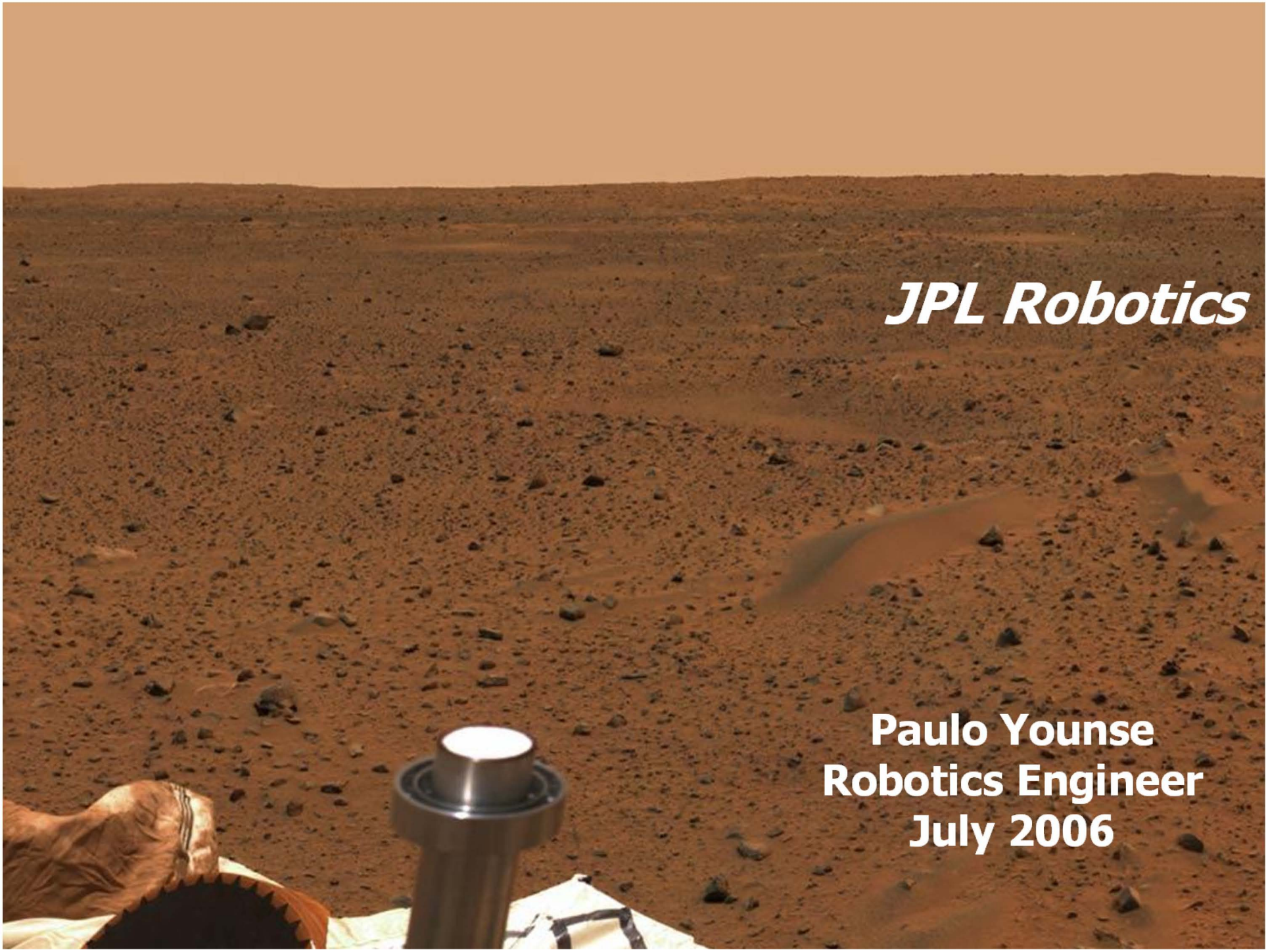


JPL Robotics

Paulo Younse
Robotics Engineer
July 2006

Overview

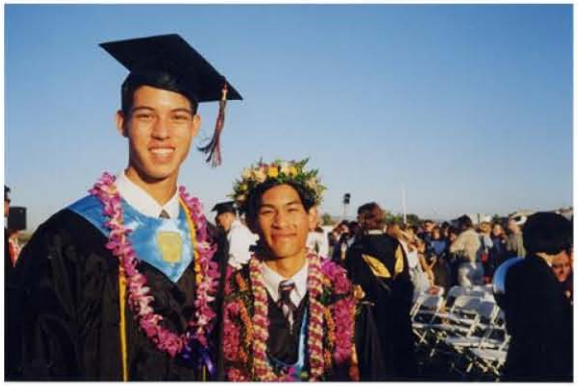
- **Background**
- **Description of Section 347**
- **Robot Design Components**
- **Research Efforts**
  - FIDO
  - Robotic Construction Crew
  - LEMUR IIa, Iib
  - LASSO
  - Subsurface Ice Probe
  - Cliffbot
- **What it comes down to…**
- **Working at JPL**
- **Skills to Succeed in Robotics**
- **Advice to students**
- **Questions**

