

2013 NASA Lunabotics Mining Competition: Results & Future Possibilities

Robert P. Mueller¹ and Gloria A. Murphy²

¹Surface Systems Office, National Aeronautics & Space Administration
(NASA) Kennedy Space Center, FL 32899, USA

² Education Programs & University Research Division, National Aeronautics & Space
Administration (NASA), Kennedy Space Center, FL 32899, USA

NASA's Lunabotics Mining Competition is designed to promote the development of interest in space activities and STEM (Science, Technology, Engineering, and Mathematics) fields. The competition uses excavation, a necessary first step towards extracting resources from the regolith and building bases on the moon. The unique physical properties of lunar regolith and the reduced 1/6th gravity, vacuum environment make excavation a difficult technical challenge. Advances in lunar regolith mining have the potential to significantly contribute to the United States' space vision and NASA space exploration operations.

The competition is conducted annually by NASA at the Kennedy Space Center Visitor Complex. The teams that can use telerobotic or autonomous operation to excavate a lunar regolith geotechnical simulant, herein after referred to as Black Point-1 (or BP-1) and score the most points (calculated as an average of two separate 10-minute timed competition attempts) will win the on-site mining category of the competition and earn points towards the *Joe Kosmo Award for Excellence* and the scores will reflect ranking in. The minimum excavation requirement is 10.0 kg during each competition attempt and the robotic excavator, referred to as the "Lunabot", must meet all specifications.

We will review each Lunabot design entered in the 2013 NASA Lunabotics Mining and discuss performance and relative merits. By providing a framework for robotic design and fabrication, which culminates in a live competition event, university students have been able to produce sophisticated lunabots which are tele-operated or autonomous. Multi-disciplinary teams are encouraged and the extreme sense of accomplish-

ment provides a unique source of inspiration to the participating students, which has been shown to translate into increased interest in STEM careers.



Our industrial sponsors and partner organizations (Caterpillar, Newmont Mining, Harris, Honeybee Robotics, USA, AIAA, ASCE) have all stated that there is a strong need for skills in the workforce related to robotics and automated machines. In 2013, over 70 international university teams applied, however logistics constraints only allowed 50 universities to compete in Florida. As a result, discussions are being held with external entities to promote a World Lunabotics Competition which will allow more universities to compete in regional events. An update on this possibility will be presented and discussed with participants. More students and the public were engaged via internet broadcasting and social networking media. This is expected to be of value for actual future space missions, as knowledge is gained from testing many innovative prototypes in simulated lunar regolith.

More information is available at www.nasa.gov/lunabotics/.