Software Development for Rover Operations at JPL

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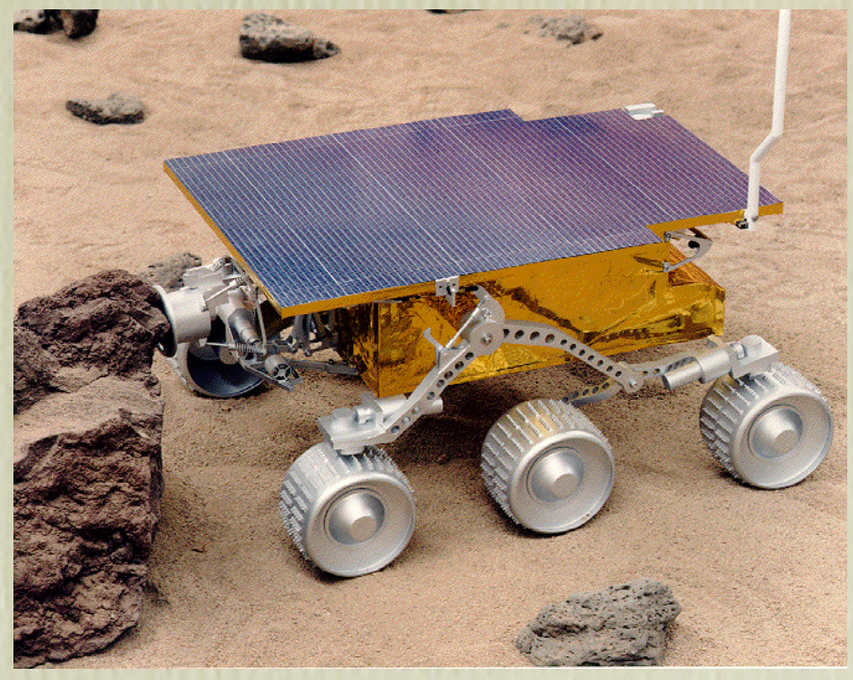
Contents

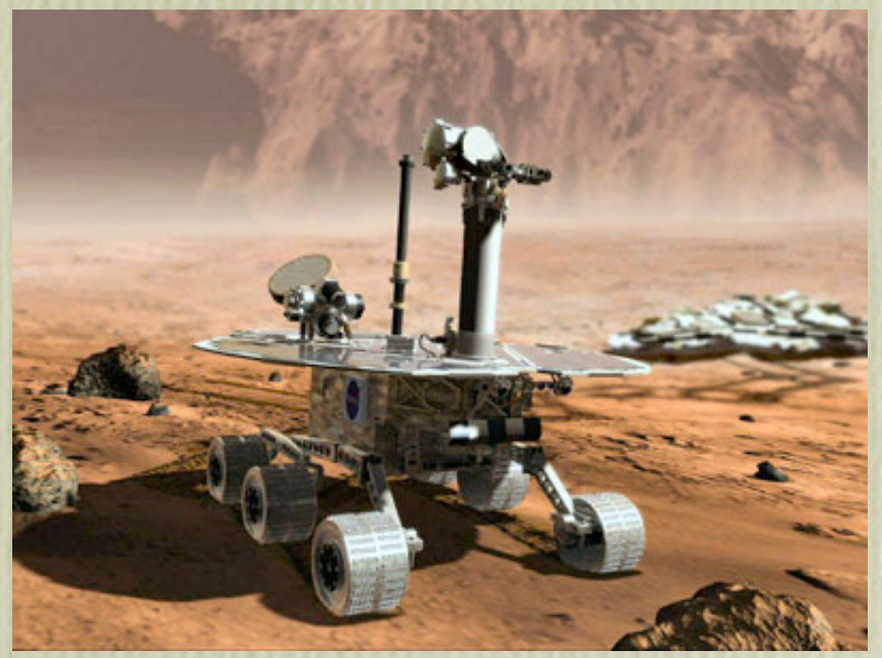
- Mars missions
- Mission planning software (current)
- Mission planning software (future)
- First iteration development
- Future iteration goals

Mars Rover Missions



- Mars Pathfinder
  - Sojourner Rover
  - Soil composition analysis
  - Analyze atmosphere and seismic movement
- Mars Exploration Rovers (MER)
  - Spirit & Opportunity Rovers

Mars Rovers Missions (cont.)



- Determine whether life ever arose on Mars
- Characterize the climate of Mars
- Characterize the geology of Mars
- Prepare for human exploration

Mars Rovers Missions (cont.)

