



U.S. ARMY
RDECOM

Semantic Spatial Understanding



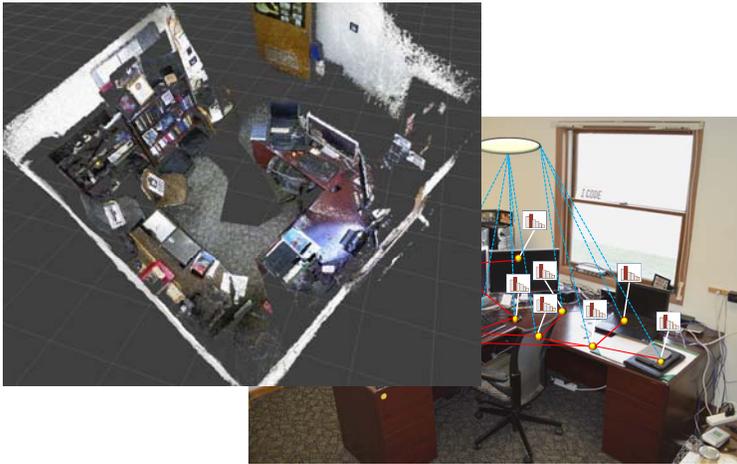
S&T Campaign: Sciences for Maneuver Vehicle Intelligence

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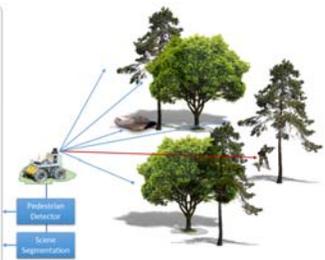
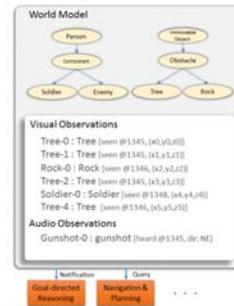
Research Objective

- Develop novel perception techniques that enable continually learning intelligent systems
- Focus on knowledge representation and storage, allowing systems to describe their environment in human understandable terms, including spatial relationships between objects and places
- Create flexible, scalable techniques for online learning and world modeling for improved cognition through the creation of adaptable systems with a focus on dynamic, experiential knowledge representation



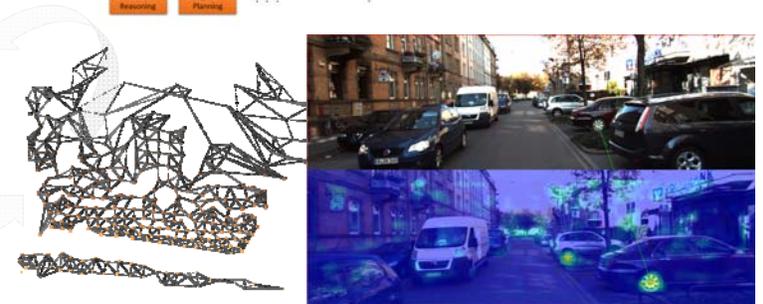
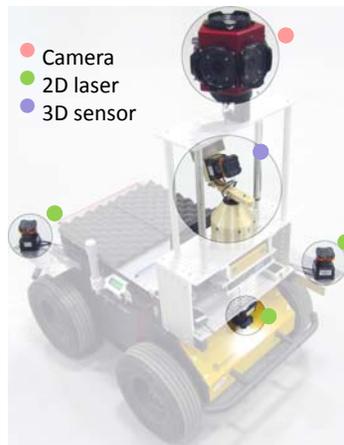
ARL Facilities and Capabilities Available to Support Collaborative Research

- Large indoor bays for controlled mobility and perception testing; access to outdoor testing facilities
- Large, two-tier, motion capture system for localized ground truth
- Multiple ground robots with diverse sensors, including multisensor calibration library
 - Velodyne HDL-32
 - Ladybug5 spherical camera
 - Point Grey monocular cameras
 - Slipring-mounted spinning Hokuyo LRF



Challenges

- Harnessing the availability of existing data sets; creating new data sets when necessary
- Adapting algorithms to learn online and continuously; modifying models based on incoming data
- Integrating and exploiting multiple modalities including image, laser, and depth sensors



Relevant Publications

- Owens, Osteen, Daniilidis. *MSG-Cal: Multi-sensor graph calibration*. IROS 2015
- Tron, Osteen, Owens, Daniilidis. *Pose optimization for the registration of multiple heterogeneous views*. MViGr 2014
- Owens, Osteen, Daniilidis. *Temporally consistent segmentation of point clouds*. SPIE DSS 2014
- Osteen, Owens, Kessens. *Online egomotion estimation of RGB-D sensors using spherical harmonics*. ICRA 2012
- Owens. *Object detection using the Kinect*. ARL TR 2012
- Owens, Fields. *Incremental region segmentation*. ASC 2010

Complementary Expertise/Facilities/ Capabilities Sought in Collaboration

- Unsupervised learning and feature discovery
- Scene understanding
- Knowledge representation
- Statistical relational learning
- Cognitive systems