RSS I: Recap

RSS Lecture 20 Monday 12 April 2010 Prof. Teller & Dr. O'Reilly

Key Questions

- What were we trying to do in RSS?
 What we covered this term, in lecture and lab
- Where might we go from here? – Other robotics-related activities at MIT and beyond

RSS I: Teaching Objectives

- Intensive introduction to mobile robotics
 - Focus on autonomous mobility & manipulation
 - End-to-end, systems perspective on robotics
 - Exposure to fundamental robotics algorithms
 - Mens et manus: lecture and lab
 - · Hands on literally every aspect of a mobile robot
 - Generalists! With depth in some area of interest
 - Course challenge: 4-6 week scope
 - Authentic, intense team-based design experience
 - Flexibility to choose your technical focus & role
- Communications
 - Briefings, engineering documents, schedules
 - Team coordination and dynamics
 - Debates: consideration of policy and ethical perspectives

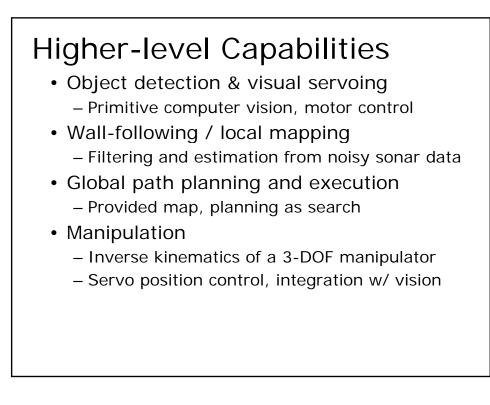
Robot Architectural Layers

- Controller board architecture
 Power, sense data, control
- Signal-level motor control – PWM, closed-loop feedback
- Reactive behavior w/ analog sensing
 Braitenberg with photoresistors
- ... All of this was managed by you
 - Direct odometry handling, motor control etc.

Abstraction via Carmen

- One possible choice of robot "O/S"
 - Publish/subscribe message abstraction
 - Message-based event handling
 - Odometry and sensor time-stamping
 - Low-level motion primitives
 - Extensibility
- Alternatives:
 - USC Player/Stage
 - Microsoft RDS
 - Willow Garage ROS
 - MIT LCM

- ...



Things We Didn't Get To

- Localization and SLAM
 - From bump sensors, sonar, vision, ...
- State estimation
 - Inference under uncertainty (e.g. Kalman filter)
- High-level vision
 - Object recognition and classification
- Human-robot interaction
 - Speech, gesture, shared mental models, ...
- High-level planning
 Action selection, unstructured environments, ...
- Distributed activity
 - Multiple communicating and coordinating bots

Areas We Didn't Get To

- Factory automation
- Walking, flying, swimming, climbing robots
- Biologically-inspired robots
- Medical robotics & haptics
- Mobile manipulation robots
- Space robotics
- Learning robots
- Assistive robots & exoskeletons
- Field and service robots
- Evolutionary robotics
- Neurorobotics

Where do we go from here?

- MIT subjects
 - Aero/Astro, EECS, MechE, Media Lab, IAP, ...
- Research (UROPs, MEng, SM, PhD)
 - RRG (Nick Roy)
 - RLG (Tedrake)
 - RVSN (Teller)
 - DRG (Rus)
 - CMG (Deb Roy)
 - SMG (Breazeal)

- ARES (Frazzoli)
- MERS (Williams)
- LIST (Asada)
- HAL (Cummings)
- NSL (Slotine)
- Biomechatronics (Herr)
- LISG (TLP, LPK)
- COE (Leonard)
- ACL (How)
- HRG (Hover)

Where do we go from here? Industrial internships Microsoft, iRobot, Willow Garage, BDI, Vecna, Evolution Robotics, Heartland Robotics, ... Government / Academic labs NASA, JPL, NRL, ARL, Sandia, Penn GRASP Lab, Berkeley, Stanford, CMU Robotics Institute, ...

Summarizing...

- Tried to give you a taste of robotics...
 - In all its interdisciplinary glory: math (geometry, inference, estimation, optimization), physics, mechanical engineering, electrical engineering, computer science, cognitive science ...
- ... as an engineering endeavor
 - -Systems thinking
 - Engineering tools and methods
 - Managing complexity
 - Deadlines and milestones
 - Team dynamics

At the end of the day

- RSS is a real engineering experience

 Structured component (lectures, labs)
 Less-structured component (challenge)
- With deliverables, communications
- Regardless of what you do next
 - -We hope that the tools and techniques used in RSS will serve you well!
- ... Break a leg in the challenge runs.