My Background

- Robotics Engineer, NASA Jet Propulsion Lab, Pasadena, CA
  - Design, build, assemble, and test prototypes of new robots
  - Need to have a background a wide variety of subjects- math, science, mechanical engineering, electrical engineering, programming, machine vision
  - Work in a team with other engineers to develop a robot

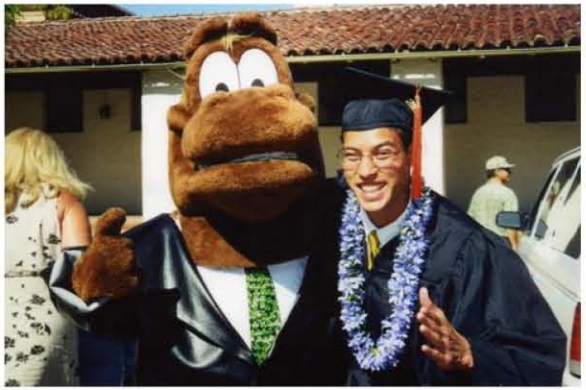
My Background

- Grew up in California and went to school at Cal High in San Ramon, CA in the San Francisco area
- I loved drawing, soccer, basketball, dinosaurs, baseball cards, comic books, travel, astronomy, science, and math
- Participated in track and cross country, as well as Interact and NHS service organizations in high school.
- Dad was a geologist, mom a florist, uncle an electrical engineer, and grandfather a restaurant owner



My Background

- Cal Poly, 1997-2002 (San Luis Obispo, CA)- BS, Mechanical Engineering Department with mechatronics focus



My Background

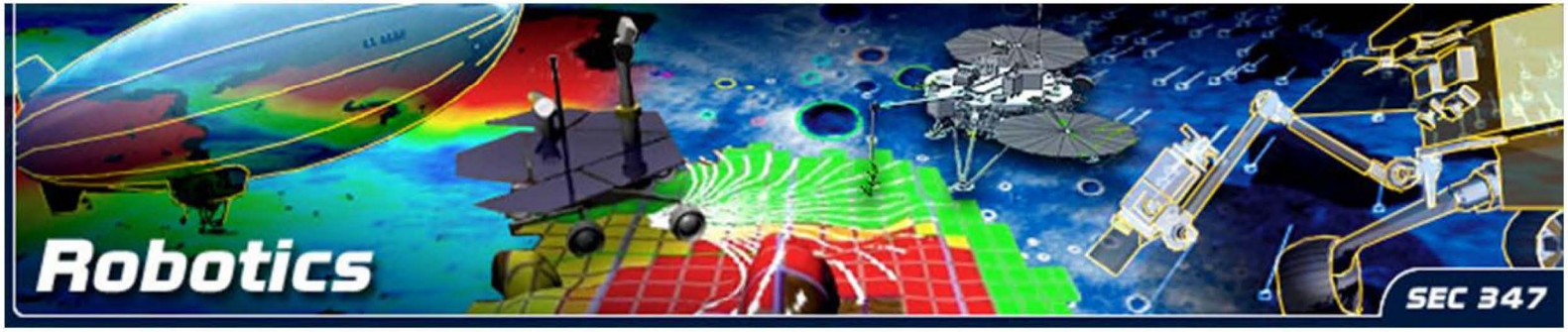
- Boeing, 2002-2003 (Anaheim, CA)- Mechanical engineer, LMRS unmanned underwater vehicle

My Background

- University of Florida, 2003-2005 (Gainesville, FL)- ME, Ag & Bio Engineering Department with focus on computer vision and vehicle navigation

- Jet Propulsion Lab, 2005-Pres (Pasadena, CA)- Mechanical Engineer for Robotic Hardware Systems Group

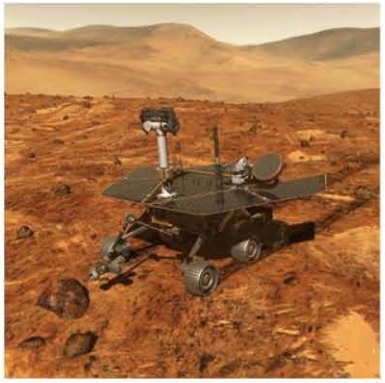
Section 347- Mobility and Robotic Systems

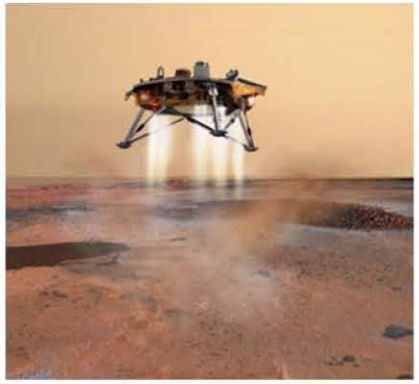


- Goal: Develop new robotic technologies
- Groups:
  - Robotic Hardware Systems
  - Robotic Software Systems
  - Mobility and Manipulation
  - Computer Vision
  - Advanced Robotic Controls

