The Autonomous Roving Exploration System for active-source seismology on the Moon and Mars

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Why ARES?
- Need resource evaluation at landing sites before human arrival [1]
- Orbiters can't do the job: no validated lava tube detections on Mars [2], and ice content is questioned [3]
- Active source seismology well developed [4] and has been done on the Moon before.
- Seismic data complements ground penetrating radar (GPR) data, and rovers could include GPR if desired [5,6]

ARES components
- 1 Source rover with simple and repeatable accelerated weight drop source
- 2+ Receiver rovers with mounted wireless geophones

In preparation for human exploration:
1). Near surface ice content surveying for ISRU
2). Lava tube delineation for habitation

Source Mass Tradeoff
- Greater source energy (mass and velocity) means greater investigation depth/range [7,8]
- Greater mass means more cost and complexity

Source mass and velocity vs investigation depth/range

Receiver Coupling Tradeoff
- Inserting geophones in regolith (coupling) is complex but yields more accurate data
- Mounting geophones on rover is simple but yields reverberations that reduce data quality

Acquisition Simulation

(a) Numerical wavefield simulation of weight drop source over layered regolith model depicted in scenario 1 above. (b) Synthetic data (with interpretation) as would be recorded by ARES along a radial survey line. See abstract for lava tube imaging example

References: