The RSS
Course Challenge

RSS Lecture 11
Wednesday, 12 March 2014
Prof. Seth Teller
Overview

- Historical context
- RSS Challenge scenario, requirements
- What you are provided
- Schedule through end of term
- Graded challenge milestones
- Q&A
Why Challenges?

• Determine longitude while at sea
  – Solved in (read the book Longitude)

• Emperor’s food preservation prize
  – Offered £12,000 (hundreds of $K today)
  – Solved in ; led to canning industry

• Prize for ship-sinking in war-time
  – Led to development of first submarine

• Ivory substitute for billiard balls
  – Catalyzed celluloid, led to plastics industry

• Many modern variants (DGC, X-prize etc.)
Build a Shelter on Mars

Goodyear STEM (Stay-Time Extension Module) concept, 1979
Build a Shelter on Mars

• Prior delivery of *materials*, at planned & unplanned locations; some destroyed
• Coordinates of *fiducials* established (via satellite) throughout environment
• Robot is then deposited within arena
  – Can assume known or unknown location
• Robot must then:
  – Move itself within the environment
  – Identify and collect available materials
  – Transport them to a suitable site
  – Arrange simple shelter or structure there
Challenge sub-tasks

- **Plan and Navigate:**
  - Navigate, starting from known location (team places robot)
  - Optional: handle unknown start location (staff places robot)
  - Form motion plans around mapped, unmapped obstacles

- **Identify Construction Site:**
  - Define site location *a priori*, or have robot choose it online

- **Find Objects:**
  - Detect objects of known types at expected locations
  - Detect objects at unknown locations, identify object types

- **Gather and (Optionally) Store Objects:**
  - Collect blocks on, under, or within robot body

- **Transport Objects:**
  - Convey blocks to construction site (all, serially, in groups)

- **Construction:**
  - Create a simple structure of your choice (e.g. group, row, open/closed wall, stack, multi-story wall) at construction site

- **Optional:**
  - *Any* technical aspect on which your team wishes to focus
What you are provided

- Robot through final lab, and other parts
- ROS source, staff solution code
- Map of challenge environment, blocks
- Fiducial locations, color coding
- Rules / constraints
What you are provided

• Materials
  – Standard RSS microbot, sensors, etc.
  – Delrin, Lexan, sheet metal, plywood etc.
  – Any parts needed from RSS, EECS stockroom
  – $50 budget for outside components
    (use MIT’s tax-free number, save receipts)
  – Absolutely no cardboard or duct tape
    (decorative or cosmetic cardboard is OK)

• Shop access
• An approximate map of challenge area
• Fiducial locations, color coding
• Rules / constraints
Shop Access

- MIT has many shops
  - EECS shop, hobby shop, MechE, Aero/Astro...
- And fabrication facilities
  - Waterjet cutter, Laserjet cutters, 3D printers, ...
- RSS does not arrange shop access...
  - Why? Scaling, fairness
- ... BUT we urge you to be resourceful, i.e. coordinate access through home dep’ts, UROPs/club/independent activities
Examples from Past Years

Block marshalling, servo-controlled release mechanism

Alternative design from another team
Examples from Past Years

Block marshaller

Funneling mechanism
What you are provided

• Materials
• Shop access

• An approximate map of challenge area
  – Global coordinate frame
  – Polyline perimeter of operation area
  – Mapped obstacles (some will be unmapped)
  – Mapped blocks (some will be unmapped)
  – Fiducials
  – Start location (optional)

• Fiducial locations, color coding
• Rules / constraints
What you are provided

- Hardware
- An approximate map of challenge area
- Fiducial locations, color coding
  - Two vertically-stacked colored balls
  - Coordinates and radius of each ball
  - Use blob detector from visual servo lab
- Rules / constraints
What you are provided

- Hardware
- An approximate map of challenge area
- Fiducial locations, color coding

- Rules / constraints
  - Team must be ready to run when called
  - Team has 2 minutes to stage and launch bot
  - Bot must run autonomously for 10 minutes
  - Bot can’t make destructive/irreversible changes
  - Walls will not move (much) if bot hits them

  - Each team should *narrate* its own bot’s run

- External sensors, code?
Challenge Schedule 2014

- **This Friday 14 March:**
  - Forum on expectations for team-written challenge proposal
  - Challenge Design Document *outline* (CDO) assigned, due 3/21

- **Next Friday 21 March:**
  - Challenge Document *Outlines* due in Forum (one per team)

- **Wednesday 2 April:**
  - CDOs returned with engineering comments

- **Friday 4 April:**
  - Forum: From CDO to CDD; CDD assigned, due 4/11

- **Wednesdays 9, 16, 23 & 30 April:**
  - Ungraded/Graded Challenge Milestone Demos 1, 2, 3, 4 (in lab)

- **Friday 11 April:**
  - CDDs due

- **Monday 5 May:**
  - Timed and non-graded challenge *dry runs* in lab

- **Wednesday 7 May:**
  - Timed and graded challenge *final runs* in lab

- **Monday 12 May:**
  - Component breakdown and stowing, in lab *(mandatory)*
Graded Milestone Demos

- **As specified in team-written Challenge proposal**
  - Will be graded by staff
- **Wednesday 9 April:**
  - Ungraded Challenge milestone demo (in lab)
- **Wednesday 16 April:**
  - Graded challenge milestone demo (in lab)
- **Wednesday 23 April:**
  - Graded challenge milestone demo (in lab)
- **Wednesday 30 April:**
  - Graded challenge milestone demo (in lab)
- **Monday 5 May:**
  - Timed, ungraded Challenge dry runs (in lab)
- **Wednesday 7 May:**
  - Final timed and graded Challenge runs
  - Narrated by each team, to entire class (no slides)