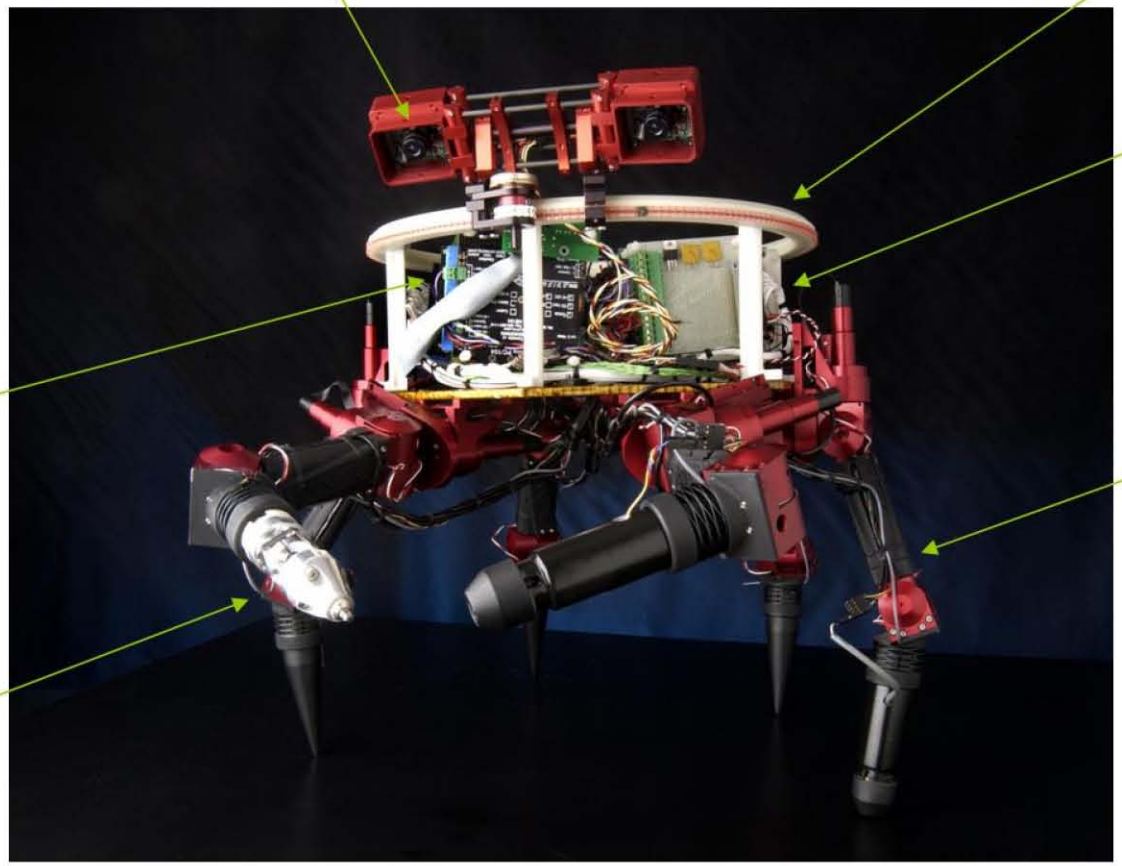
Research Tasks & Flight Projects

- NASA and JPL Research Programs
- External Programs: US Navy, DARPA
- Flight Projects: Mars Exploration Rovers, Phoenix Lander, Mars Science Laboratory



