EARTH MOVING INDUSTRY - LABORATORY AND NUMERICAL MODELING TOOLS APPLIED TO LUNAR ENVIRONMENTS

E. A. Reiners¹ and P. T. Corcoran¹,¹
¹ Caterpillar Inc., Technical Center, P.O. Box 1875, Peoria, Ill., 61656-1875  Reiners_Eric_A@cat.com, corcoran_paul_t@cat.com

Introduction: Long-term Moon and Mars missions will require planetary infrastructure for In-Situ Resource Utilization (ISRU) and living facilities on a scale previously unknown in planetary exploration. The construction of these facilities plus ISRU tasks will require equipment capable of excavating, transporting and accurately emplacing relatively large masses of Regolith. These tasks need to be accomplished without the traditional terrestrial techniques that utilize a suite of specialized heavy equipment vehicles where each performs one or two tasks. The planetary construction equipment will need to be light, compact, power efficient, modular and capable of performing several varied tasks in support of facility construction and ISRU and capable of accomplishing these under autonomous and/or manned control.

Current state-of-the-art laboratory and numerical modeling tools used in the development of earth based regolith moving equipment should be leveraged to expedite the concept and development of Lunar/Mars regolith handling equipment. Current state-of-the-art tools include:

- Regolith Scale Modeling Laboratories
- Numerical Regolith Modeling
- Numerical Machine Modeling and Regolith Integration
- Numerical Site Modeling of Systems of Machines

The next steps in leveraging these tools for Lunar Regolith Handling Machines and Systems, include:

- Developing a thorough understanding of the physical and mechanical properties of the material
- Incorporating this understanding as inputs to the above mentioned tools and modifying the tools as necessary to represent the Lunar/Mars environment
- Capturing the desired tasks and requirements of surface machines.
- Using the above tools and requirements to develop and evaluate machine concepts including end-effectors, enhanced traction or anchoring technologies. Site simulation and evaluating systems of machines will be a necessary part of the concepting task.

The vision of the final machine concepts are light, modular “host” machines providing propulsion and power for a wide variety of work tools to meet mission tasks and requirements.