

NASA 5th Annual Robotic Mining Competition for Universities: Robot Configurations and Results

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NASA's Robotic Mining Competition (RMC) 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 Mars. The unique physical properties of Martian regolith and the reduced 3/8 gravity, soft vacuum environment make excavation a difficult technical challenge. Advances in basalt regolith mining have the potential to significantly contribute to our nation's 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 basalt 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, must meet all specifications.

We will review each mining robot design fielded in the 2014 NASA Robotic Mining Competition report the competition results and classify the configurations. By providing a framework for robotic design and fabrication, which culminates in a live competition event, university students have been able to produce sophisticated robots which are tele-operated or autonomous. Multi-disciplinary teams are encouraged and the ex-

treme sense of accomplishment 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, National Instruments, Harris, Honeybee Robotics, Moon Express, ASCE, Space Florida, igus, Lockheed Martin) have all stated that there is a strong need for skills in the workforce related to robotics and automated machines. In 2014, approximately 39 university teams from the USA participated. 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 basalt regolith.

More information is available at
<http://www.nasa.gov/offices/education/centers/kennedy/technology/nasarmc.html>