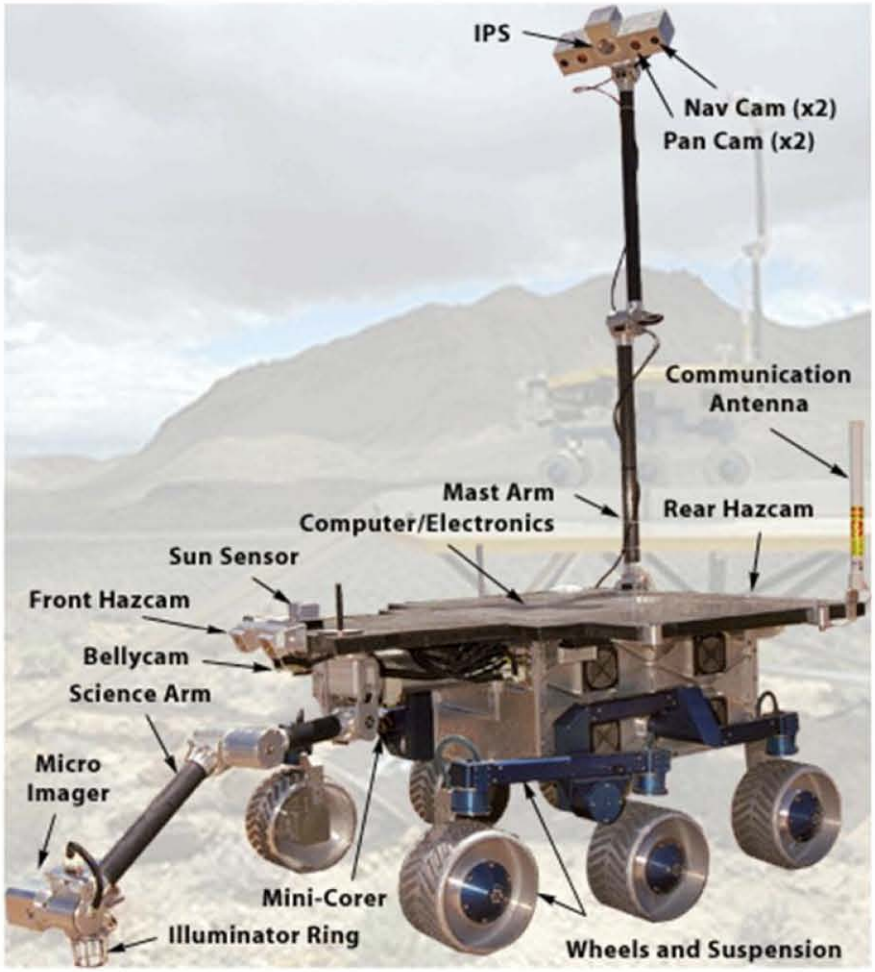


Robot Design Components



FIDO - Field Integrated Design and Operations Rover

- FIDO Rover – Prototype for Mars Exploration Rovers



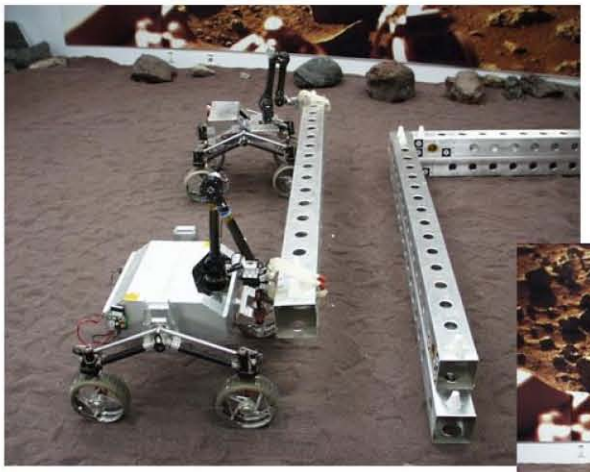
Black Rock Summit, Nevada

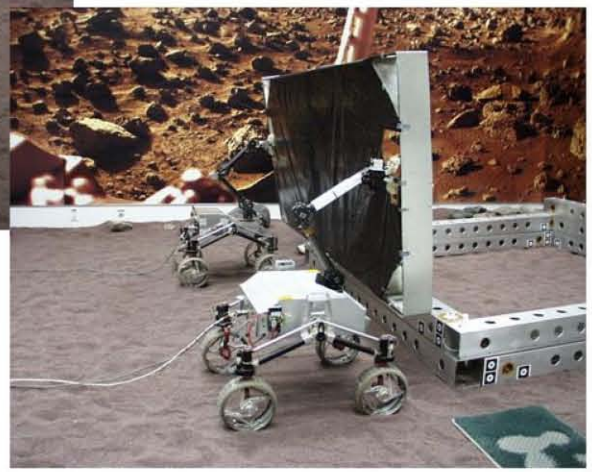
Operations (Planetary Robotics Lab)

Robotic Construction Crew

- Robots working together to carry beams and construct habitats on the moon and Mars
- Force control and communication between two rovers

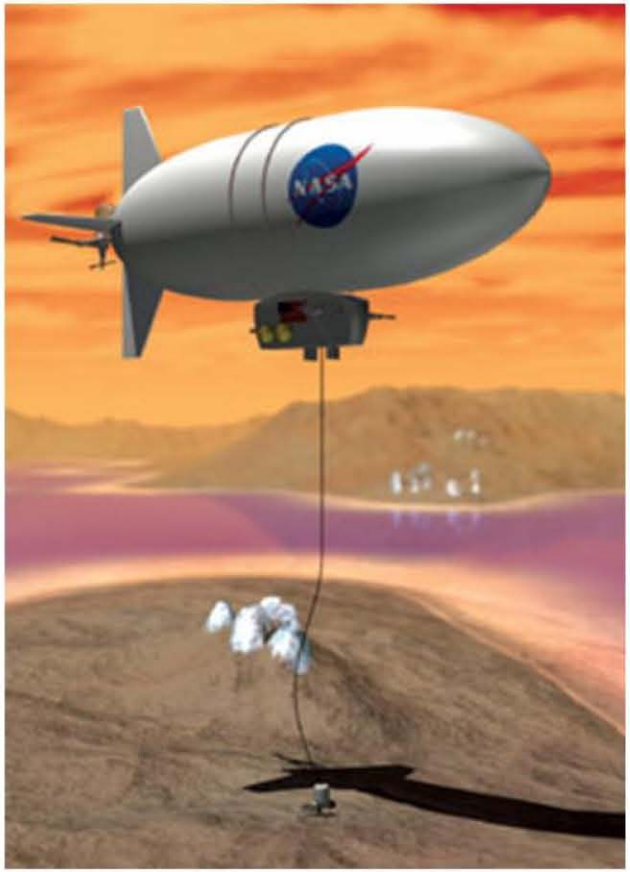
JSC Artist's conception of a deployable lunar habitat





