The RSS Course Challenge

RSS Lecture 11

Wednesday, 12 March 2014

Prof. Seth Teller

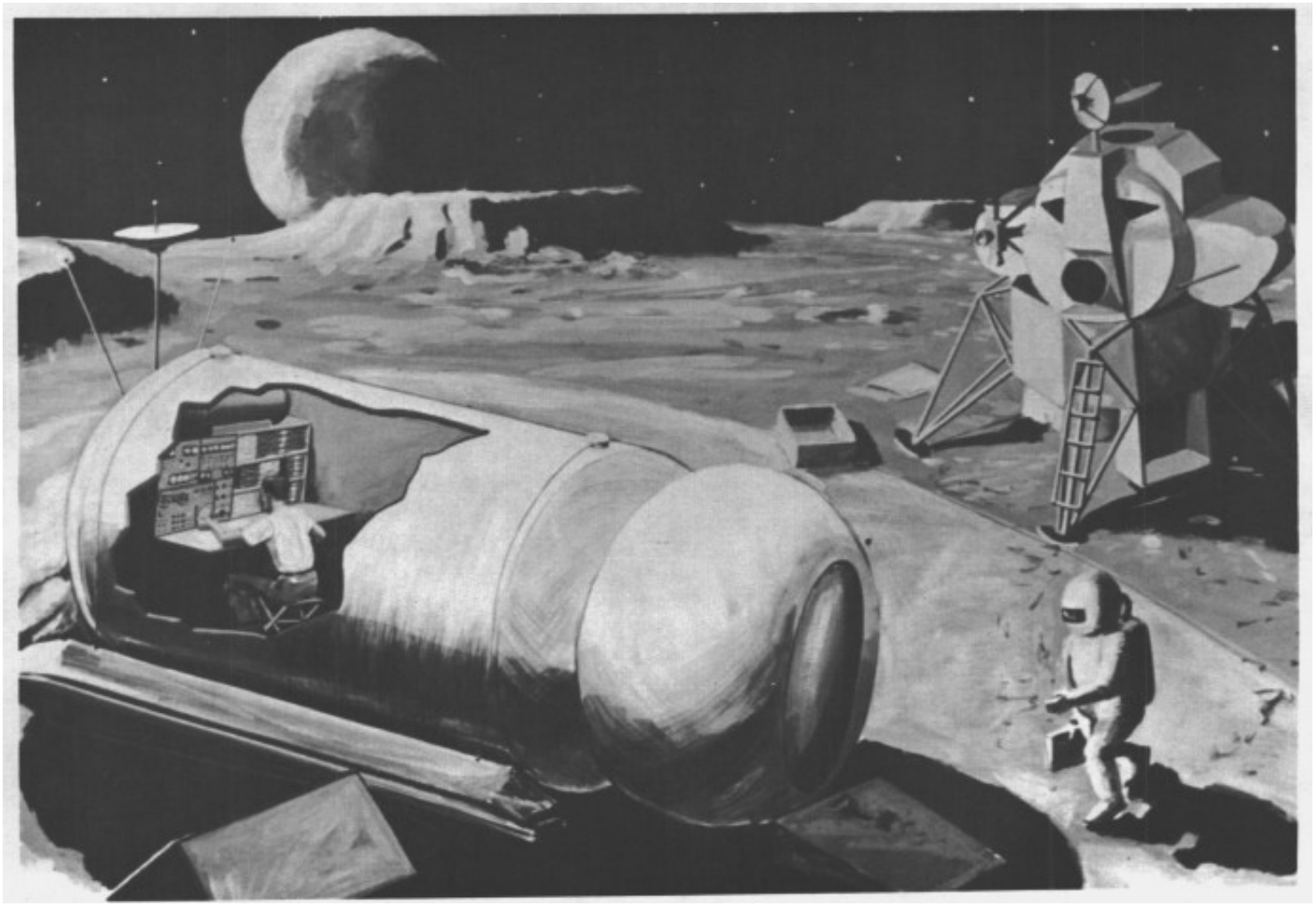
Overview

- 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

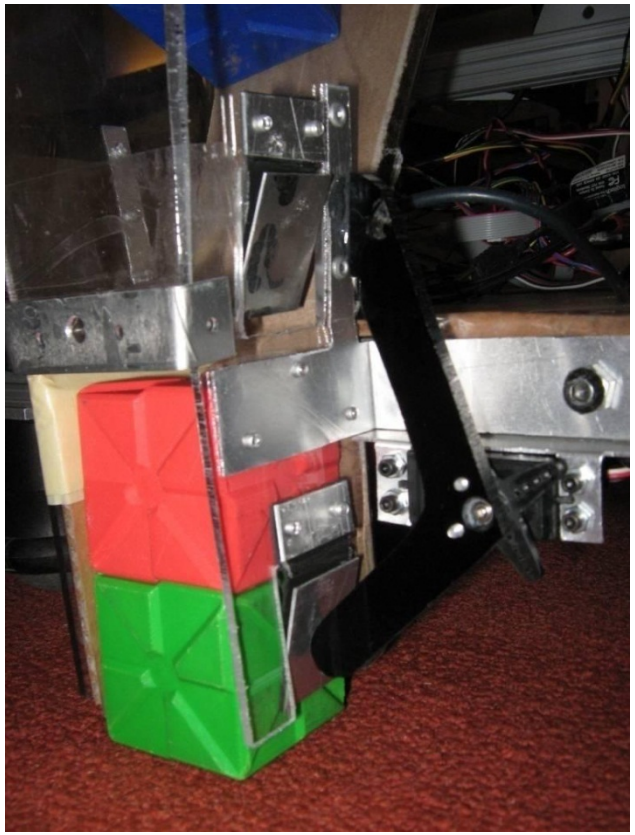
What you are provided

