ENGINEERING, CONSTRUCTION, AND OPERATIONS IN CHALLENGING ENVIRONMENTS

Earth & Space 2006

PROCEEDINGS OF THE TENTH BIENNIAL ASCE AEROSPACE DIVISION INTERNATIONAL CONFERENCE ON ENGINEERING, CONSTRUCTION, AND OPERATIONS IN CHALLENGING ENVIRONMENTS

March 5–8, 2006
League City/Houston, Texas

EDITED BY
Ramesh B. Malla
University of Connecticut, Storrs, CT, USA

Wieslaw K. Binienda
University of Akron, Akron, OH, USA

Arup K. Maji
University of New Mexico, Albuquerque, NM, USA

Volume 1 of 3

Printed from CD-ROM with permission by:
Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571
www.proceedings.com

CSIN: 9999900113
Contents
Volume 1 of 3

Advanced Aerospace Systems
Aerospace Structures, Quantitative Methods

1 Probabilistic Structural Evaluation of Uncertainties in Radiator Sandwich Panel Design
Latife Kuguoglu and Damian Ludwiczak

9 Sensor Placement for Aerospace Vehicle Health Monitoring Systems
R. F. Guratzsch and S. Mahadevan

17 Acoustic Testing of Hollow Core Fairing Designs
John Higgins, Andrew Williams, and Emil V. Ardelean

25 Design of “Assessment and Decision Aiding Software for Application in High Risk Fields” with a Case Study: The Challenger Tragedy

33 Wind Tunnel Investigation of Grid Finned Missile Configuration over Planar Control Surfaces
K. Sivaprakaash and K. M. Parammasivam

Deployable Structures I

40 A New Design Variant of the Large Deployable Space Reflector
E. Medzmariashvili, Sh. Tserodze, N. Tsingadze, M. Sanikidze, L. Datashivili, A. Sarchimelia, K. Chkhikvadze, N. Siradze, and G. Bedukadze

48 Membrane and Thin Shells for Space Reflectors
L. Datashvili and H. Baier

56 Dynamic Characterization for Multi-Layer Membrane Space Altimeter
J. C. Heald and A. Pointel

Deployable Structures II

64 SAR Membrane Tensioning
M.-J. Potvin and J. C. Heald

72 Numerical Simulations of a Deployable Structure
Tang-Tat Ng

78 Cable Vibration Control with a Magnetorheological Fluid Based Tuned Mass Damper
W. J. Wu and C. S. Cai

Dynamics and Controls of Aerospace Structures

86 Lumped and Distributed Parameter Models of a Spacecraft with Elastic Appendages: Exact Frequencies and Mode Shapes
Joel A. Storch
94 Effect of Wall on Mixing of Low Speed Multiple Rectangular Jets  
G. Mahendra Perumal and B. T. N. Sridhar

104 Experimental and Computational Studies on Delta Wing Configurations with Different Leading Edge Profiles  
M. Gopinath and K. M. Parammasivam

Enabling Technologies for Space Exploration and Transportation

114 Infrared Aircraft Deicing System  
Henry W. Hessing

120 Space Power Grid—Evolutionary Approach to Space Solar Power  
N. Komerath, N. Boechler, and S. Wanis

125 Accuracy Requirements for Cannon-Launched Space Missions  
P. T. Putman, S. J. Scruggs, Y. X. Zhou, H. Fang, and K. Salama

133 Preliminary Mission Study: Mass Driver for Earth-Bound Asteroid Threat Mitigation  
Cole K. Corbin and John E. Higgins

Granular Materials in Lunar and Martian Exploration (The 2nd Workshop)

Cratering

141 Cratering by a Subsonic Jet Impinging on a Bed of Loose Particles  
Robert B. Haehnel, Benoit Cushman-Roisin, and W. Brian Dade

149 Functional Scaling for the Cratering of a Granular Surface by an Impinging Jet  
C. M. Donahue, P. T. Metzger, and C. D. Immer

Granular Flow

155 Particle-to-Particle Interaction during Shearing of Granular Materials  
Bashar A. Alramahi and Khalid A. Alshibli

163 Contrasting Terrestrial and Lunar Gravity: Angle of Repose and Incline Flows  
S. Ji and H. H. Shen

Lunar and Martian Dust, Modeling and Mitigation

171 Image-Based Modeling of Lunar Soil Simulant for 3-D DEM Simulations  
Takashi Matsushima, Jun Katagiri, Kentaro Uesugi, Akira Tsuchiyama, and Tsukaka Nakano

179 Charged Dust Dynamics near the Lunar Surface  
J. E. Colwell, S. R. Robertson, M. Horányi, X. Wang, and P. Wheeler

184 A Layered Architecture for Mitigation of Dust for Manned and Robotic Space Exploration  
Frederick A. Slane and Gary Rodriguez

192 Lunar Simulants as Feedstocks for ISRU Processing: Mineralogy and Chemistry  
E. Hill, A. D. Patchen, B. Deane, Y. Liu, J. Park, and L. A. Taylor