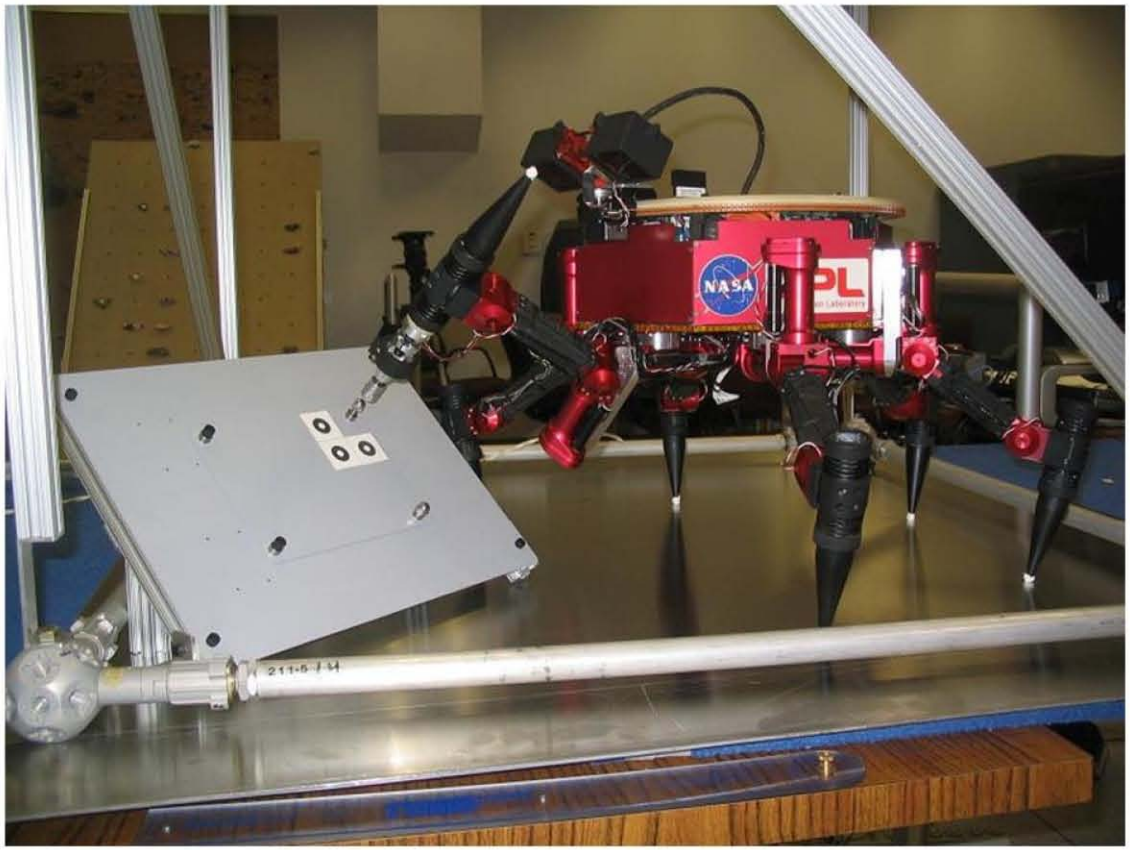
Aerobot

- Airship design for future exploration missions to Mars, Venus, and Titan



LEMUR IIa

- Limbed robot for in-space assembly, maintenance, and inspection

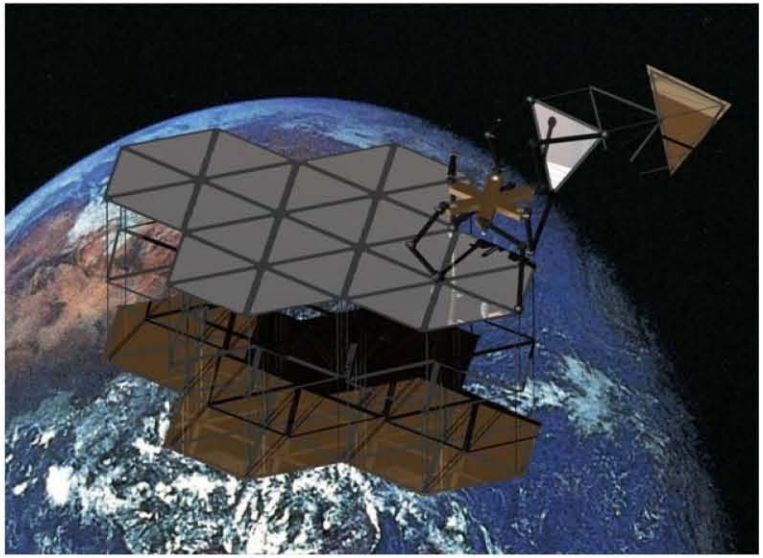


LEMUR IIb

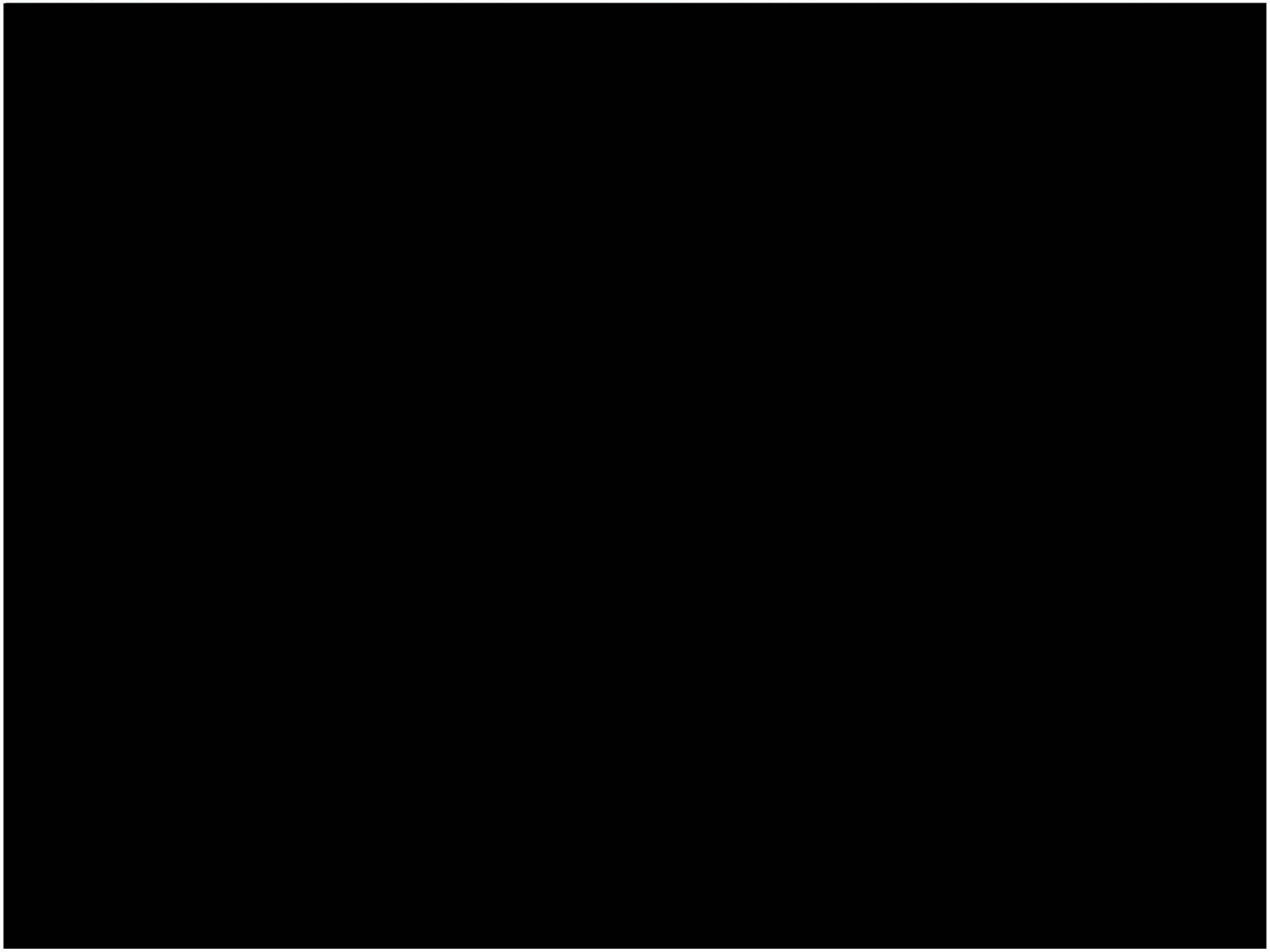
- Climbing robot to scale steep terrain and cliffs

LASSO - Large Aperture Space Surveillance Optics

