SUPERBOTS ON THE LUNAR SURFACE: MINI-MOBILE INVESTIGATION SYSTEM (MINI-MIS).
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Introduction: SuperBots are autonomous robotic modules that can *self*-reconfigure into different systems for different tasks [1]. An elegant example of "design for reuse" they can reduce cost and payload mass of a mission while enhancing performance, reliability, and safety. SuperBot modules and systems can be used to accomplish an enormous range of tasks [e.g. 2,3].

The Mini-MIS concept: One particularly appealing near- and long-term application is to use SuperBots as small, inexpensive, highly capable mobile platforms for science investigations. We call the concept Mini-Mobile Investigation System (Mini-MIS). The fundamental idea is that sets of 8 to 10 SuperBot modules would reconfigure to form a mobile platform with a specialized science or exploration device included inside a module or attached as a separate specialized module. The module set (Mini-MIS) would be able to reconfigure itself depending on the mobility or instrument deployment needs: wheels (for efficient travel), spiders or centipedes (for climbing), snakes (for burrowing), towers for communications (Fig. 1).

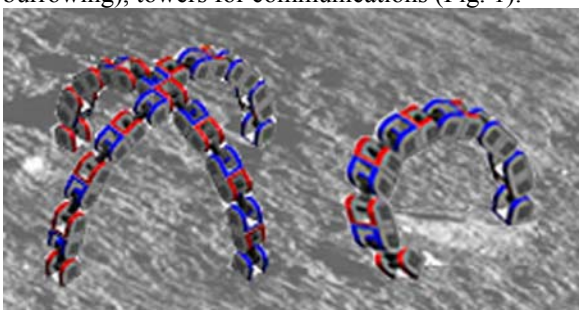

Fig. 1. Two configurations of Mini-MIS, each equipped with a specialized module (buried) for scientific observations or other exploration functions.

Mini-MIS modules can combine in a variety of ways as they move across the lunar surface. For delivery to the Moon, they can be efficiently packed into cubes, or disseminated throughout a lander. For deployment, the modules would assemble into one or more Mini-MIS platforms and crawl off the lander autonomously. We highlight below some near-term investigations where the Mini-MIS can greatly enhance lunar exploration.

Polar Explorer: The lunar Polar Regions are enriched in hydrogen [4], possibly in the form of H_2O ice trapped in permanently shadowed regions. This may constitute a valuable resource for propellant production on the Moon. However, the abundance, form (crystalline or amorphous ice), concentrations of impurities (CH_4, CO, NH_3, etc.), and spatial distribution of the H_2O are not known. Prospecting for the resource requires measurements in more than one location to provide a statistically-sound sampling of a region. This implies a rover, yet mission budget constraints might prohibit a large, robust rover. Thus, a resource survey involving a lander in one location would be greatly enhanced by using SuperBots as inexpensive rovers that could carry specialized modules to search for water over distances of a few kilometers. Two Mini-MIS assemblages could move in orthogonal directions from a lander, sampling every 100-200 meters.

Active Seismic Surveyor: The structure of the upper few hundred meters of the lunar surface is not characterized quantitatively. We believe that a network of 6-10 Mini-MIS consisting of 6-8 Superbot modules, each with a specialized geophone attached, could autonomously deploy itself into multiple, reconfigurable lines or arrays to map the lunar subsurface. Small triggered explosives would be used as a source for seismic signals. The Mini-MIS seismic surveyor could map typical regolith areas and impact crater structures and deposits.

Resource Prospector: Mini-MIS could also carry a chemical analytical device to measure the concentration of marker elements for specific types of potentially useful deposits. Examples are measuring (1) the concentration of Zr, K, or P to find deposits rich in KREEP components, representing the last chemical remnants of the magma ocean (2) Cl or F to find enrichments of volatile sublimates in volcanic glass deposits.

Navigation Beacons: Mini-MIS could be used as beacons for local navigation on the lunar surface. A Mini-MIS beacon could climb a local hill to broadcast or relay signals, allowing astronauts to traverse in a rover out of sight of the lunar outpost.

References: [1] Shen et al., this volume [2] Lentz et al, this volume [3] Lawrence et al, this volume; [4] Feldman, W.C. et al. (2000) *J. Geophys. Res., Planets,* Vol. 105, #E2, 4175