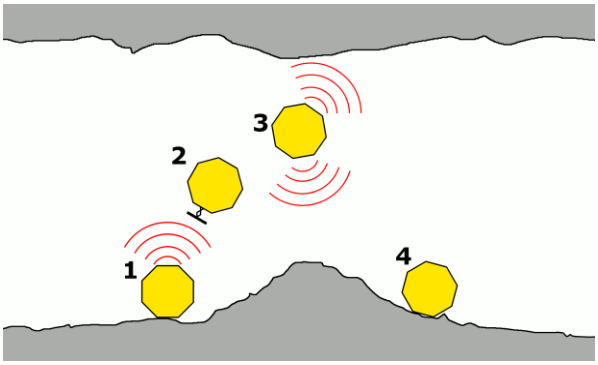
USING HOPPING ROBOTS TO CHART LUNAR LAVA TUBES. L. W. Tombrowski[1] and A. A. Mardon[1], [1]Antarctic Institute of Canada (aamardon@yahoo.ca, Suite #103 11919-82 Str. NW, Edmonton, AB T5B 2W4)

Introduction: Lunar lava tubes may provide potential locations for long-term human habitation on the surface of the Moon. Since they are beneath the Moon's surface, these tubes offer protection from cosmic radiation, while also providing an environment with a significantly more consistent temperature than on the lunar surface.[1][2] However, before a manned mission can make use of a lava tube, the potential mission site must be thoroughly explored and charted. This abstract proposes the idea that a "hopping" robot probe could be used to explore a lunar lava tube and collect detailed scans of the interior.

Advantages: There are multiple potential advantages to using a "hopping" probe over a traditional wheeled rover or rocket propelled probe. For instance, a spring-powered robot is able to easily clear obstacles and obstructions which would cause difficulty for a rover. While a rocket or jet-propelled probe requires fuel to keep it in the air for extended periods of time, a jumping robot would only need enough energy to reset the position of its "foot" each time after launching itself. Lower Moon gravity would also mean that it would be able to stay in the air longer and require less force to launch itself each time.

Challenges: A jumping probe would need to be built very ruggedly in order to withstand repeated landings on the rocky floor of a lunar lava tube. It would also have to be able to re-orient itself into a jumping position after each landing. Re-orientation could be made easier by making the probe more spherical in shape and adding multiple launching "feet" around the robot's exterior. Alternatively, maneuvering thrusters could be added to help control each ascent and descent and ensure that the probe always lands right-side-up. Fine adjustments would have to be made to the hopping mechanism in order to ensure the probe hops with the correct amount of power. Too much power would risk launching the probe into the ceiling of the lava tube. Being inside a lunar lava tube may create too much interference for the probe to directly transmit data back to Earth. This problem could be solved by placing a transmitter on the landing segment of the probe near the entrance of the tube. This transmitter would then be able to store collected information and relay it back to Earth.

Possible movement pattern: After the landing module arrives close to the entrance of the lava tube, the probe launches itself inside and begins its imaging of the tube's interior. The movement pattern for the robot could proceed as such: 1. Probe scans the ceiling and sides of the tube and orients itself to prepare for the next launch. 2. Probe launches itself in an arc to a position deeper inside the tube, while continuing to scan the walls of the tube.. 3. Near the apex of its trajectory, the probe uses its vantage point to scan the area ahead and underneath it. 4. The probe lands on the floor of the tube. The scans of the area ahead are processed, and the pattern repeats. These steps are illustrated in the diagram below:



Conclusion: The concept of using hopping probes in order to chart lunar lava tubes is purely theoretical at this point in time. Further research and design must be conducted in order to determine the legitimacy of the idea. However, their usage may potentially help plan future manned missions to the Moon.

References: [1] G. De Angelis et al. (2002) *LPS XXXIII*, Abstract #1417. [2] Y. Cheryl Lynn et al. (1992), "Lunar lava tube sensing", *Lunar and Planetary Institute, Joint Workshop on New Technologies for Lunar Resource Assessment*, 51–52