- Developing concepts for large deployable orbiting telescope
- Large 100 m diameter optical mirrors constructed by smaller triangular mirror facets with 2 m sides that unfold in space and are assembled by a robot.

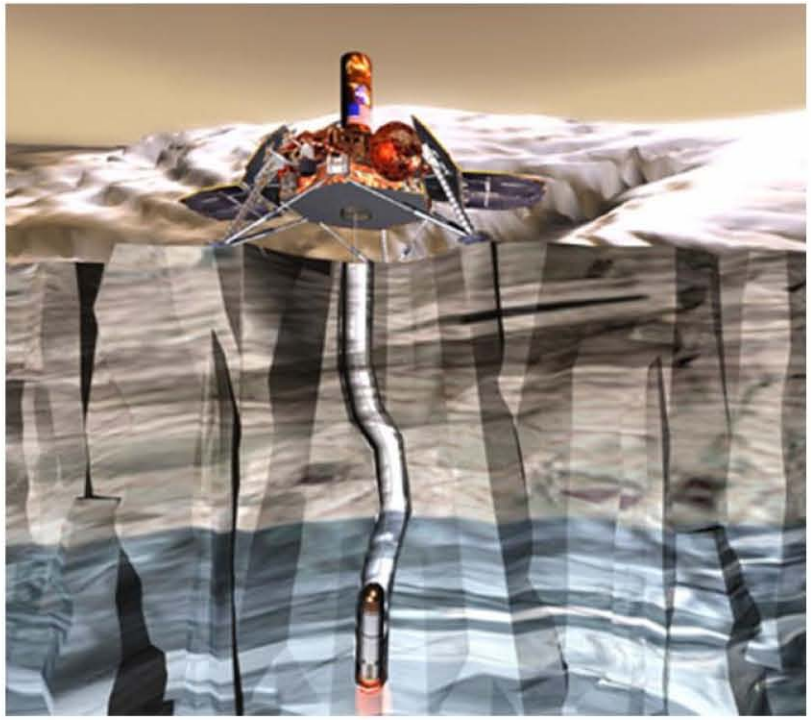


LASSO - Demo



SIPR – Subsurface Ice Probe

- Heated nose melts through glacier ice and analyzes the ice melt to explore dominant climate cycles
- Being proposed for future Mars scout missions



