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Meta-Cognition, Self-Reflection and Proprioception

S&T Campaign: Sciences for Maneuver
Vehicle Intelligence

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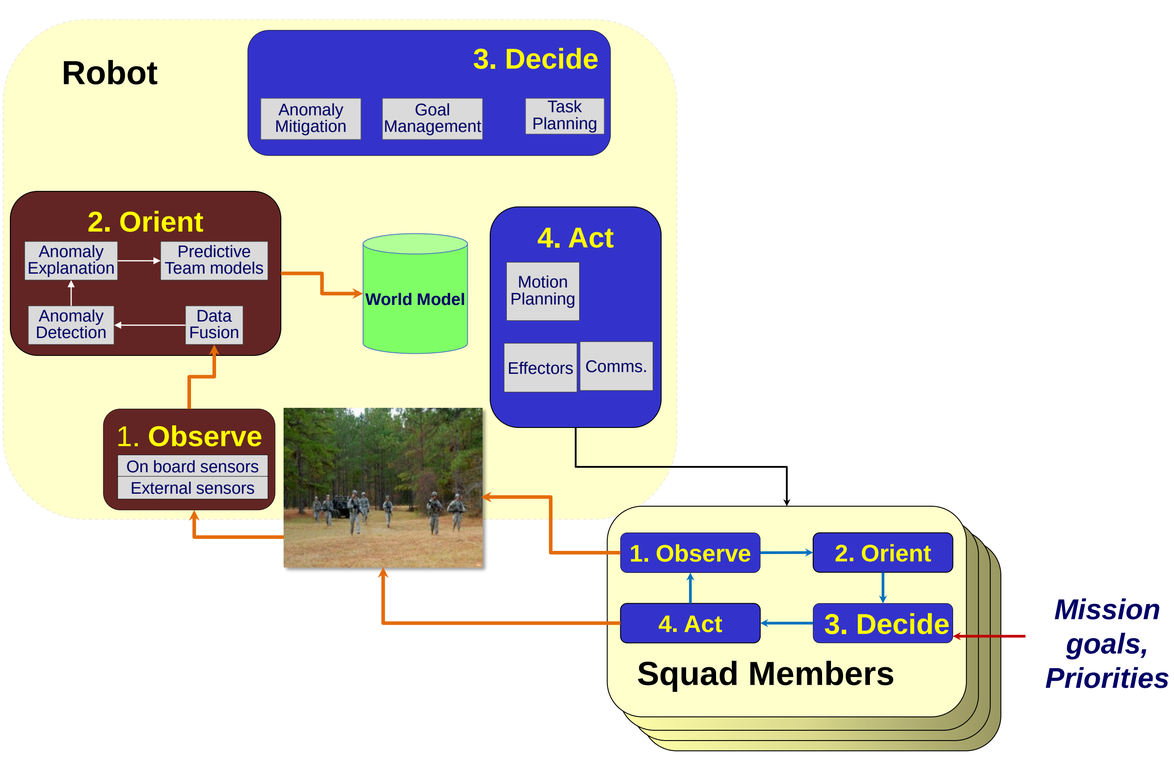
Research Objective

Develop technologies that enable an autonomous system to recognize transitions between normal operations and behaviors to abnormal operations and behaviors for both itself and its team enabling it to adjust its behavior to support the squad's dynamically changing goals.

Current autonomous systems cannot participate in squad missions that require them to dynamically adjust their behavior to support the changing goals of a squad.

Challenges

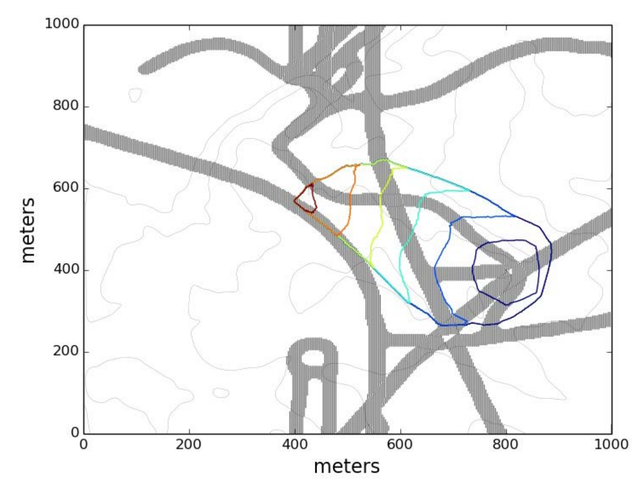
- **Collecting data on coordinated activities**
- **Developing predictive models for military team behaviors from incomplete observations**
- **Aligning robot actions with overall team goals**



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.

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**
- **Partnerships with the Naval Research Laboratory and the ARL Human Research & Engineering Directorate**



Probabilistic model of teammate location as a function of time and space. Each contour represents probable location at a given time.

Relevant Publications

- Pulido, Lennon, Fields and Barnes, *Constructing a Movement Model for a Small Unit. Conference on Applied Statistics in Defense*.
- Tron, Osteen, Owens, Daniilidis. *Pose Optimization for the Registration of Multiple Heterogeneous Views*. Robotics Science and Systems, 2014.
- Garcia, Richard D., Laura Barnes, and MaryAnne Fields. "Unmanned aircraft systems as wingmen." *The Journal of Defense Modeling and Simulation: Applications, Methodology, Technology* 9.1 (2012): 5-15.
- Fields, M-A., et al. "Effective robot team control methodologies for battlefield applications." *Intelligent Robots and Systems, 2009. IROS 2009. IEEE/RSJ International Conference on*. IEEE, 2009.

Complementary Expertise/ Facilities/ Capabilities Sought in Collaboration

- **Unsupervised learning**
- **Activity Recognition**
- **Dynamic Scene understanding**
- **Goal Reasoning**
- **Statistical relational learning**
- **Multi-Sensor Fusion**
- **Reasoning in partially observed environments**
- **Online performance measurement and analysis**

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