Small Spinning Landers for Solar System Exploration Missions

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1985 Hughes Family of Spacecraft
From Dual-Spin Spinning Spacecraft to Spinning Lander

Despun Section + Leg System = Spinning Lander*

Spun Section + Landing Radar

* U.S. patent #20090206204; foreign patents pending
Size Comparison for GLXP Win
Why Consider Spinning vs. 3-Axis Landers?

- Proven dual-spin system robustness and scalability
- Avionics and flight software ~1/3 as complex
- Propulsion ~1/2 as complex
- Single landing radar vs. 3
- No chance of tip-over at landing
- Excellent hopping capability (mobility)
- Overall development and I&T ~1/2 as complex
- Potential for significantly lower total mission cost
SCSG GLXP Concept

- ~240 kg wet; ~50 kg dry
- Falcon 1e / Star 30 TLI
- Solar panels + batteries
- Direct comm to Earth
- HD camera
- Biprop for all other maneuvers
  -- ~4.5 km/s ΔV capability
  -- Full thruster complement
  -- ~5 km hopping capability
- ~$20 million total mission cost
~3U CubeSat Concept
(Lunar Polar Crater Surveyor)

- ~5 kg wet; ~4.4 kg dry
- Carried to surface by ‘Mothership’
- Batteries only
- Comm to Mothership or orbiter
- TBD science or tech payloads
- Hydrazine prop module
  -- Hover & translate thrusters
  -- ~2-minute hovering capability
  -- ~6 km hopping capability
- Single-digit $ millions for several
1: Initial and final landing target

2: Crater rim target

3: Crater base target

~1 km
Meteor Crater Example

Phase I: Survey

Phase II: Data Relay

Phase III: Grab-and-Go sample

Start & End
Issues With 3U Concept

- May not be stable spinner
- Potentially limiting propulsion
- Toxic propellant
- Limited power capability
CubeSat ‘Grande’ Concept
(Lunar Polar Crater Surveyor)

• ~11-14 kg wet; ~7-10 kg dry
• Carried to surface by ‘Mothership’
• Batteries; optional solar panels
• Comm to Mothership or orbiter
• TBD science or tech payloads
• ADN + isobutane prop module
  -- Full thruster complement
  -- ~0.8 to 1.0 km/s ΔV capability
  -- ~10-minute hovering capability
  -- ~15-20 km hopping capability
• Single-digit $ millions for a few
Next Steps

• Cal Poly MS thesis
  – Configuration and layout options
  – Leg system design and assessment
  – Mission performance assessments
  – Host platform(s) integration options

• Partnering!
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See me at booth #32!