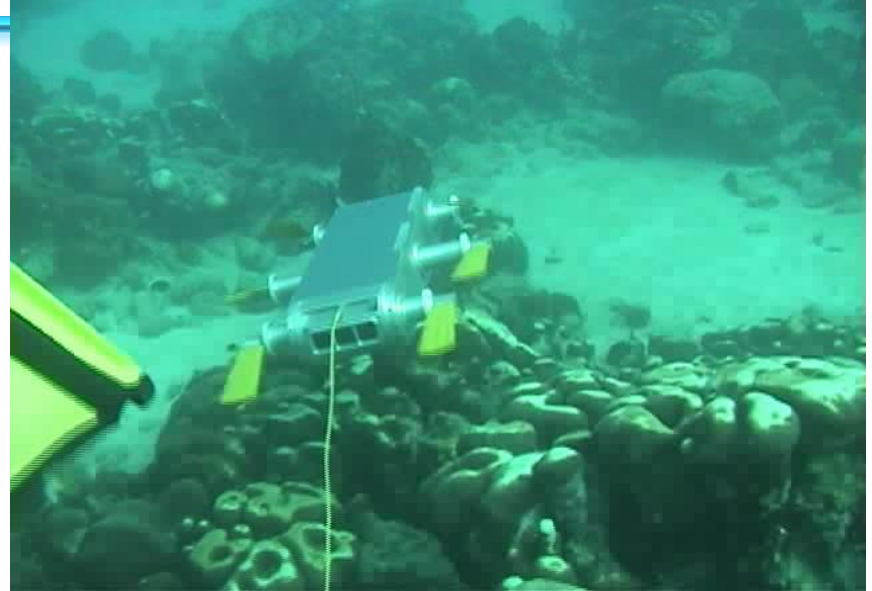# CS-417 INTRODUCTION TO ROBOTICS AND INTELLIGENT SYSTEMS

Introduction

Ioannis Rekleitis

Why Robotics

Mars Exploration Rover animation

Underwater exploration, Barbados

Roomba vacuuming robot in action.
More than 5M sold!

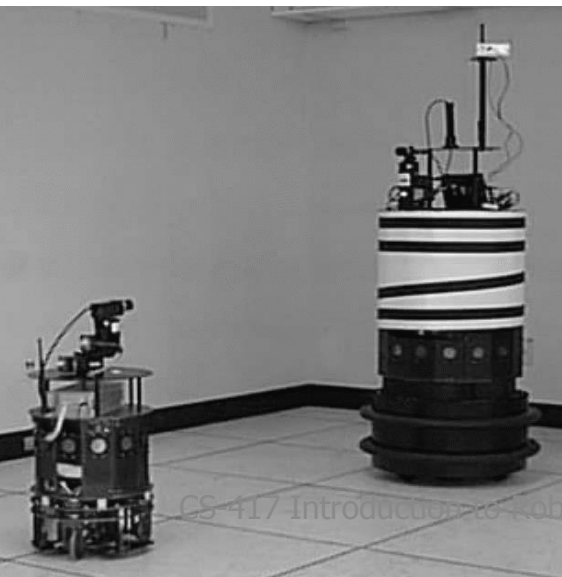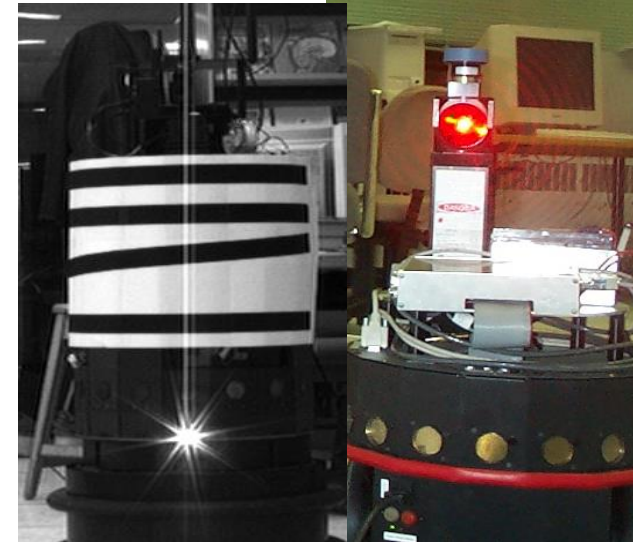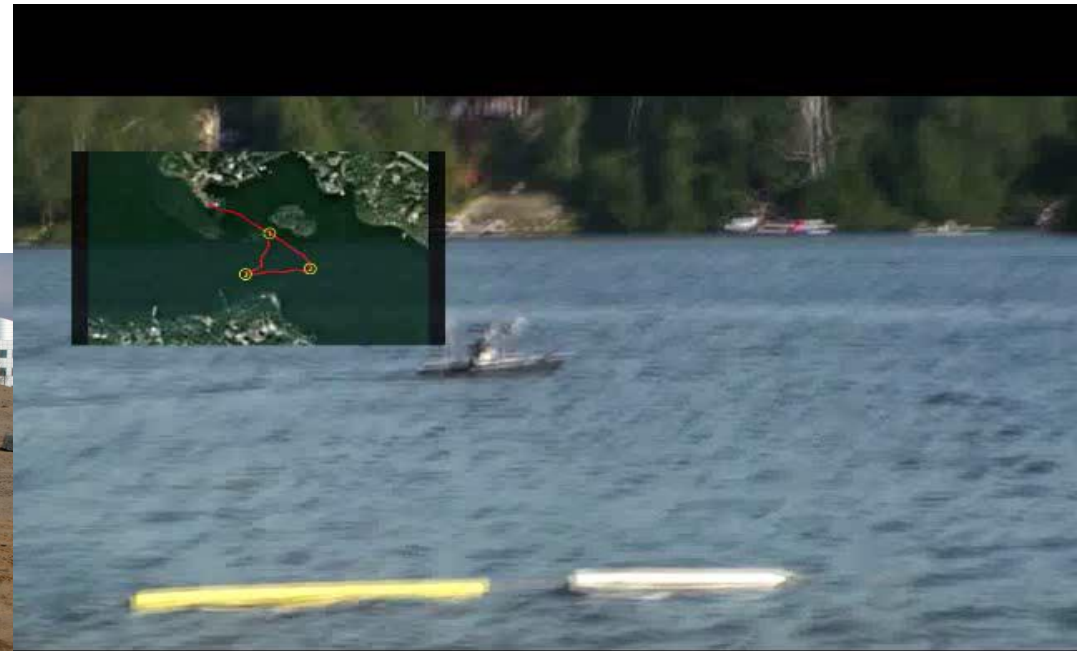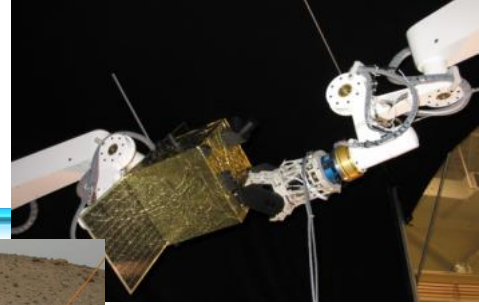Planetary exploration experiment at CSA

