Publications and Presentations List for the NASA Lunar Sciences Institute Project "Exploration and Scientific Potential of the Lunar Poles" Topic area on "Excavation and Mobility Modeling"

July 22, 2013.

Refereed Journal Publications

1. Oravec, H.A., X. Xeng, and V.M. Asnani. 2010. Design and characterization of GRC-1: A soil for lunar terramechanics testing in Earth-ambient conditions, J Terramechanics (2010), 47(6), 361-377, doi:10.1016/j.jterra.2010.04.006.
2. Zeng, X., He, C., Oravec, H. A., Wilkinson, A., Agui, J., & Asnani, V. M. (2010). Geotechnical properties of JSC-1A lunar soil simulant. *ASCE Journal of Aerospace Engineering* , 23(2), 111-116.
3. Knuth, M. A., J. B. Johnson, M. A. Hopkins, R. J. Sullivan, J. M. Moore. 2012. Discrete element modeling of a Mars Exploration Rover wheel in granular material. J. of Terramechanics, p. 27-36, doi: 10.1016/j.jterra.2011.09.003, http://dx.doi.org/10.1016/j.jterra.2011.09.003
4. Green, A, K. Zacny, J. Pestana, D. Lieu, R. Mueller, (2013), Investigating the Effects of Percussion on Excavation Forces, J. Aerosp. Eng. doi: 10.1061/(ASCE)AS.1943-5525.0000216
5. Agui, J. H. , M. Bucek, A. DeGennaro, R. A. Wilkinson, and X. Zeng. "Lunar Excavation Experiments in Simulant Soil Test Beds: Revisiting the Surveyor Geotechnical Data," J. Aerospace Eng. 26(1), pp. 117-133, 2013.
6. Green, A. and K. Zacny. In review. Effect of Mars atmospheric pressure on percussive excavation forces. J. Terramechanics.
7. Hopkins, M. A. In press. Polyhedra faster than spheres, Engineering Computations.

Technical and Internal Reports and PhD Dissertation

1. E. Rame, A. Wilkinson, A. Elliot, and C. Young, "Flowability of JSC-1a," NASA Glenn Research Center, Cleveland, OH, Technical Report TM-2009-215625, 2009.
2. Kulchitsky, A., M.A. Hopkins, J.B. Johnson. 2010. LOSp: Large objects small particles interaction (LOPSI). Unpublished documentation for a new DEM optimized for parallel supercomputers and other computing environments.
3. Green, A. 2011. *A Numeric Predictive Failure Model for Percussive Excavation*, PhD Dissertation, University of California at Berkeley, December 2011

Conference Papers (with associated presentations)

1. A. Wilkinson, "Surface energy of lunar soil simulants," Central Regional Meeting of the American Chemical Society: May 20-23, 2009.
2. Hopkins, M.A., Polyhedra on the cheap, proceedings of DEM5-2010, London, 25-26, August, 2010.

3. Knuth, M., M. Hopkins, and D. Cole. 2010. Discrete element modeling of Vicksburg sand and lunar simulant, In G. Song (Ed.), *Earth and Space 2010: Engineering Construction, and Operations in Challenging Environments.* Honolulu, Hawaii: ASCE, March 14—17, 2010. http://dx.doi.org/10.1061/41096(366)6
4. Zacny, K., J. Wilson, J. Craft, V. Asnani, H. Oravec, C. Creager, J. Johnson, T. Fong. 2010. Robotic lunar geotechnical tool, In G. Song (Ed.), *Earth and Space 2010: Engineering, Construction, and Operations in Challenging Environments.* Honolulu, Hawaii: ASCE, March 14—17, 2010. http://dx.doi.org/10.1061/41096(366)19
5. Oravec, H. A., P.B. Abel, V.M. Asnani. 2010. Simulation of the lunar environment for the study of regolith strength, In G. Song (Ed.), *Earth and Space 2010: Engineering, Construction, and Operations in Challenging Environments.* Honolulu, Hawaii: ASCE, March 14—17, 2010. http://dx.doi.org/10.1061/41096(366)23
6. Knuth, M., and M. Hopkins. 2011. A comparison of scuff tests from the Martian rover Opportunity and a discrete element method model 17th International Conference of the ISTVS (International Society for Terrain-Vehicle Systems, Virginia Tech., Blacksburg, Sept. 18-22, 2011.
7. Kleinhenz, J.E. and Wilkinson, A., 2012, ISRU Soil Mechanics Vacuum Facility: Soil Bin Preparation and Simulant Strength Characterization, 50th Aerospace Sciences Meeting and Exhibit. American Institute for Aeronautics and Astronautics. AIAA-2012-0359.
8. Green, A, K. Zacny, J. Pestana, D. Lieu, R. Mueller. Percussive Excavation and its Nullifying Effect on the Influence of Soil Relative Density, ASCE Earth and Space 2012, 16-18 April 2012, Pasadena, CA.
9. Zacny, Z., M. Bualat, P. Lee, L. Alvarez, T. Fong, M. Deans, L. VanGundy, and D. Lees. 2012. Using Percussive, Dynamic, and Static Soil Penetrometers to Assess Geotechnical Properties and the Depth to Ground Ice of the Mars and Lunar Analog Terrains on the Devon Island, Canadian Arctic. In K. Zacny (Ed.), *Earth and Space 2012:Engineering for Extreme Environments: Engineering, Science, Construction, and Operations in Challenging Environments.* Pasadena, California: ASCE, April 15—18, 2012.
10. Creager, C., S. Moreland, K. Skonieczny, K. Johnson, V. Asnani and R. Gilligan. 2012. Benefit of "Push-Pull" Locomotion for Planetary Rover Mobility. In K. Zacny (Ed.), *Earth and Space 2012:Engineering for Extreme Environments: Engineering, Science, Construction, and Operations in Challenging Environments.* Pasadena, California: ASCE, April 15—18, 2012.
11. Hopkins,M. A., M. A. Knuth, and A. Green. 2012. Discrete Element Method Simulations of Digging in JSC-1a. In K. Zacny (Ed.), *Earth and Space 2012:Engineering for Extreme Environments: Engineering, Science, Construction, and Operations in Challenging Environments.* Pasadena, California: ASCE, April 15—18, 2012.
12. Green, A., K. Zacny, J. Pestana, D. Lieu, and R. Mueller. 2012. Percussive Excavation and Its Nullifying Effect on the Influence of Soil Relative Density. In K. Zacny (Ed.), *Earth and Space 2012:Engineering for Extreme Environments:*

