Multi-Robot Control (MRC)

W11: Course Review
Plan of the Day

Project Update
• Projects should be done today!
• Project briefs: 5-7 minutes
• Review of documentation and code starting tomorrow
  – Will post comments this week and may ask for clarification

Course Review
• Revisit course goals and evaluate progress
• Lessons learned
  – What worked?
  – What didn't?
Goals

As a result of completing this course you should be able to...

• Describe some of the current multi-robot research efforts.
• Read and understand a research publication associated with multi-robot control and comment on the larger research context.

• Apply a subset of the most common multi-robot techniques using analytic, simulation and experimental techniques
  – **Use** Linux, ROS and Git for controlling robots
  – **Program** robot control in MATLAB/Simulink
• Design, test and implement your own multi-robot algorithms using a principled implementation process.
Theory and Practice

Breadth: 10k' view of the field
Depth: tools and skills of implementation

- **Theory**: Classic algorithms, Research literature
- **Practice**: Hardware (UGVs, sensors, actuators), Software (ROS, MATLAB)
Research Articles

- Drop one?
- Keep one?

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<tr>
<th>Week</th>
<th>Monday</th>
<th>Leader(s)</th>
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| 2: 8 April | Multi-Robot Overview  
Distributed Intelligence: Overview of the Field and its Application in Multi-Robot Systems, Lynne E. Parker | Lebrun   |
| 3: 15 April | Behavior-Based Control  
Designing and Understanding Adaptive Group Behavior, Maja J. Mataric | Magee   |
| 4: 22 April | Behavior-Based Control  
STP: Skills, Tactics, and Plays for Multi-Robot Control in Adversarial Environments, B. Browning et al. | Tsatsanifos |
| 5: 29 April | System-theoretic control  
| 6: 6 May | System-theoretic control  
| 7: 13 May | Applications  
Cooperative control of mobile sensor networks: adaptive gradient climbing in a distributed environment, Ogren, Fiorelli and Leonard. | Lowry |
| 8: 20 May | Applications  
Multi-AUV control and adaptive sampling in Monterey Bay, E. Fiorelli et al. | Price |
Assignments

- Assignment 1: Introduction to Linux and Git (19-3)
- Assignment 2: ROS Tutorials Part 1 (19-3)
- Assignment 3: ROS and MATLAB/Simulink (19-3)
- Assignment 4: Networking, Turtlebot Setup, Waypoint Navigation (19-3)
- Assignment 5: Navigation, Path-Planning and Action Interface (19-3)
- Assignment 6: Action Server and Multiple TurtleBot3 Localization (19-3)
- Assignment 7: Leader Follower and RFID (19-3)
- Final Project 19-3: DTE Robotics Challenge
Working Hypothesis

- Students focusing on unmanned systems should be able to...
  - Proficient users of ROS
    Which means they need to be users of Linux, Git, etc.
  - Proficient developers in MATLAB/Simulink

This is a hypothesis; I'm interested in your experience and observations throughout the course.
Review Questions

Theory vs. Practice
• Majority of the effort was practical – did reading articles complement or distract?

A set of tools:
  Linux+ROS+MATLAB+Git
• Too large of a scope?
• Consistent? What didn't fit?

Next Steps
• Will you use these tools in the immediate future?
• Are there missing pieces?
Summary

Read seven research articles
- Lead discussion on one

Seven assignments/labs
- Fundamentals: Linux, Git, ROS
  - Integrating other software components
- Hardware Integration: Multiple computers, sensor integration
- Map-based localization
- Simple waypoint guidance via Simulink-ROS
- move_base waypoint guidance via MATLAB-ROS
- Multi-Robot implementation
  - Namespaces and tf_prefixes

Final Project
- Developing your own application and documentations