Why Robotics?

- Manufacturing
- Labor shortage (agriculture, mining)
- Point where computers fast/cheap
- Automation of cars→more cars on highways
- To reach areas where no human can go

Past Projects

Past/Current Projects

Current work in U/W Robotics

Three Main Challenges in Robotics

1. Where am I? (Localization)

2. What the world looks like? (Mapping)
   - Together 1 and 2 form the problem of *Simultaneous Localization and Mapping* (SLAM)

3. How do I go from **A** to **B**? (Path Planning)
   - More general: Which action should I pick next?

- What should I do next? (Planning)

Syllabus

Week 1: Syllabus presentation, Round Table, Introduction, History of Robotics.

Week 2: Actuators. Locomotion. Manipulators.

Week 3: ROS, Control

Week 4: Sensor (Tactile, Range Finders, GPS, IMU, Position Encoders).

Week 5: Mapping: Metric Maps, Topological Maps, hybrids

Week 6: Sensor (Vision).

Week 7: Visibility Graphs, Bug Algorithm, Potential Fields.

Week 8: Generalized Voronoi Graphs, Atlas.

Week 9: **Mid-Term.** Semantic hierarchy of spatial representations. Configuration Space, PRMs

Week 8: Architectures. HRI

Week 9: Coverage, Multi-Robot Coverage

Week 10: State Estimation, Dead reckoning, Landmarks, Bayesian Filtering

Week 11: Particle Filters, Kalman Filters, SLAM

Week 12: SLAM, BoeBots tutorial

Week 13: Planetary Exploration, On-Orbit Servicing of Satellites, Underwater Robots

Week 14: In class demo, Review of Material

Week 15: **Final**

Evaluation
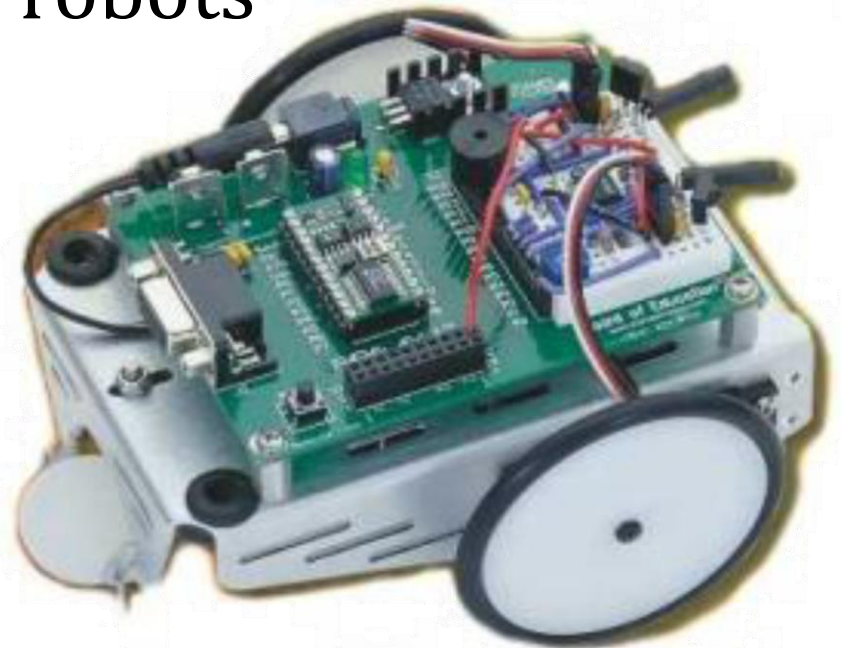
- 3 Assignments, 10% each: 30%
- Midterm Examination: 10%
- Final Examination: 35%
- Team Project   20%
- In class participation   5%

Assignments

- Using ROS
- Using Simulations
- Using sensor data from real robots
- Using real robots (BoeBots)

Contents

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- TA: Malika Meghjani

Walter's *Tortoise 1950's*

http://www.youtube.com/watch?v=lLULRlmXkKo