Engineering, Science, Construction, and Operations in Challenging Environments. Pasadena, California: ASCE, April 15—18, 2012.

13. Oravec. H., P. Abel. 2012. Simulated lunar environment for the study of regolith strength: An improved vacuum bevameter design. In K. Zacny (Ed.), *Earth and Space 2012:Engineering for Extreme Environments: Engineering, Science, Construction, and Operations in Challenging Environments.* Pasadena, California: ASCE, April 15—18, 2012.

Conference Abstracts (with associated presentations)

1. Johnson, J.B., J. Agui, V. Asnani, D.M. Cole, M.A. Hopkins, M. Knuth, A. Kulchitsky, L.A. Taylor, A. Wilkinson, K. Zacny. Lunar regolith mobility and excavation modeling. Presentation and abstract at the NASA Lunar Science Forum, NASA Ames Research Center, July 20—22, 2010.
2. Kulchitsky, A., and J. B. Johnson. 2010. Hybrid broad phase contact detection method for lunar/mars regolith modeling designed for use on heterogeneous computer systems. American Geophysical Union, Fall Meeting 2010, abstract #IN41A-1357, URL: http://adsabs.harvard.edu/abs/2010AGUFMIN41A1357K .
3. Agui, J. and R. A. Wilkinson. 2011. Lunar excavation and penetration experiments in a simulant soil test bed. NASA Lunar Science Forum 2011, NASA Ames Research Center, July 19-21, 2011, URL: http://lunarscience2011.arc.nasa.gov/lunar-excavation-and-penetration-experiments-simulant-soil-test-bed
4. Green, A., D. Lieu, K. Zcny, B. Mellerowicz, R. Mueller, J. Johnson. Variables of percussive excavation in lunar regolith simulant. NASA Lunar Science Forum 2011, NASA Ames Research Center, July 19-21, 2011, URL: http://lunarscience2011.arc.nasa.gov/variables-percussive-excavation-lunar-regolith-simulant
5. Johnson, J. B., J. Agui, V. Asnani, M. Hopkins, M. Knuth, A. Kulchtsky, A. Wilkinson, L. Zacny. Lunar regolith mobility and excavation experiment and modeling progress. NASA Lunar Science Forum 2011, NASA Ames Research Center, July 19-21, 2011, URL: http://lunarscience2011.arc.nasa.gov/lunar-regolith-mobility-and-excavation-experiment-and-modeling-progress
6. Knuth, M. and M. Hopkins. 2011. Discrete element modeling for mobility and excavation. NASA Lunar Science Forum 2011, NASA Ames Research Center, July 19-21, 2011, URL: http://lunarscience2011.arc.nasa.gov/discrete-element-modeling-mobility-and-excavation
7. Kulchitsky, A., J. Johnson. 2011. Scripting language usage with discrete element method (DEM) modeling. Lunar Science Forum 2011, NASA Ames Research Center, July 19-21, 2011, URL: http://lunarscience2011.arc.nasa.gov/scripting-language-usage-discrete-element-method-dem-modeling
8. Kulchitsky, A., J. Johnson. 2011. Discrete element modeling of the cone penetrometery test using COUPI model. Lunar Science Forum 2011, NASA Ames Research Center, July 19-21, 2011, URL: http://lunarscience2011.arc.nasa.gov/discrete-element-method-modeling-cone-penetrometry-test-using-coupi-model

