DESIGN SIMULATION OF LUNAR EXPLORATION AND ISRU PROTOTYPE VEHICLES AND MISSION SCENARIOS. B. Damer[1] D. Rasmussen[1], P. Newman[1], B. Blair[2], M. Duke[2], R. King[2], T. Muff[2], M. Shirley[3], W.-M. Shen[4], [1]DigitalSpace (343 Soquel Ave, #70, Santa Cruz CA 95062, bdamer@digitalspace.com), [2]Colorado School of Mines, [3]NASA ARC, [4]ISI, University of Southern California.

Introduction: NASA's return to the Moon by 2020 calls for sustainable human presence, suggesting that crew will make use of local resources for mission consumables. Generally referred to as In Situ Resource Utilization (ISRU), lunar regolith may be mined for small scale production of hydrogen, oxygen, water and volatiles. The Colorado School of Mines constructed and tested a prototype Bucket Wheel Excavator (BWE) in 2003 (fig 1) [1]. This vehicle is an early prototype of a common mining vehicle adapted for lunar size and power. Under SBIR program support, DigitalSpace created a virtual model of this vehicle, placing it in a simplified simulated regolith environment to prove that a physics-based, force feedback joystick driven virtual vehicle simulation (figure 2) could be delivered to consumer personal computers via the internet.

Figure 1

Figure 2

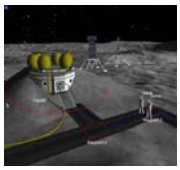

Figure 3

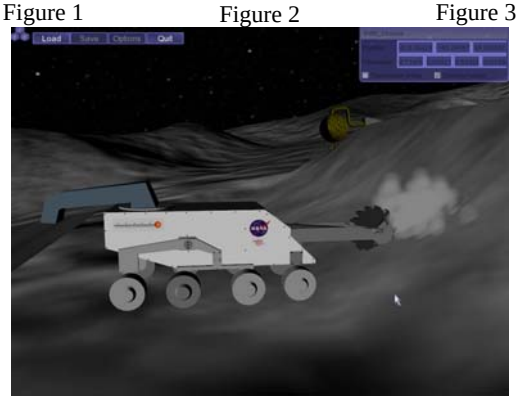

Figure 4

Results: DigitalSpace created a model of the vehicle drive train, bucket wheel operation, limited surface dynamics and dust behavior model (figure 4) and placed the vehicle in a lunar base/ISRU processor setting (figure 3). DigitalSpace is pursuing this work further by assembling a team of expert advisors and building a collaborative design platform to iterate a dozen or more lunar surface mission vehicles and scenarios. In the years 2006-2007 we plan to host regular telephone conference calls in which participants will operate design concept lunar vehicles and mission scenarios in synchronized real-time 3D environments. Participants will comment on the designs and this commentary will be used to iterate the virtual vehicles. During this period a parallel effort at Colorado School of Mines' "Project Dust" NASA H&RT research and development effort will create granular materials and dust behavioral simulations that will be used to create a medium fidelity virtual regolith sandbox for this effort.

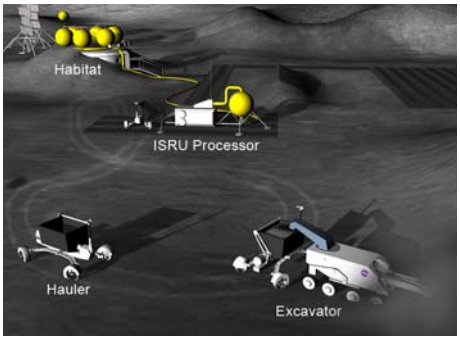

Figure 6

As the lunar robotics exploration program (LREP) is expected to create a roadmap for several types of surface missions it is hoped that this early prototyping effort will generate a number of viable designs for vehicles including:

1. Mobile platforms to explore permanently shadowed lunar Polar regions to test the hypothesis that water ice may be found there.
2. Drills to permit deeper exploration of loose aggregates or coring of stable regolith.
3. Excavator/processor vehicle designs for regolith handling and processing (figure 6).
4. "Superbots" style innovative robotics permitting one stationary lander to deploy smaller reconfigurable explorers [2].
5. Construction, inspection and maintenance telerobotics to provide base assembly and astronaut assistance on the lunar surface.

Call for Participation: DigitalSpace is calling for participation by LEAG, Space Resources Roundtable and the LPI communities to participate in this project.

References: [1] Muff, T., Johnson, L., King, R., Duke, M.B., A Prototype Bucket Wheel Excavator for the Moon, Mars and Phobos, Proceedings of STAIF-2004. [2] Taylor et al, this volume.