- 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

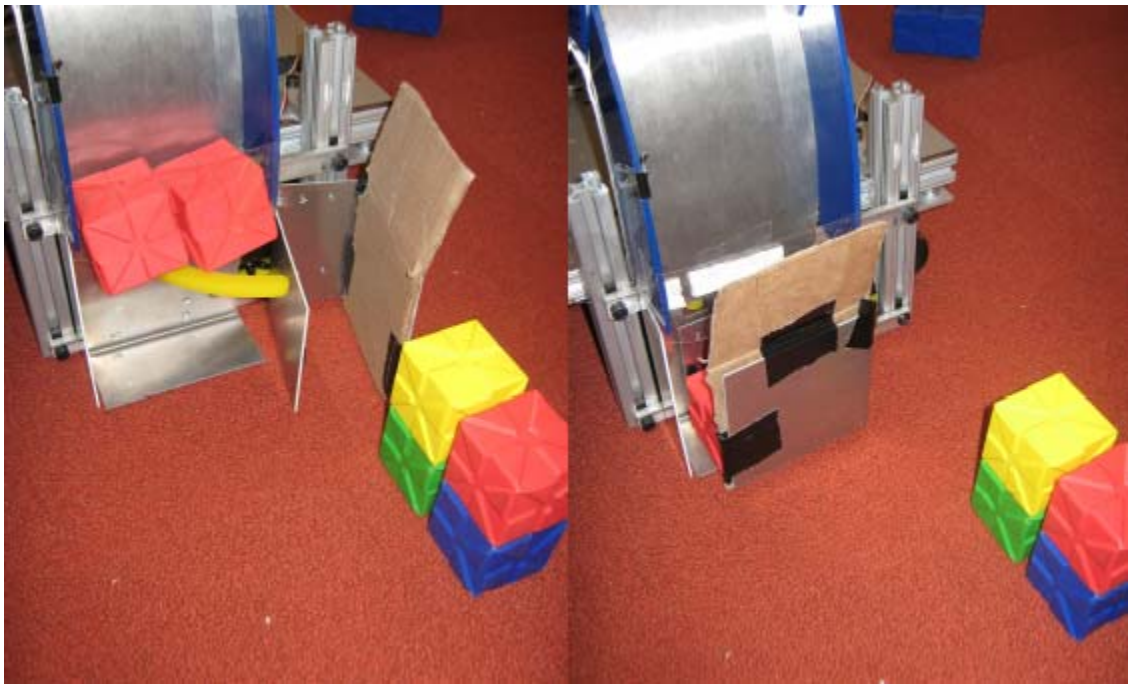
Shop Access

- 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

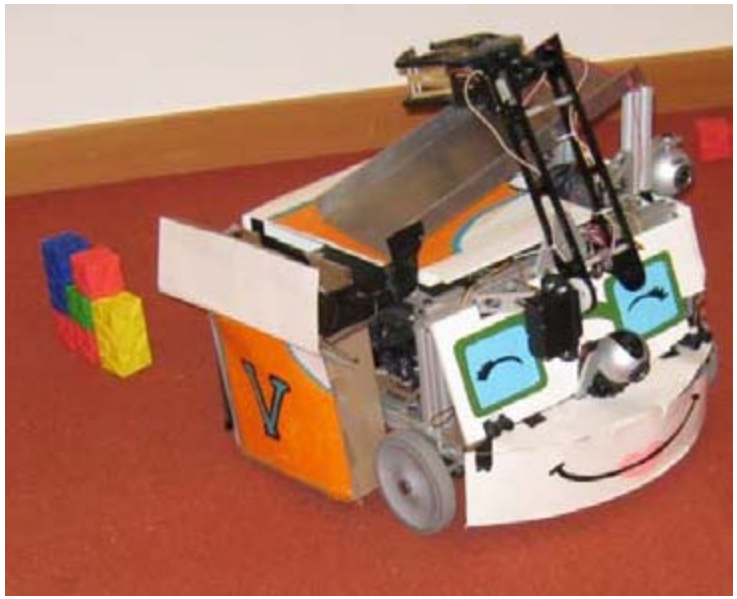


Block marshalling, servo-controlled release mechanism

