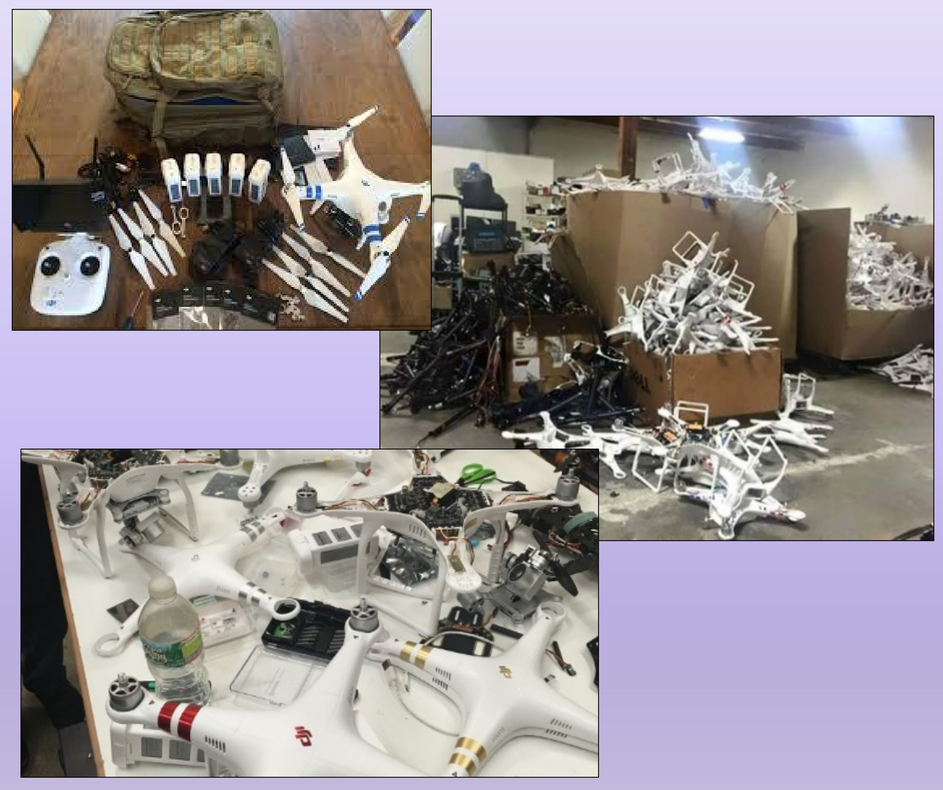


Sensor rich platforms


Manipulation platforms

Challenges

- Establishing a feedback loop between the Perceptual and Cognitive systems that enables effective use of context, experience and visual input
- Linking general world knowledge, ontologies, and external knowledge databases to a cognitive architecture to support analogical reasoning and scene understanding.
- Incorporating new knowledge without forcing the unmanned system to learn it from scratch
- Collecting data on coordinated activities
- Developing predictive models for military team behaviors from incomplete observations
- Aligning robot actions with overall team goals

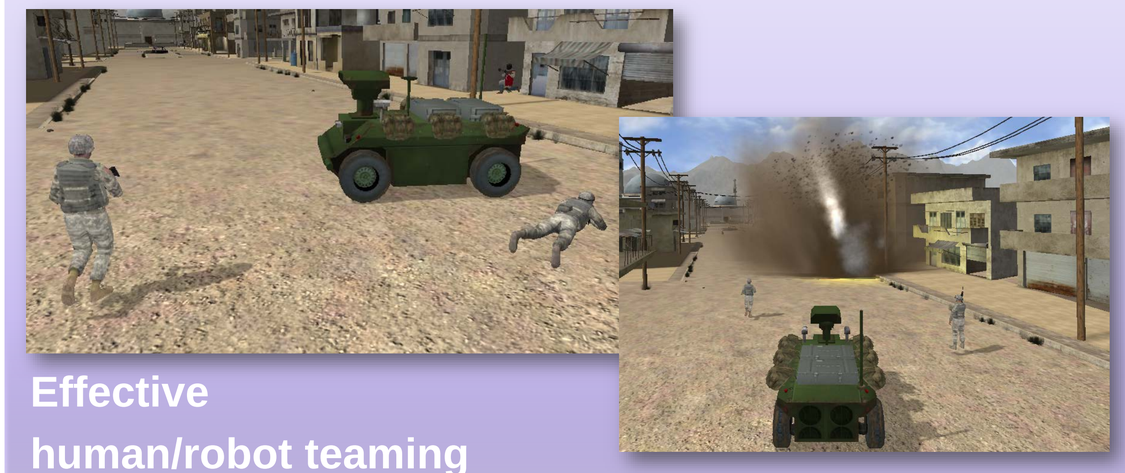


Scene interpretation

- Find a quadrotor that is ready to fly
- Find an image that shows evidence of recent human activity

ARL Facilities and Capabilities Available to Support Collaborative Research

- **Large indoor facilities for controlled mobility and perception testing; access to outdoor testing facilities**
- **Multiple ground robots with diverse sensors**
- ***High-fidelity battlefield simulation tools***
- **High performance computing assets**
- **Access to Soldiers and military units**
- **ROS algorithms**
- ***ROS/ACT-R connection***



Effective human/robot teaming

Effective human/robot team behavior requires the robot to model the behavior of its teammates as individuals and as a group. Our current research concentrates on building predictive models of military team behavior from incomplete observations.

Complementary Expertise/ Capabilities Sought in Collaboration

- **Artificial general intelligence**
- **ACT-R/ Cognitive architectures**
- **Cognitive robotics**
- **Machine Learning**
- ***Coordinated* activity recognition**
- **Dynamic scene understanding**
- **Reasoning in partially observed environments**
- **Online performance measurement and analysis**
- **Theory and concepts of Categorization**

Relevant Publications

- M. Fields, C. Lennon, C. Lebiere, and M. K. Martin. Recognizing Scenes by Simulating Implied Social Interaction Networks. In International Conference on Intelligent Robotics and Applications (pp. 360-371). 2015.
- C. Lennon, M. Childers, R. Camden, L. Sapronov, M. Martin, A. Dornbush, E. Willer, M. A. Fields, and C. Lebiere. Assessment of RCTA Research. In Proceedings of the SPIE 10195, Unmanned Systems Technology XIX, 1019502, 2017.
- M. A. Fields, C. Lennon, M. Martin, and C. Lebiere. Priming for autonomous cognitive systems. SPIE Micro- and Nanotechnology Sensors, Systems, and Applications, 2017.
- M. Martin, C. Lebiere, M.A.Fields, & C. Lennon. A cognitive model of feature selection and categorization for autonomous systems. To appear in Proceedings of SBP-BRiMS in Washington, DC.
- M. K. Martin, C. Lebiere, M. Fields, and C. Lennon. Learning category instances and feature utilities in a feature-selection model. Presented at The 2016 ACT-R Workshop, Lancaster, PA, 2016.
- M. Martin, C. Lennon, M. A. Fields, & C. Lebiere. Recognizing scenes by implied social interactions. Under review.