

**NATIONAL SPACE GRANT
SOUTHEAST REGIONAL
MEETING**

OCTOBER 23-24, 2014

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FSGC – Research Awards

Dr. Hamid Hefazi (Florida Institute of Technology))

Title of Project – Discrete Element Modeling (DEM) of Regolith During Lunar Landing

PI – Dr. Hamid Hefazi, Florida Institute of Technology

Connection to NASA priority – KSC (TA-07 Human Exploration Destination Systems: ISRU including dust mitigation and construction using regolith)

Key Points

- Develop a computational methodology for the study of the interaction of supersonic rocket plume with lunar regolith
- Preliminary work has modelled the cratering of granular sand due to rocket exhaust in Earth's atmospheric conditions
- Results of the work are somewhat in agreement with experiments conducted by Phil Metzger and others at KSC



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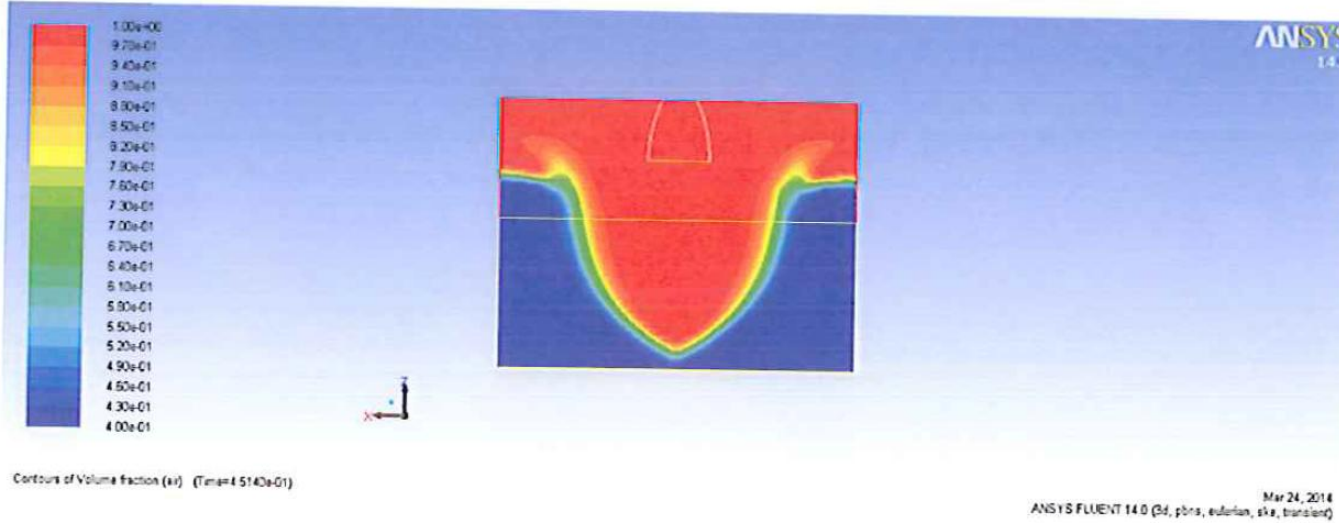


Figure 3: Sand (blue) and Air (red) phases showing cratering of granular sand due to rocket exhaust plume at Earth's atmospheric conditions.



FSGC – Research Awards

Dr. Norm Fitz-coy (University of Florida)

Title of Project – Development of a Visual Inspection System for Post-impact Characterization of DebrisSat

PI – Dr. Norm Fitzcoy, Aerospace and Mechanical Dept.

Connection to NASA priority – MSFC -orbital debris mitigation

Key Points

- A 50 KG satellite, DebrisSat, was subjected to a ground hyper velocity impact test to generate typical debris components that would result from an on-orbit collision. These debris fragments will be characterized and the results used to update the NASA Standard Breakup Model to improve its capability of accurately predicting orbital breakups



FSGC – Research Awards

Dr. Norm Fitz-coy (University of Florida)

Key Points (cont.)

In order to efficiently catalogue the thousands of fragments generated during the impact test, a visual inspection system (VIS) was built that will (i) reduce the time taken to analyze each fragment and (ii) minimize the measurement errors. Without the VIS, each fragment would be measured with calipers by hand in three dimensions and an image taken manually (used only for visual characterization).



Figure 4: Preliminary VIS analysis of known objects



FSGC – Research Awards

Dr. Norm Fitz-coy (University of Florida)

