# NASA STTR 2017 Phase I Solicitation

## T4.02 Regolith Resources Robotics - R^3

**Lead Center: KSC**

**Participating Center(s): ARC, LaRC**

**Technology Area: TA7 Human Exploration Destination Systems**

The use of robotics for In-Situ Resource Utilization (ISRU) in outer space on various planetary bodies is essential since it uses large quantities of regolith that must be acquired and processed. In some cases this will happen while the crew is not there yet, or it will take place at a remote destination where the crew cannot spend much time doing Extra Vehicular Activity (EVA) due to radiation exposure limits. Large communications latencies mandate autonomous robotics applications. Proposals are sought which provide solutions for the following regolith resources and robotics related technology areas:

**Robotic Site Preparation and Construction for Civil Engineering Infrastructure**

Future human bases on planetary surfaces, moons and asteroids will require infrastructure to ensure the survival of the crew as well as to prolong the life times of equipment operating in harsh and extreme environments. Since humans will not be at the destination in the early phases of the base construction, robotic equipment that operates autonomously will be required. Civil engineering infrastructure such as landing pads, berms, roads, equipment hangars, dust free zones, thermal wadis, shelters, radiation shielding and habitats will be needed. Regolith handling systems, fully autonomous site preparation, paver laying robots, inter-locking brick stacking robots, modular structure assembly robots and regolith 3D additive construction systems are encouraged. Proposals are sought for innovative robotic site preparation and construction mission concepts, technology development, and demonstrations. Proposals will be evaluated on the basis of mass, power, volume, feasibility of the concept of operations and complexity.

**Regolith Derived Feed Stocks for In-Situ Robotic Manufacturing**

By manufacturing spare parts, structures and surface systems on planetary surfaces, moons and asteroids, large logistics reductions can be achieved by avoiding the transportation of raw materials, commodities and goods from Earth. The regolith contains many minerals that can be processed to extract resources for manufacturing such as metals, organics, ceramics, glasses and polymers. In addition, the regolith can be used as a bulk aggregate which can be melted, sintered, or consolidated with a binder material such as in-situ manufactured polymers or other naturally occurring binder materials to form concrete like materials. Proposals are sought for regolith derived feed stocks that can be used to manufacture spare parts, structures or surface systems. Digital materials and associated regolith derived materials for use in voxel based manufacturing and innovative additive manufacturing methods are also encouraged. Other innovative manufacturing methods such as automated casting, materials deposition or automated assembly methods are also in scope. The emphasis in Phase I shall be on proving that a viable material can be developed with a proof of concept demonstration and related materials properties shall be provided. In Phase II a full scale robotic manufacturing demonstration shall be accomplished which would show how the feedstock could be used to make useful parts, structures or surface systems. Proposals will be evaluated on the

basis of material accessibility, economic viability of the ore, feasibility of extraction or processing, materials properties, the concept of manufacturing and applications.

Proposals are sought for associated innovative resource utilization mission concepts, technology development, and demonstrations but must be based on regolith materials, robotic methods and highly innovative technologies.