200 Submicron Particle Size Distribution of Apollo 11 Lunar Dust  
Modeling Issues for Granular Material

206 Micromechanical Modeling of the Interaction of a Soil-Rigid Wheel System
Claudia Medina and Mourad Zeghal

214 Footprints: The Role of Particle Characteristics
Hyun-Ki Kim and J. Carlos Santamarina

Modeling Methodology

221 AModel for Large Scale Near-Real Time Simulation of Granular Material Flow
E. G. Nezami, Y. M. A. Hashash, and J. Ghaboussi

229 Injecting Particle Scale Physics into Continuum Models of Granular Materials for Large-Scale Applications
S. D. C. Walsh and A. Tordesillas

237 On the Behavior of Granular Materials in Rough Wheel Contacts on Mars
C. Fred Higgs III, Venkata Jasti, Christopher Racusen, Courtney Heller, Nadav Cohen, and John Tichy

Property Measurements, Computational

245 Multiscale Analysis of the Effects of Changing Gravity on Stress Propagation in a Material Subject to an Indenting Rigid Flat Punch
Maya Muthuswamy and Antoinette Tordesillas

253 Evolution of Contact Forces, Fabric, and their Collective Behavior in Granular Media under Deformation: A DEM Study
J. T. Bosko and A. Tordesillas

261 Simulation of Agglutinates Formation
Chotipong Somrit and Masami Nakagawa

268 Determination of Axial Stress and Deformation Variations in a Cylindrical Bed of Granular Material with Applications in Space
Ramesh B. Malla and Ganesh Anandakumar

Property Measurements, Experimental

277 Cam Cap Models for Lunar Soil: A First Look
Richard A. Schultz

284 Morphology and Physical Characteristics of Apollo 17 Dust Particles
Y. Liu, J. Park, E. Hill, K. D. Kihm, and L. A. Taylor

290 Lunar Regolith Geotechnical Properties: Implications for Exploration
S. N. Batiste and M. R. Lankton

Structure/Machine/Tool-Soil Boundary

297 Concept of Virtual Soil Bin by DEM for Lunar Locomotion Studies
Hiroshi Nakashima, Shigeru Aoki, Hiroshi Kanamori, and Akira Oida

305 How to Swim in Sand
M. Bzdega and S. A. Koehler
Human Exploration and Development of Space
Advanced Life Support Systems I

313 Abiotic Ammonia Mass Transfer in a Biotrickling Filter
Eric McLamore, Sybil Sharvelle, Kathy Banks, and Stephen Clark

322 Macro- and Micro-Scale Contaminant Removal and Resource Recovery from Urine via the Freeze Concentration Process
J. M. Schmidt and J. E. Alleman

330 Thermophilic Aerobic Solid Waste Processing for Long-Term Crewed Missions
D. R. Whitaker and J. E. Alleman

Advanced Life Support Systems II

338 Treatment of an Early Planetary Base Wastestream in a Rotating Hollow Fiber Membrane Reactor
Tony Rector, Jay Garland, Kristina Reid-Black, Richard F. Strayer, Mary Hummerick, Mike Roberts, and Lanfang Levine

344 A Novel Membrane Bioreactor for Spacecraft Water Recycling
Daniel Smith, Jay Garland, and Tony Rector

Exploration and Utilization of Space

350 Returning to the Moon: Resources, Future Development, and Colonization
Tapan R. Kulkarni, Mukul M. Agnihotri, and Shantanu C. Prabhune

357 Space Traffic Control Mission Assurance
Michael H. Elder

365 A Lunar Miner Design: With Emphasis on the Volatile Storage System
Matthew E. Gajda, Gerald L. Kulcinski, Gregory I. Sviatoslavsky, and Igor N. Sviatoslavsky

373 Asteroid/Comet Classification for Mining Purposes
Leslie Sour Gertsch, John L. Remo, and Richard Gertsch

Multiphase Flow in Space Exploration Systems

381 Bubbles and Droplets in Tubing in Reduced Gravity
Steven H. Collicott

389 Fundamental Characteristics of Granular Flow Under Variable g-Levels
Richard M. Lueptow, Tim Arndt, Antje Brucks, and Julio M. Ottino

394 Two Phase Flow Analysis on Filling Processes of Microfluidic/Microarray Integrated Systems
B. Johnson, C. P. Chen, A. Jenkins, S. Spearing, L. A. Monaco, A. Steele, and G. Flores

Space Engineering and Construction

400 Curing of Surfaces Formed by Tailored Force Fields
S. Wanis and N. Komeraeth

405 “All Up” Analog Simulations: Why They are Essential for Planning Long Duration Human Missions to the Moon and Mars
Cathy Dankewicz, Ruthan Lewis, and Kurt A. Micheels
Space Business, Commerce, Tourism, and Law

413  Space Commerce and Space law: Making the Twain Meet
     Debarupa Banerjee

421  Crossing the Infinite Frontier: An Analysis of Property Rights Regime in Corpus Juris Spatialis
     Ketan Mukhija

429  Public Attitudes Toward Different Space Goals: Building Public Support for the Vision for Space Exploration (VSE)
     Thomas L. Matula and Karen A. Loveland