Cliffbot

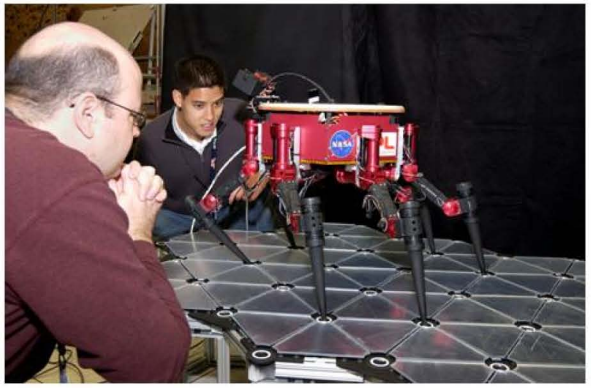
- Team of cooperative robots to repel down cliff faces
- Testing concept for future Mars missions
- Traveling with team to Svalbard in the Arctic for field testing this August

What it comes down to…

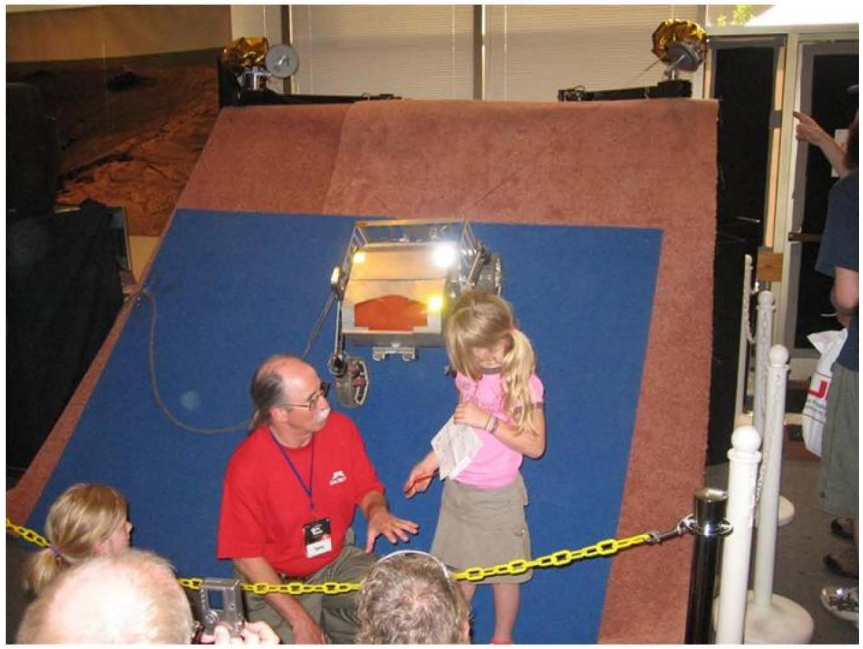
- Developing new ideas for robotic technologies and novel concepts for future space exploration missions
- Design, building, and testing prototypes to demonstrate these ideas
- Carry these ideas into actual flight missions

Working at JPL

- Current tasks I support
  - **Cliffbot (Mechanical Lead):** Developing new rover body, integrating robot arm and instruments onto vehicle, supporting field testing in the Arctic
  - **Subsurface Ice Probe (Deployment Device Lead):** Designed motorized reel to deploy and retrieve probe from the ice, integrated electronic devices, wired control box
  - **Launch and Retrieve Robot (Task Manager):** Researching new concepts for exploring the moon, writing proposal, developing prototype for a hopping legged robot
  - **Rover Maintenance (Mechanical Support):** Fix rover and robot arms when they break down, design, build, and assembles upgrades to the test rovers
- Additional Responsibilities
  - Monthly presentations/progress reports
  - Mentoring two summer interns
  - Educational outreach, talks, tours
  - Advising co-workers, other projects



Working at JPL

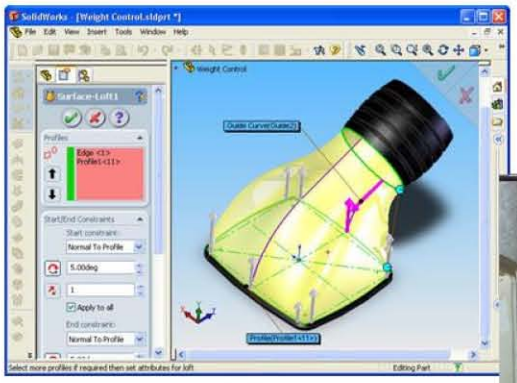


Cliffbot exhibit during JPL Open House

Teaching Mrs. Maljian's 6th Grade class about engineering

Skills to Succeed in Robotics

- High School
  - Math, science, physics, biology, speech, English, auto shop, wood shop, art, computer science and programming (C, C++), CAD (Autocad, Solidworks)
- College
  - Mechanical, electrical, computer science, materials, statics, dynamics, mechatronics, controls, instrumentation, robotics
  - Math, statistics, pattern recognition, machine vision/image processing, AI, signal processing
  - Internships and co-ops
- Additional Skills
  - Machining
  - Technical writing
  - GD&T
  - Speech
  - Research
  - Leadership
  - Management
  - Teamwork