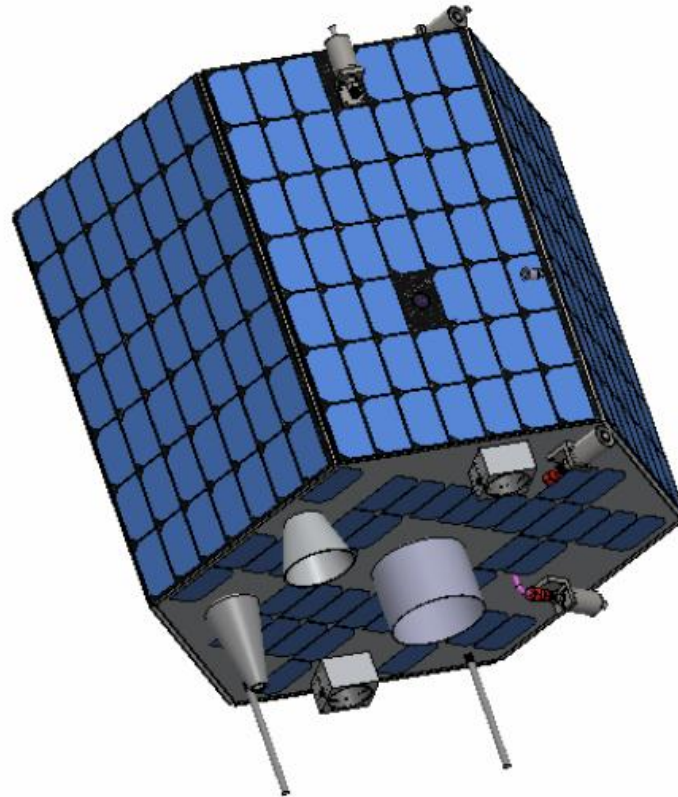


Figure 5: DebrisSat



FSGC – Research Awards

Dr. Jihua Gou (Univ. of Central Florida)

Title of Project – Self Healing Nanocomposites for Cryogenic Hydrogen Storage Tanks

PI – Dr. Jihua Gou, Mechanical and Aerospace

Connection to NASA priority – MSFC (Space Transportation); KSC (TA-13 Ground and Launch Systems - On-Site Production, Storage, Distribution and Conservation of Fluids), Stennis (Advanced Non-Destructive Technologies)

Key Points

- The application of lightweight high performance carbon fiber reinforced composites as structures is critical to the success of the next generation of Reusable Launch Vehicles (RLV).
- Developed a novel self-healable face sheet for sandwich structures by combining a hybrid paper (porous sheet) composed of carbon nanotubes (CNT) and graphene sheets (GS) with a self-healable shape memory polymer (SMP) resin



FSGC – Research Awards

Dr. Jihua Gou (University of Central Florida)

Key Points (cont.)

- The project team interacted with research engineers from NASA KSC and United Space Alliance (USA) on this technology development for space applications. Particularly, the Nondestructive Engineering Group at USA is interested in working with us on NDE inspection of external composites tank developed in this project
- Funded Research Proposal Based on this Project
 - 3D Electrical Actuation of Shape Memory Polymer Composites for Footwear Applications
 - Amount: \$120,000
 - PI: J. Gou Co-PI: Y. Xu (UCF)
 - Funding Agency: HB Polymer Company



FSGC – Research Awards

Dr. Louis Chow (Univ. of Central Florida)

Title of Project – Effect of Vibration on Cryogenics Boil-off During Launch, Transfer and Transport

PI – Dr. Louis Chow, Mechanical and Aerospace

Connection to NASA priority KSC (TA-13 Ground and Launch Systems - On-Site Production, Storage, Distribution and Conservation of Fluids

Key Points

- Researchers at NASA/KSC Cryogenic Test laboratory obtained preliminary data which show several-fold increases in boil-off when a cryogenic tank is placed on a mechanical shaker, simulating the condition of launch. This indicates that there is a very significant conversion of mechanical vibrational energy to thermal energy



FSGC – Research Awards

Dr. Louis Chow (Univ. of Central Florida)

Key Points (cont.)

- UCF and KSC researchers have identified excitation frequency and amplitude, and the density and viscosity of the cryogenic fluids to be key parameters in the energy conversion.
- Collaborative effort between NASA/KSC and UCF whereby NASA carried out the experimentation while UCF performed the analysis and simulation.



No excitation



In launch (simulated) 5-fold increase

The boil-off of liquid nitrogen on the right is from the cryogenic tank placed on a shaker, and is several times higher than on the left.



FSGC Awards

- Dr. Dan Kirk, FIT, Self-Assembly in Biology and the Origin of Life (TA-06, KSC)
- Dr. Ronnal Reichard, FIT, Quick Connect Composite Struss Joint (TA-04, KSC)
- Dr. Michelle Manuel, UF, Crack closure and intrinsic toughening mechanism for shape memory alloy embedded composites (Stennis)
- Dr. Necati Catbas , UCF, Monitoring and Non-Destructive Evaluation of Composite (Stennis)
- Dr. Donald Malocha, UCF, Correlator Transceiver Development for Wireless Sensors (KSC)
- Dr. Sathya Gangadharan ERAU Investigation of On-Orbit Cryogenic Fluid Management Technologies (KSC)



FSGC Awards

- Dr. Mark Archambault, FIT, Computational Modeling of Solid Rocket Plume Radiation (Stennis)
- Dr. Kunal Mitra, FIT , Understanding Bone Loss in Microgravity through Nanoscale finite element analysis of load bearing structures in bones (KSC - TA-06 Human Health, Life Support and Habitation Systems; MSFC - Space Systems, Habitation Elements and Life Support)
- Dr. Rodney Roberts ,FSU, Improving on-orbit teleoperation by Reducing Mental Workload (KSC - TA-04 Robotics, Tele-robotics and Autonomous Systems)
- Dr. Jian Ge, UF, Design Study of an Extremely Compact Near-IR 3-D Imaging Spectrometer for Remote Sensing (msfc, Stennis)