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SURF PROGRESS REPORT 7/23/09

Outline

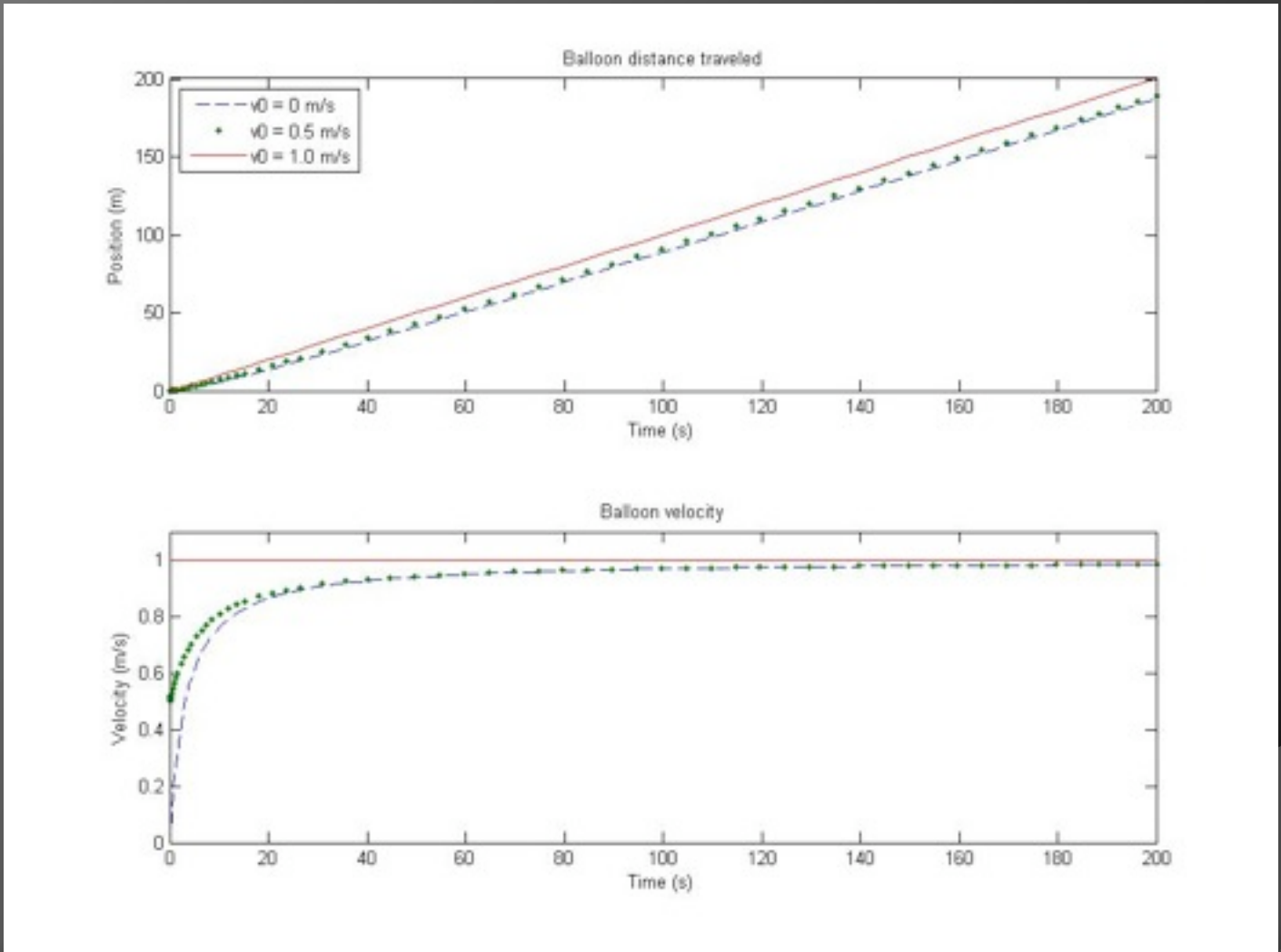
- Titan balloon
  - Initial analysis
  - Further work
- Axel Sampling
  - Sampling background info
  - Drilling experiments

Titan Balloon Dynamics

- Assumptions:
  - Balloon + payload mass ≈ 300 kg
  - Diameter = 11 m
  - Fluid density ≈ 5 kg/m^3
  - C_d = 0.4 (rough sphere @ Re=10^6)
  - Surface wind speed ≈ 1 m/s