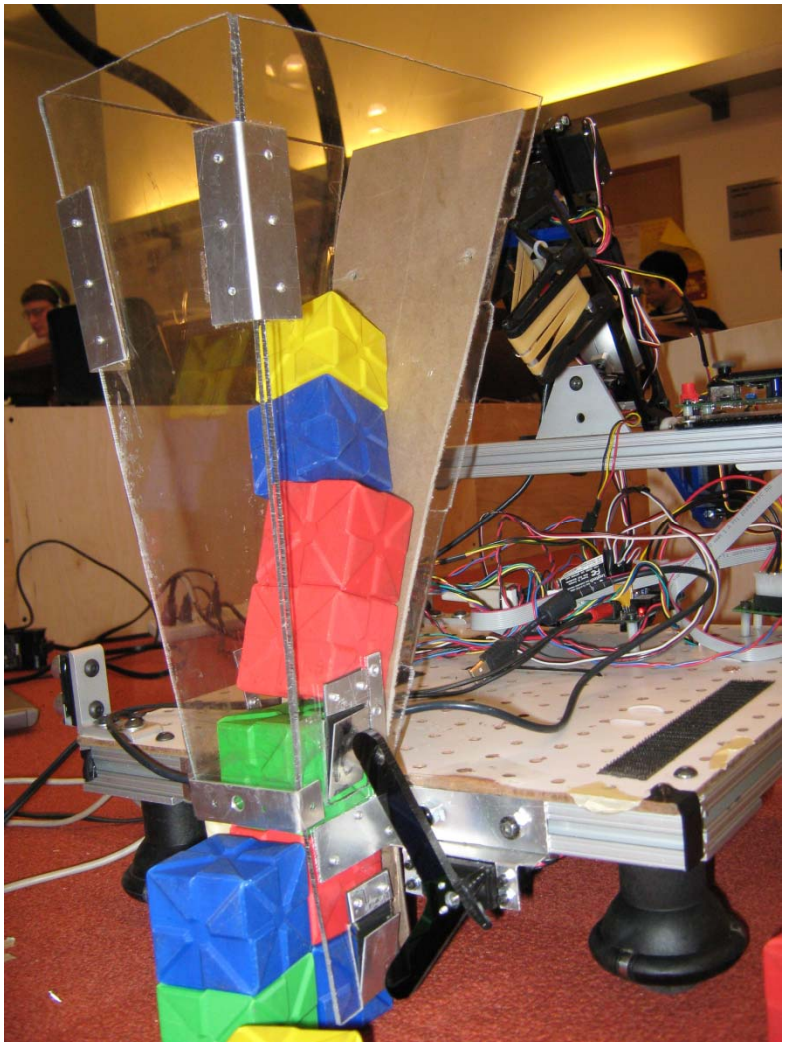


Alternative design from another team

Examples from Past Years



Block marshaller



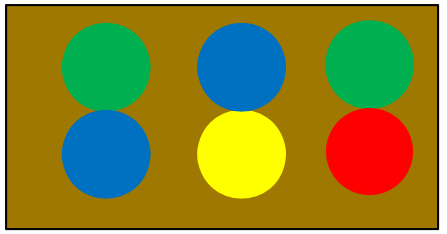
Funneling mechanism

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)