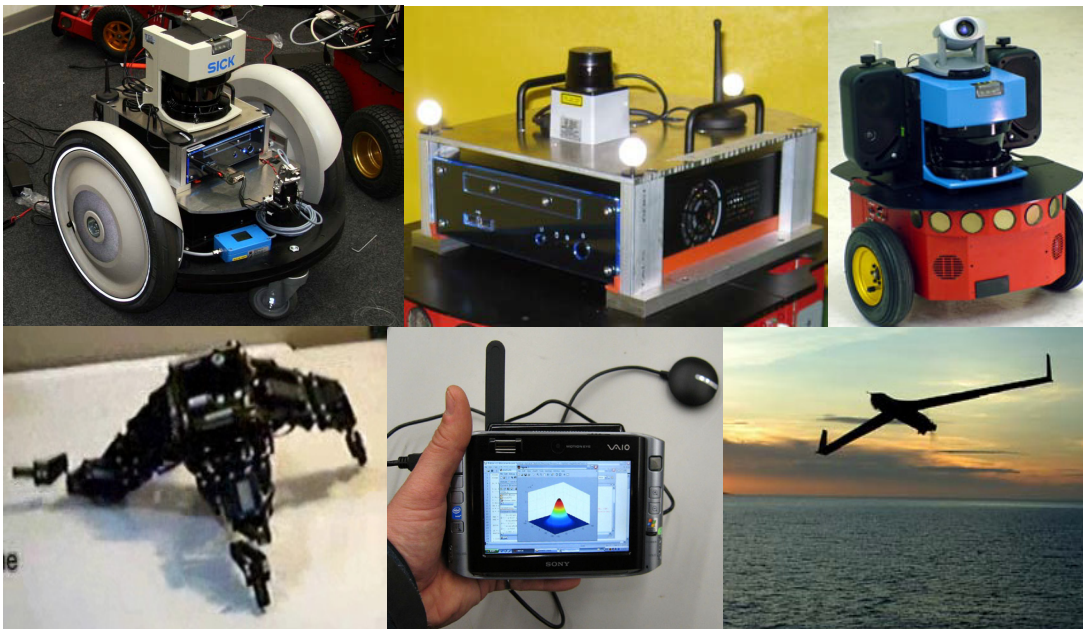


# M.Eng. and Undergraduate Project Announcement

## Robotics projects in the Autonomous Systems Lab

Overview: A variety of projects are available in the Autonomous Systems lab. The lab focuses on all types of robotics, including theory, hardware, software, and networking for a variety of applications in the general area of autonomous/semi-autonomous robotic systems. Example motivational missions include: search and rescue, planetary exploration, surveillance, environmental monitoring, security systems, disaster relief, urban operations, etc. The lab currently has a variety of vehicles (rovers, aerial quad-rotors, walking robots), sensors (laser range finder, camera/vision, infra-red/thermal), networking using wireless Ethernet, accurate GPS-like indoor localization systems using multiple fixed cameras, computer cluster for off-board control and data processing, user interfaces using hand-held computers, and a modular testing area to simulate scenarios such as partially collapsed buildings during fires. Examples are given below:



Most projects will focus on solving a research problem using a small team (several MEng/UG students, PhD students, Professors). Example: network of humans with handhelds and robots searching an area. The need is for MAE, ECE, and CS students. Projects are typically hands on, and a working knowledge of programming is helpful, but not necessarily required. A partial list of projects is given below.

***An Information Session will be held on Wednesday, August 26<sup>th</sup> at 4:30 PM in the lab (153/155 Rhodes Hall).*** People that cannot make this session can join our first lab meeting of the semester on Wednesday, September 2nd at 5:00 PM in the lab.

**Faculty sponsors:** Prof. Mark Campbell (mc288) and Prof. Hadas Kress-Gazit (hk478)

**Lab wiki:** [http://asl.mae.cornell.edu/wiki/index.php/Main\\_Page](http://asl.mae.cornell.edu/wiki/index.php/Main_Page)

**Number of Undergraduates and MEngs.** Approximately 10

**Needed Skills:** A subset of the following skills: Proficiency in software engineering, programming in C and C++, mechatronics, communication and networking; filtering, control systems; artificial vision, electronics, design and CAD work, shop experience.

**Time Frame:** Fall 2009 - Spring 2010 (two semesters or summer + one semester min).

### **Application Instructions:**

- 1) Download ([www.mae.cornell.edu/campbell/Student\\_Application.rtf](http://www.mae.cornell.edu/campbell/Student_Application.rtf))
- 2) Rename file "LastName\_FirstName" (either rtf or pdf)
- 3) Fill out application, including desired projects
- 4) Email to Profs. Campbell (mc288) and Kress-Gazit (hk478).

### **Specific Projects in ASL:**

- Project A.* Design of a Two Axis Gimbal: Design of a two axis gimbal for a rotating laser sensor such that the sensor and gimbal axes are aligned.
- Project B.* Multi-robot Task planning: Develop software and algorithms to transform high-level language-based specifications into multi-robot control.
- Project C.* Embedded controller design for new, small robots: Design control and software components for a set of new robots in the lab.
- Project D.* Quadrotor control: Design control and software components to enable our indoor quad rotors to hover, point, and move from point to point.
- Project E.* Hybrid controller for rover/quad rotor: Design and implement a path planner using motion primitives in a hybrid system framework.
- Project F.* Develop SLAM components: Learn about and implement software components in our lab for simultaneous localization and mapping. Could use open source codes. Demonstrate with single and multiple vehicles.
- Project G.* Vision based detector: Using computer vision techniques, develop a software component that enables the detection of objects (chairs, tables, robots, etc.) from a camera image in real time.
- Project H.* CAD models of uncertainty: Create 3D CAD models from robotic mapping software algorithm outputs and determine the best way to represent uncertainty
- Project I.* Vision processing toolkit: Evaluate open-source vision processing libraries and incorporate them into the ASL software architecture to enable a suite of tunable vision processing algorithms that support multiple different cameras (Basler, Fire-I, Quad rotor)
- Project J.* Robotic Mapping Datasets: Determine robotic mapping datasets available from community and the storage techniques and formats used. Create support software for our robots that enables publication of standard format robotic mapping data with emphasis on large collections or 3D laser data
- Project K.* Networking Infrastructure for Research Studies: Quantify performance of laboratory wireless network and evaluate software to perform artificial degradation of network and implement in laboratory
- Project L.* Multiple Vehicle Planning: Evaluate different multi-agent planning techniques vs. formation following techniques and implement on robots to coordinate resources to achieve a common goal (ex: area search).
- Project M.* Visual Odometry: Develop a visual odometry system for use on the robots and quantify camera parameter accuracies on performance of the system.
- Project N.* UAV Planners in DDD Simulator: Design and integrate UAV path planners into the DDD simulator, a multiple vehicle simulator designed by the US Air Force.