

**NASA MUREP Space Technology Artemis Research (M-STAR) Implementation Awards**

**Title: Advancing Site Preparation, Excavation and Mining Technologies in Support of Future Lunar Missions**

**Institution: University of Arizona**

**City/State: Tucson, AZ**

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**Summary:**

Significant advances have been made in robotic hardware, particularly sensors, actuators and computers. This has spawned lightweight, highly dexterous robots that have the potential to match and exceed human physical capabilities in space and planetary environments. Yet these robots are significantly behind in terms of their cognitive capabilities. Current planetary robots are typically tele-commanded. Human commands are carefully weighed to minimize overall risks, where there is limited situational awareness and unintuitive interfaces. The challenge is compounded for multirobot tasks that require complex robot-robot interactions and manipulation within the environment. Use of conventional tele-commanded methods could lead to operator fatigue, slow operations, lower productivity and worse, accidents. Future surface missions on the Moon will depend on multiple robots interacting seamlessly to explore, prepare a lunar base and perform resource harvesting. Robot controllers will need to learn to improvise, by performing smart response to unexpected conditions. It is especially critical that the robot controllers can learn from their mistakes and improve over time. Our solution is to enhance robot autonomy by utilizing a neuromorphic architecture called HEART that enables rapid rewiring of its architecture and content. Our plan involves incorporating advancement of lunar site preparation, excavation and mining technologies as new project node to the rapidly growing and successful ASTEROIDS Laboratory and UREP Program. The program will extend UREP to include space systems mining and resource utilization as another area undergrad students can perform research with faculty. This will open the door to mining students to get involved in aerospace research. The program will also support graduate student mentors whose thesis projects include excavation, site preparation and off-world resource extraction themes both in the mining and aerospace engineering departments. In addition, we will extend our external partnership with NASA KSC and STMD to facilitate student internships in off-world excavation, site-preparation and resource mining.