- Rovers must be told what to do
- Need way to command rovers
- Need way to handle emergencies

Science Activity Planner (SAP)

- Publicly available under the name “Maestro”
- Science operations interface of Mars rovers and landers
- Supported MER
- Java software of the year
- NASA software of the year!!

WITS: Downlink Browser

Browser View Image Action

Lookup Table Editor

Show Histogram Window

Line LOG

SQRT GAMMA

Piecewise Smooth

OK Apply Cancel

site-1
site-2
collections
navcamWedgeS
pancamWedge
pos-1
bellyCam
frontHazcam
ips
microImager
navcam
pancam
view-0
view-1
view-2
view-3
view-4
view-5
wdg-0
wdg-1
wdg-2
wdg-3
wdg-4
wdg-5
rearHazcam
pos-2
pos-3

170 180 190 200 210 220 230 240 250 260 270 280 290 300

downlink/sites/site-2-position-1/pancam/wdg-1-2001...

X rotation
Y rotation
1.0
Index 1.0 3.0

Chart Az:246 El:156

Chart Az:246 El:156

255
254
253
252
251
0 2
Band
Pixel Values
Series1

downlink/sites/site-2-position-1/pancam/wdg-1-2001...

Image width: 640 height: 480 bands: 3
Cursor: 417,324 Value: (140,139,145) xyz: (none)

280
0

downlink/collections/site-2/navcamWedgeSet.wdml

View Center
N
E
Down

SAP: Uplink Browser

Browser View

- sol-1
  - geology
    - myplan.rml
    - plan-x.rml
    - plan.rml
    - plan.wuml
    - sharedViews
    - storedViews
  - mineralogy
    - plan.rml
  - sowg

Instrument: pancam

ID
GET_FINE_ATTITUDE_CMD
PANCAM_MOSAIC
CAPTURE_PANCAM_MULTI_
CAPTURE_PANCAM_TIER
CAPTURE_PANCAM

Targets | Observations

/sol-1/geology/plan.rml *

	Name	Priority	Constrained
Observation	Take pre-drive pictures		
Activity	CAPTURE_FHAZ	1	×
Activity	CAPTURE_RHAZ	3	×
Activity	CAPTURE_PANCAM	3	
Activity	CAPTURE_IMAGE_ADVAN	0	
Observation	Drive to rock garden		×
Activity	STOW_CAMERA_CMD	1	×
Activity	GO_TO_WAYPOINT_CMD	1	×
Activity	CAPTURE_FHAZ	2	×
Activity	CAPTURE_PANCAM_MUL	0	
Activity	CAPTURE_PANCAM_MUL	0	
Activity	STOW_CAMERA_CMD	0	

/sol-1/geology/plan.rml *

Definition Unit

Name: CAPTURE_FHAZ

Id: ID000001_0

Priority: 1

Constrained: ✓

Notes:

Arguments

Name	Value
pri	10
lcamera	FLHAZ
rcamera	FRHAZ
bpp	8

/sol-1/geology/plan-x.rml *

	Name	Priority	Constrained	No
Observation				
Activity	CPU_ON	0		
Activity	SYS_HEALTH	0		
Activity	SURF_TRANS_N_CNFG	0		
Activity	X_COMM_HGA	0		
Activity	ADD_COMM_WNDW_CN	0		

/sol-1/geology/myplan.rml *

	Name	Priority	Constrained	Notes
Observation				
Activity	CPU_CYCLE	0		
Activity	CAPTURE_FI	0		
Activity	CAPTURE_R	0		
Activity	ARC_CMD	0		
Activity	TURN_ABSO	0		

Maestro (2.0)

- Currently in development
- Activity planner software for future Mars missions (MSL)
- Open-source: Rover-Ware

Maestro (cont.)

- Developed with common tools & technologies
  - Eclipse IDE
  - Eclipse Rich Client Platform (RCP)
  - Eclipse Modeling Framework (EMF)
  - Java 3D

First Iteration

- Plan activities and properties viewer
  - Allows viewing and manipulating of activity properties
  - Loading and saving of plans
- Interface with CLARAty code
  - Computer simulated arm movements
- 3-Dimensional rover viewing and interaction
  - Visual representation of simulation

