

# Mapping 3D Indoor Environments with Heterogeneous Robot Teams



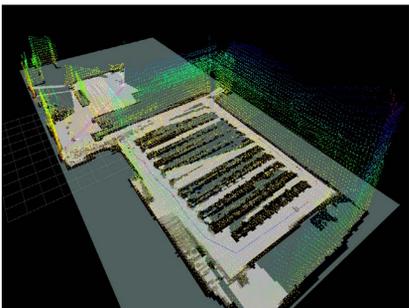
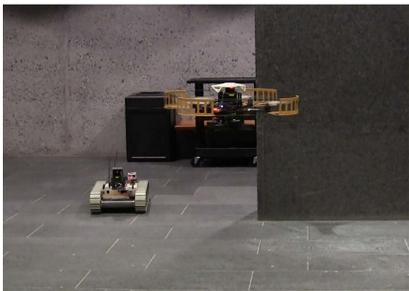
**S&T Campaign: Information Sciences**  
*Intelligent Systems: Computational Intelligence*

**S&T Campaign: Science for Maneuver**  
*Vehicle Intelligence: Intelligence and Control*

John Rogers, (301) 394-1811  
john.g.rogers59.civ@mail.mil

## Research Objective

- Perform autonomous navigation and exploration using UAVs and UGVs in unknown environments
- Scenarios considered relate to reconnaissance and persistent surveillance using heterogeneous teams of mobile robots

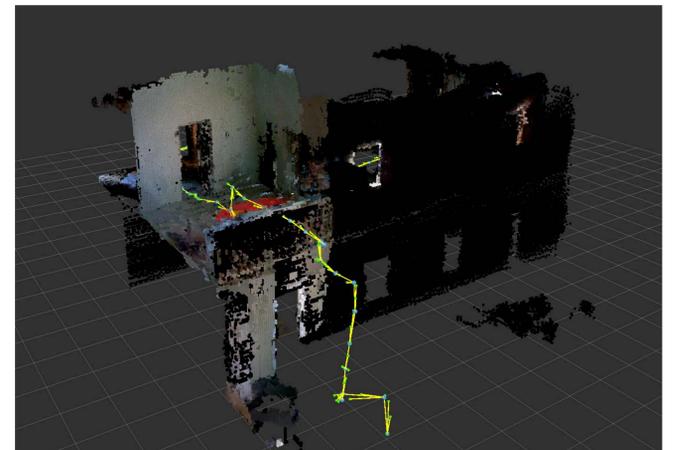


## ARL Facilities and Capabilities Available to Support Collaborative Research

- Indoor urban test facility with full-size multi-story buildings for air and ground autonomous systems experimentation
- Heterogeneous robotic platforms
- Research codebase built on Robot Operating System (ROS) for easy integration
- Nieto-Granda, C., Rogers, J. G., & Christensen, H. I. (2014). Coordination strategies for multi-robot exploration and mapping. *The International Journal of Robotics Research*, 0278364913515309
- Trevor, A. J., Rogers, J. G., & Christensen, H. I. (2014, May). Omnimapper: A modular multimodal mapping framework. In *Robotics and Automation (ICRA), 2014 IEEE International Conference on* (pp. 1983-1990). IEEE.

## Challenges

- Demonstrate UAVs and UGVs working together to build a pose-graph map using existing mapping algorithms
- Demonstrate 3D Mapping with heterogeneous robots using 2D and 3D sensors
- Develop frontier-based as well as novel information-gain based autonomous exploration strategies for multiple robots
- Develop new techniques for coordination between heterogeneous robots, leveraging the strengths of each modality
- Develop multi-floor mapping capability
- Deploy small "MAST relevant" sized robots capable of running existing mapping algorithms



## Complementary Expertise/ Facilities/ Capabilities Sought in Collaboration

- Effectively increase scalability in order to conduct larger scale experiments
- Methodology to efficiently share and distribute global map computation in real time
- Extend task allocation mechanism to reason about capabilities of heterogeneous platforms in executing exploration task

