Subsurface Access Mechanism
SAM Purpose and Objectives

Science Investigation

• Find life
• Detect environmental boundary conditions of microorganic life
• Examine biological oases and microorganic communities

Mechanism Objectives

• Access subsoil to depth of 3-5 cm
• Create furrow and disturb surface layer
• Overturn rocks (<20cm, <2kg)
• Measure soil properties
Relevant Space-Bound Technology

Too expensive or hard to acquire
Our application requires larger SAM footprint

Courtesy: Honeybee Robotics, JPL
SAM Requirements & Design Issues

Low mass and power
Passive vs. Actuated

Method of deployment
Packaging with relevant instruments

Method of physical interaction
Plow, Scoop or Drill

Time for operation

Integration with Hyperion
Robustness: Many operations, various soils
SAM Footprint vs. Hyperion footprint

Entrapment

Needed stiffness

Development

<p>| | |</p>
<table>
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<tr>
<td>Y1</td>
<td>Soil &amp; Plowing Test</td>
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<td>Y2</td>
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<td>Y3</td>
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Field Implementation
Plow Concept #1 (Prototyped & Tested)
Evaluation of 1st Prototype

Pros
- Worked in loose soil, gravel, and rocks
- Plow profile and scale appropriate for task
- Creates consistent furrow
- Requires minimal power for surface scraping

Cons
- Could cause rover to get stuck
- Requires high downward load
Power Measurements

Life in the Atacama, Design Review, December 19, 2003
# Plowing Power vs. Normal Driving

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Driving @ 0.3 m/s without plow

Pile of slag Dug 2"-4"

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Initial SAM Design Concept

Backwards facing deployable plow
Cut furrow ~3 cm deep along path
Overrun small rocks via compliant force actuation
Minimal selectivity
Technical Approach

• Continue to develop pieces of the SAM mechanism and test with rover in the field
• Pursue a passively deployed plow for year 2
Implementation Issues

- Package actuation for deployment and downward force application in single mechanism
- Engineer deployment mechanism that provides self-protection and eliminates rover hang-up
- Fine tune mechanism to ensure continuous shallow plowing
- Coordinate with rover state feedback to detect problems during deployment