File Edit Window Help Plan Menu 3D Menu Plan Editor

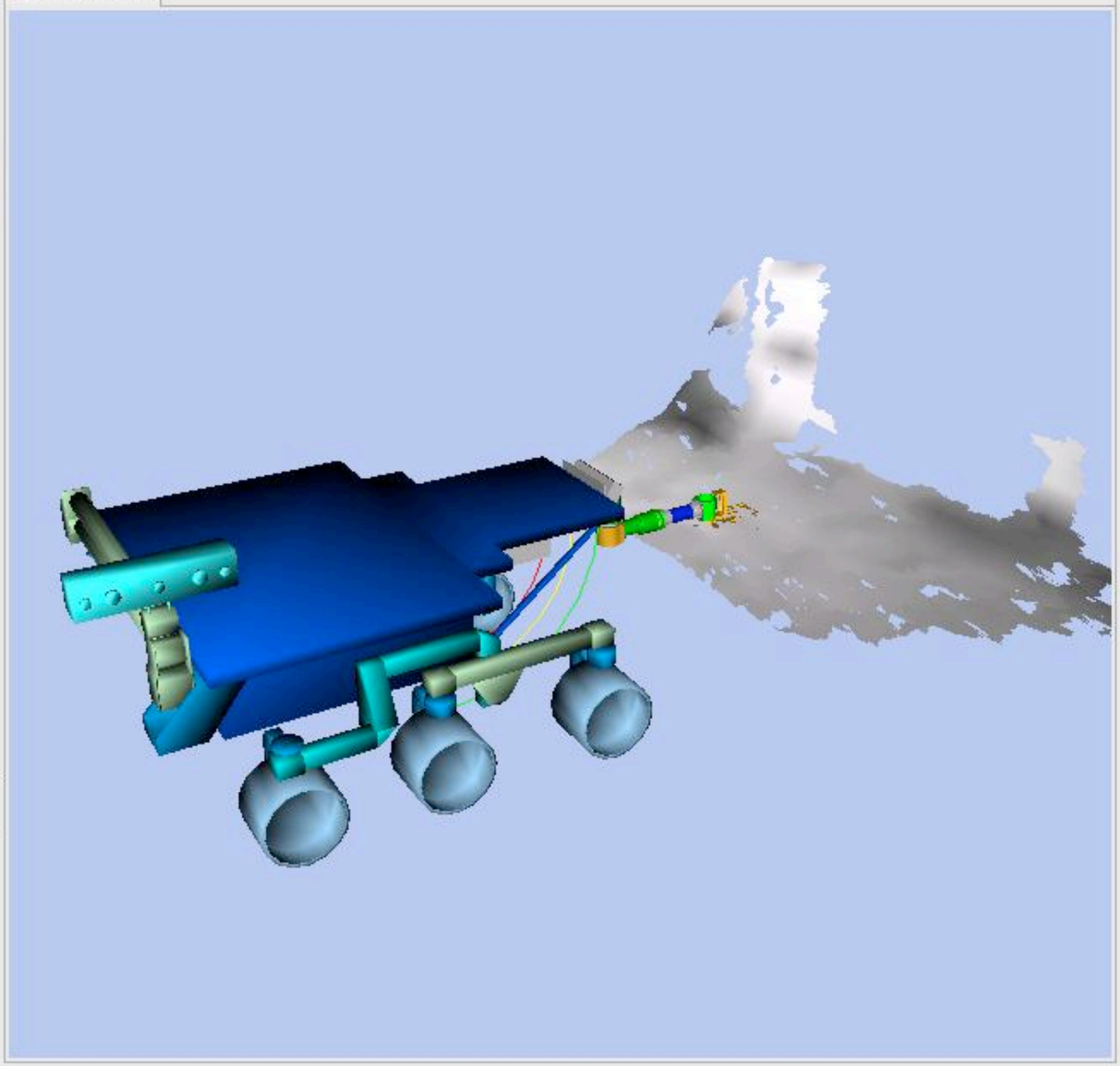
*file:/home/jmfox/plan.plan

file:/home/jmfox/plan.plan
Plan
Move Arm XYZ 0.0 0.0 0.0
Move Arm Joints 0.0 0.0 0.0 0.0 0.0
Move Arm XYZ 0.0 0.0 0.0

Properties

Property	Value
J0	0.0
J1	0.0
J2	0.0
J3	0.0

3D View



Selected Object: Move Arm Joints 0.0 0.0 0.0 0.0 0.0

First Iteration Challenges

- Eclipse learning curve
- Extreme Programming
  - Test-driven
  - Pair programming
- Design decisions
  - Predicting 5 years into the future

Future/Current Goals

- Convert a plan to CLARAty commands
- Receive, process, and view Rocky8 navcam images

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References

- marsrovers.jpl.nasa.gov
- mars.telascience.org