9. Wilkinson, A., A DeGennaro, H. Oravec, J. Agui, J. Johnson. 2011. Cone penetrometery as a validation for geotechnical discrete element modeling. Lunar Science Forum 2011, NASA Ames Research Center, July 19-21, 2011, URL: http://lunarscience2011.arc.nasa.gov/cone-penetrometry-validation-experiment-geotechnical-discrete-element-modeling
10. Kulchitsky, A. V., J. B Johnson, A. Wilkinson, A. J. DeGennaro, P. Duvoy. 2011. Discrete Element Method (DEM) Application to The Cone Penetration Test Using COUPi Model, American Geophysical Union Fall Meeting, P13D. Science Enabled by the NASA Lunar Science Institute (NLSI): Progress and Future Directions IV Posters, December, 2011.
11. Knuth, M., M. A. Hopkins. 2011. Discrete element modeling for mobility and excavation, American Geophysical Union Fall Meeting, P13D. Science Enabled by the NASA Lunar Science Institute (NLSI): Progress and Future Directions IV Posters, December, 2011. http://static.coreapps.net/agu2011/html/P13D-1706.html
12. Green, A., D. Lieu, J. Pestana, K. Zacny, B. Mellerowicz, J. Craft, A. Wilkinson, J. Agui, R. Mueller, J. Johnson, A. Kulchitsky. 2011. Variable Contributions to Shear Strength Reduction for Percussive Excavation in Lunar Regolith Simulant, AGU Fall meeting, 5-8 December, 2011
13. Kulchitsky, A., J. B. Johnson, A. Wilkinson, and A. J. Degennaro. 2012. Discrete element method modeling of cone penetration test on lunar regolith. In K. Zacny (Ed.), *Earth and Space 2012:Engineering for Extreme Environments: Engineering, Science, Construction, and Operations in Challenging Environments.* Pasadena, California: ASCE, April 15—18, 2012.
14. Zacny, K., A. Green, J. Johnson, Percussive Excavation for Lunar Mining and ISRU, Abstract 492, NLSI, 19-21 July 2012 Moffett Field CA
15. Kulchitsky, A., A Wilkinson, J. B. Johnson, P. Duvoy. 2012. Cone Penetrometry Test in Lunar Simulant JSC-1A Simulation with COUPi DEM Model and Experimental Validation, Abstract 550, Lunar Science Forum, July 17-19, 2012, NASA ARC, Moffett Field, CA, http://lunarscience.nasa.gov/lsf2012/cone-penetrometry-test-lunar-simulant-jsc-1a-simulation-coupi-dem-model-and-experimental-validation
16. Agui, A., A. Wilkinson. 2010. Lunar Excavation Experiments in Simulant Soil Test Beds—Revisiting the Surveyor Geotechnical Data, Abstract 617, Lunar Science Forum, July 17-19, 2012, NASA ARC, Moffett Field, CA , http://lunarscience.nasa.gov/lsf2012/lunar-excavation-experiments-simulant-soil-test-beds%E2%80%94revisiting-surveyor-geotechnical-data
17. Duvoy, P., C. Creager, A. Kulchitsky, J. B. Johnson. 2012. Analysis of bevameter/regolith interaction mechanics using the COUPi discrete element method, Abstract xxx, Lunar Science Forum, July 17-19, 2012, NASA ARC, Moffett Field, CA , http://lunarscience.nasa.gov/wp-content/uploads/2012/08/43_BVM_v4x.pdf ; http://lunarscience.nasa.gov/lsf2012/analysis-bevameterregolith-interaction-mechanics-using-coupi-discrete-element-method-model .
18. J. B. Johnson, J. Agui, C. Creager, A. Green, M. Hopkins, M. Knuth, A. Kulchitsky, . Oravec, A. Wilkinson, K. Zacny. Excavation and Mobility Modeling

of lunar regolith as part of the NLSI the Scientific Exploration Potential of the Lunar Poles Project. http://lunarscience.nasa.gov/lsf2012/excavation-and-mobility-modeling-lunar-regolith-part-nlsi-scientific-exploration-potential-lunar-pol ; http://lunarscience.nasa.gov/lsf2012/agenda ;

19.
20. Kulchitsky, A., J. Johnson, P. Duvoy, A. Wilkinson, C. Creager. 2012. Cone penetration and bevameter geotechnical tests in lunar regolith simulants: discrete element method analysis and experimentation, Abstract 1498015, Poster P43B-1923, AGU Fall Meeting, 3-7 Dec. 2012, San Francisco, Session P43B – Lunar Science in the Wake of Human Exploration: Four Decades of Samples and Surface Data.

Presentations

1. Johnson, J. B. 2011 (Invited). The discrete element method and its use in physical modeling. Keck Institute for Space Studies workshop on "xTerramechanics: Integrated Simulation of Planetary Surface Missions". California Institute of Technology, June 20-24, 2011, URL: http://www.kiss.caltech.edu/workshops/xterramechanics2011/presentations/johnson.pdf
2. Johnson, J. B., J. Agui, C. Creager, M. A. Hopkins, M. Knuth, A. Kulchitsky, H. Oravec, A. Wilkinson, and K. Zacny. 2012. Lunar regolith mobility and excavation modeling. In K. Zacny (Ed.), *Earth and Space 2012:Engineering for Extreme Environments: Engineering, Science, Construction, and Operations in Challenging Environments.* Pasadena, California: ASCE, April 15—18, 2012.