

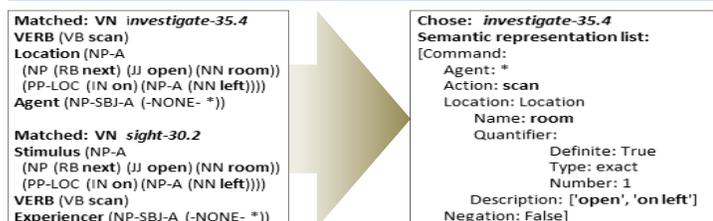


S&T Campaign: Information Sciences
System Intelligence and Intelligent Systems
S&T Campaign: Science for Maneuver
Vehicle Intelligence

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Research Objective

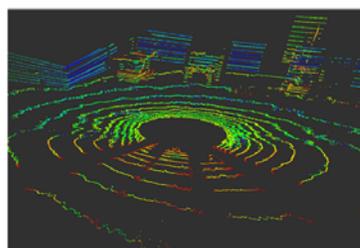
Develop methods for mobile robots to understand their surroundings and communicate via natural language in order to autonomously complete mission objectives.



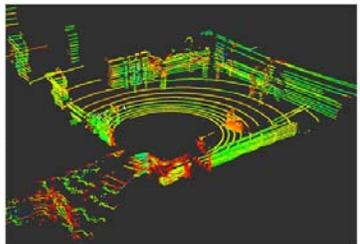
Extracting structured commands from natural language commands

Challenges

- Representing semantics of spatial language.
- Ground sentences about scenery and route planning in incomplete 2D and 3D world models.
- Align entities across modalities using NLP, Computer Vision, & SLAM (Simultaneous localization and mapping)



R₄₁: I can see in the entrance
 C₄₂: Enter and scan first room



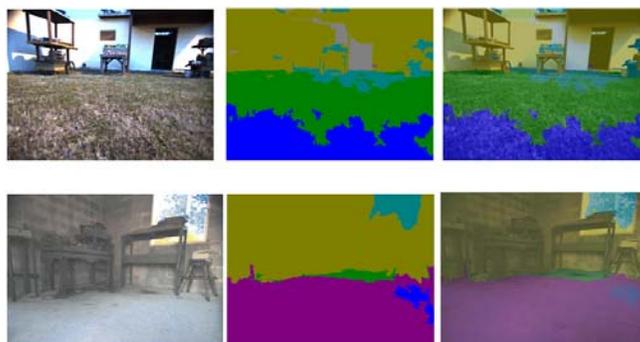
R₄₃: I see a door to the right
 and a door to the left
 C₄₄: Scan next open room on left

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
- A fleet of mobile robots, including PackBots and Jackals, with a wide array of sensor capabilities
- High Performance Computing center with world-class supercomputer cluster

Publications

- Cassidy et al, "Turn-Taking in Commander-Robot Navigator Dialog", 2015, *AAAI Spring Symposium Series*
- Summers-Stay et al, "Joint Navigation in Commander Robot Teams", COLING 2014, *V&L Net*
- Voss et al, "Collaborative Exploration in Human-Robot Teams: What's in Their Corpora of Dialog, Video, & LIDAR Messages?" EACL 2014, *Dialog in Motion*



Outside & Inside: Camera Image (L), Semantic class labels (middle), Overlay (R)

Complementary Expertise/ Facilities/ Capabilities Sought in Collaboration

- Expertise in 3D scene understanding – going from registered point clouds and images to labeled objects
- Expertise in spatial semantics – turning natural language statements about the physical world into usable spatial representations
- Experience with machine learning: the connections between physical scenes and natural language
- AI Planning alongside multi-modal task-oriented dialogue
- Undergraduate and graduate students to:
 - design and conduct experiments,
 - develop data annotation schemes,
 - propose, implement, and test algorithms for natural language processing of collected dialog data.