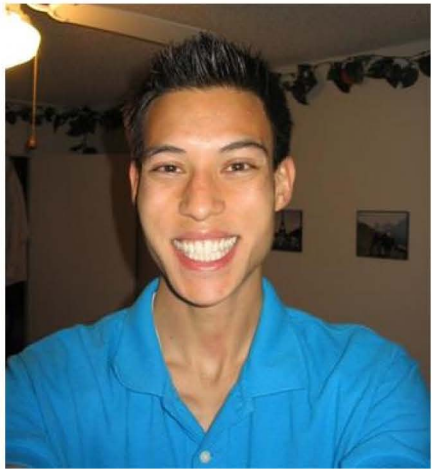
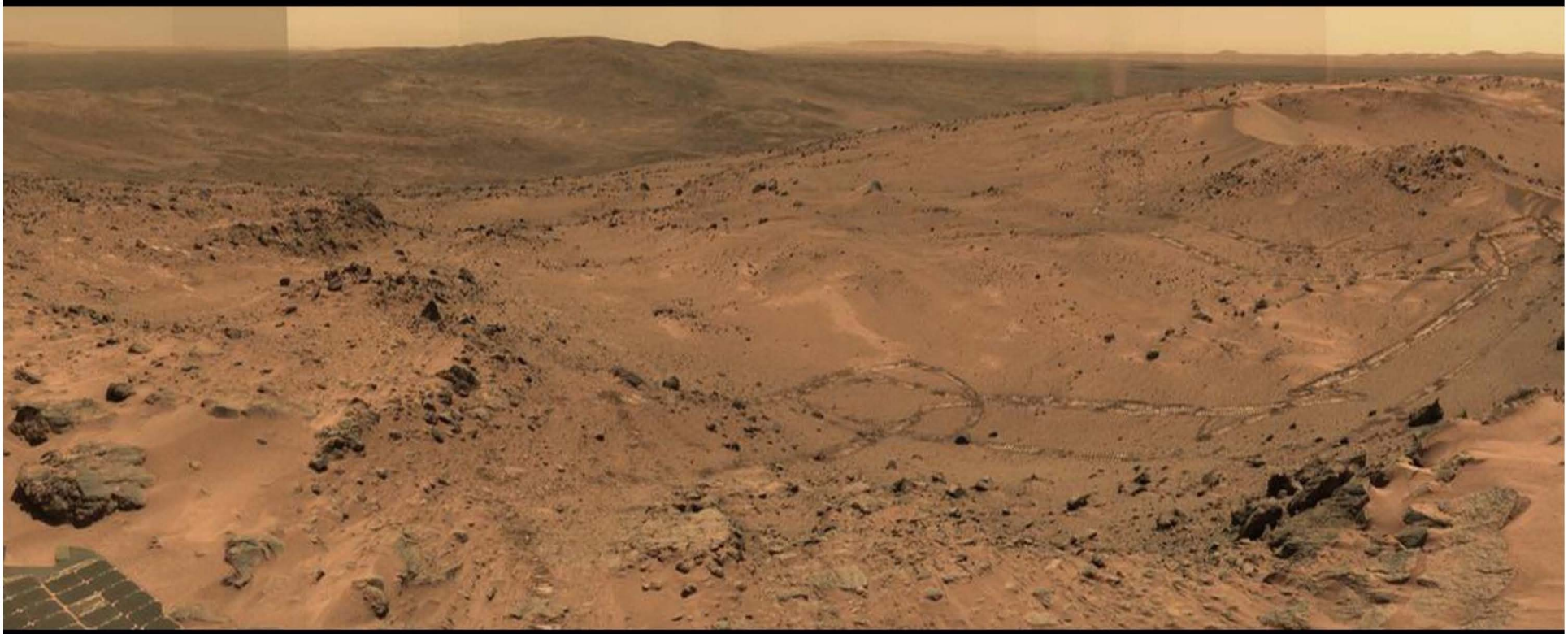


Advice to Students

- **Right now**
  - Do your best in high school- classes, clubs, sports: do well in all subjects, gain leadership skills, help prepare you and get you into a good college
  - Figure out what you want to do, start looking into colleges: school councilor, family, friends, internet
  - Worried about money? Money and scholarships: school councilor
  - Even if you don't know exactly what you want to be, that's alright because going to college will help you out, and graduating from a good college will get you almost any job
- **College**
  - Study hard, figure out exactly what you want to do
  - Internships
  - Have fun, join clubs, gain leadership/speaking skills- companies look for leadership skills, well-rounded people, and people they want to work with
- **Graduate school**
  - Focus more on the particular field you want to go in
  - Helps you get a better job, gain more contacts
- **Work**
  - Most people start at one company, learn about the field, and then move into another company until they find what they love (me- NASA Ames, Boeing, JPL)

Advice to Students

- **Figuring out what you want to do**
  - You spend 40 hours a week at your job
  - Start meeting people in the field you are interested, ask them:
    - What they do
    - Why they like their job
    - What skills and school subjects are important
    - What colleges they recommend going to
    - Visit their workplace
    - Keep in touch with them: continuously ask for advice on how to join their company
    - People love to offer advice and love to know that they helped you succeed



Questions?