- $F_d = \frac{1}{2}\rho V^2 A C_d$
  - Max force on balloon ≈ 100 N

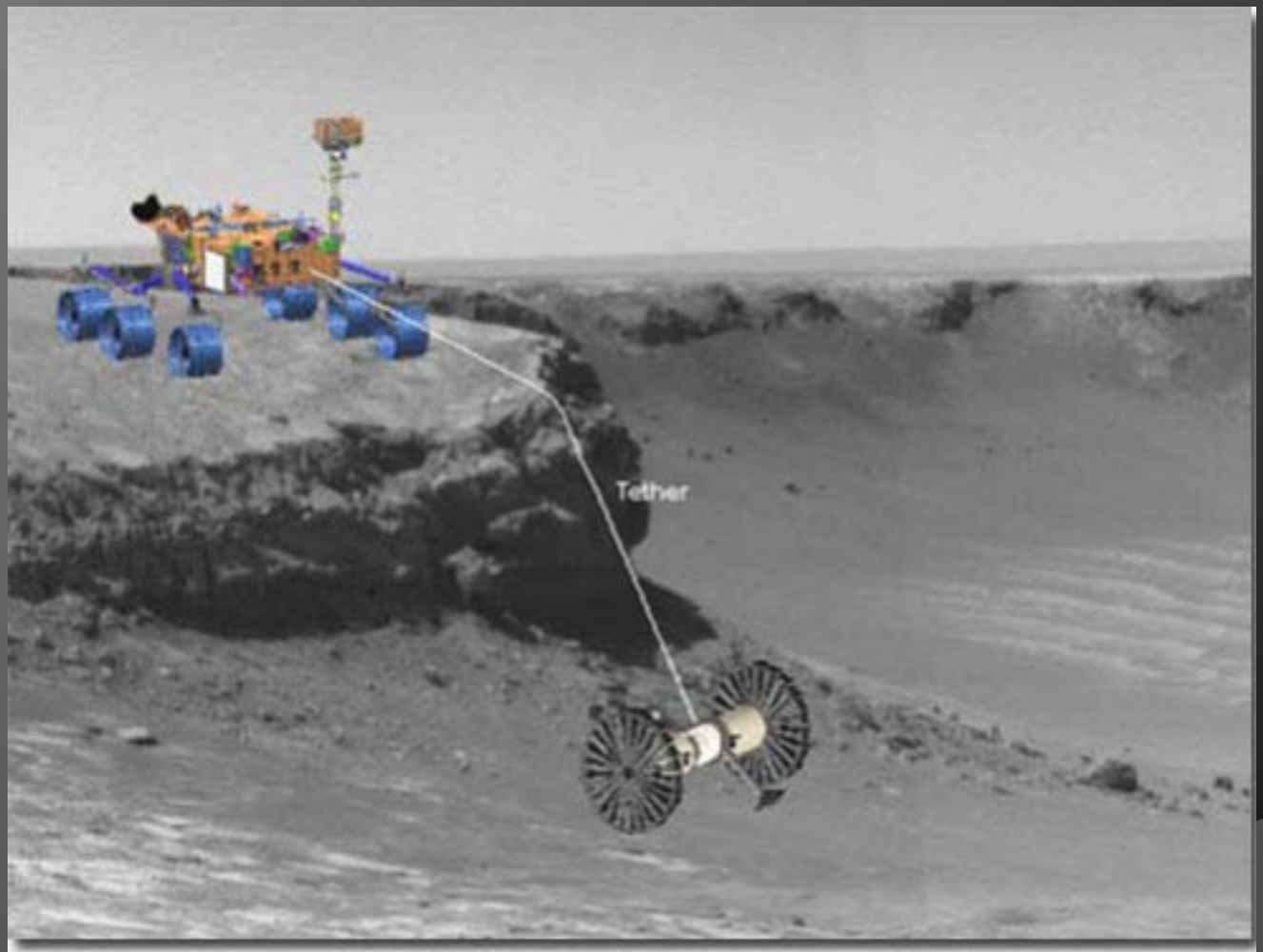
Titan Balloon Dynamics



Further work

- Develop simulation of balloon/tether/sampler system
  - Control variable: tether length
  - Goals: analyze vertical and horizontal forces on ground
  - Develop tether management strategy to maximize time on ground
- Compare with power requirements for ballistically dropped packages

Axel Sampling



Sampling Options

- Core extraction
  - Sample integrity conserved
  - Valuable for return to Earth
  - Core break off?
- Powder/chips
  - More susceptible to contamination
  - Technology exists

Drilling Options

- USDC

Drilling Options

- Rotary-percussive

Experimental setup

- Question: Can Axel sample while hanging from a vertical wall?
- Variables:
  - Drilling option
    - USDC vs. Rotary-percussive
  - Drill angle & time
  - Rock type
    - Kaolinite
    - Limestone
    - Breccia
    - Saddleback basalt

Rock Types

Rock type	Compressive strength (MPa)
Kaolinite	2
Limestone	20
Breccia	19-35
Saddleback basalt	117
Belleville basalt	280

Experimental setup

Test video

Test video

Preliminary results

- Kaolinite trials
  - 1 minute drill time
  - Power consumption ≈ 30 W
  - Reaction force ≈ 10-13 N (5° drill angle)
  - Drilled 1 cm deep

Future plans

- Complete experiment for other rock types
- Compare with rotary-percussive performance
- Implementation on Axel