



GUIDANCE AND CONTROL 2008

**Volume 131
ADVANCES IN THE ASTRONAUTICAL SCIENCES**

Edited by
Michael E. Drews
Robert D. Culp

*Proceedings of the 31st Annual AAS Rocky
Mountain Guidance and Control Conference
held February 1-6, 2008, Breckenridge,
Colorado.*

*Published for the American Astronautical Society by
Univelt, Incorporated, P.O. Box 28130, San Diego, California 92198
Web Site: <http://www.univelt.com>*

Copyright 2008
by
AMERICAN ASTRONAUTICAL SOCIETY
AAS Publications Office
P.O. Box 28130
San Diego, California 92198

Affiliated with the American Association for the Advancement of Science
Member of the International Astronautical Federation

First Printing 2008

Library of Congress Card No. 57-43769
ISSN 0065-3438
ISBN 978-0-87703-545-9 (Hard Cover Plus CD ROM)

Published for the American Astronautical Society
by Univelt, Incorporated, P.O. Box 28130, San Diego, California 92198
Web Site: <http://www.univelt.com>

Printed and Bound in the U.S.A.

CONTENTS

	Page
FOREWORD	vii
PREFACE	xiii
SECTION I: ADVANCES IN GUIDANCE AND CONTROL	1
ISS Contingency Attitude Control Recovery Method for Loss of Automatic Thruster Control (AAS 08-001) Nazareth Bedrossian, Sagar Bhatt, Abran Alaniz, Edward McCants, Louis Nguyen and Greg Chamitoff	3
Advanced AOCS Design for the Small GEO Telecom Satellite (AAS 08-002) Sten Berge, Jon Kronander, Emil Vinterhav, Peter Rathsman, Hendrik Lübbertedt and Peter Zentgraf	17
GPS Beyond LEO: Signal Environment System Design Considerations (AAS 08-003) Lee Barker	31
New Earth Sensor Design and Performance (AAS 08-004) Franco Boldrini, Stefano Brogi, Elisabetta Monnini and Elena Tremolizzo	49
Control of Satellites with Minimum Number of Control Actuators (AAS 08-005) Jason S. Hall and Marcello Romano	61
Innovative G&C Solutions Enabled by New Generation of Sensors (AAS 08-007) L. Blarre, N. Perrimon, C. Pezant and C. Chalté	81
Autonomous Orbit Control Experience on TacSat-2 using Microcosm's Orbit Control Kit (OCK) (AAS 08-008) Yegor Plam, Richard Van Allen, James Wertz and Thomas Bauer	97
SECTION II: GUIDANCE, NAVIGATION AND CONTROL FAULT MANAGEMENT	107
GN&C Fault Protection Fundamentals (AAS 08-031) Robert D. Rasmussen	109
Under the Radar: Trials and Tribulations of Landing on Mars (AAS 08-033) Eli David Skulsky, Scott Shaffer, Erik Bailey, Curtis Chen, Ben Cichy and David Shafter	129

	Page
Keeping Stereo on Course: Guidance and Control System Fault Protection (AAS 08-034)	
John W. Hunt, Jr., George J. Cancro, Daniel S. Wilson, J. Courtney Ray and Michael D. Trela	149
JWST Sun Protection (AAS 08-035)	
Judy Tillman, Satya Anandakrishnan, Delaram Gidanian, Henry Fu, Magdy Wahbah, F. Landis Markley, Peiman Maghami and Ken Lebsack	163
Building Fault Tolerance into NASA's Lunar Reconnaissance Orbiter (AAS 08-036)	
Stephen F. Andrews, Martin Houghton and Rick Saylor	175
Fault Detection and Correction for the Solar Dynamics Observatory Attitude Control System (AAS 08-037)	
Scott R. Starin, Melissa F. Vess, Thomas M. Kenney, Manuel D. Maldonado and Wendy M. Morgenstern	191
Proportional Helium Thrusters for Gravity Probe B (AAS 08-038)	
D. B. DeBra, W. J. Bencze, C. W. F. Everitt, J. VandenBeukel and J. Kirschenbaum	209
SECTION III: SPACE ENVIRONMENT	217
The Space Environment and its Effects on Space Systems (AAS 08-041)	
J. E. Mazur, J. F. Fennell and P. O'Brien	219
Implementation of Revitalized Parts, Materials and Processes Standards and Specifications (AAS 08-042)	
David C. Meshel and Pedro A. Encarnación	231
Enabling Robust and Reliable Spacecraft Function (AAS 08-043)	
Philip D. Hattis and Bradley A. Moran	239
Vacuum Sensitivity of Annealed Proton-Exchanged Integrated Optical Circuits (AAS 08-044)	
Russell Lipeles and John Coffey	253
Engineering Analysis of Guidance and Navigation Performance in the Uncertain Lunar Environment to Support Human Exploration (AAS 08-046)	
Kyle J. DeMars, Robert H. Bishop, Timothy P. Crain and Gerald L. Condon .	263
SECTION IV: DEEP SPACE NAVIGATION	283
The Evolution of Deep Space Navigation: 1962-1989 (AAS 08-051)	
Lincoln J. Wood	285
Radiometric Tracking for Deep Space Navigation (AAS 08-052)	
James S. Border, Gabor E. Lanyi and Dong K. Shin	309
A Brief History of Optical Navigation at JPL (AAS 08-053)	
W. M. Owen, Jr., T. C. Duxbury, C. H. Acton, Jr., S. P. Synnott, J. E. Riedel and S. Bhaskaran	329

	Page
XNAV for Deep Space Navigation (AAS 08-054) P. Graven, J. Collins, S. Sheikh, J. Hanson, P. Ray and K. Wood	349
New Horizons Navigation to Pluto (AAS 08-055) James K. Miller, Eric Carranza, Dale R. Stanbridge and Bobby G. Williams	365
Orion Navigation Sensitivities to Ground Station Infrastructure for Lunar Missions (AAS 08-056) Joel Getchius, Daniel Kubitschek and Timothy Crain.	377
The Next 25 Years of Deep Space Navigation (AAS 08-057) Tomas J. Martin-Mur, Shyam Bhaskaran, Robert J. Cesarone and Tim McElrath	397
SECTION V: HUMAN EXPLORATION GUIDANCE, NAVIGATION AND CONTROL CHALLENGES	405
Guidance, Navigation, and Control System Design in a Mass Reduction Exercise (AAS 08-061) Timothy Crain, Michael Begley, Mark Jackson and Joey Broome	407
Orion On-Board Navigation Architecture and Operations Concepts (AAS 08-062) John L. Goodman, Harvey R. Mamich and David W. Saley	425
Trigger Angle Targeting for Orbital Rendezvous (AAS 08-063) David C. Woffinden, M. Ben Rose and David K. Geller	445
Computing 6DoF Relative Position and Attitude Using 2D Image Data (AAS 08-064) Preston Faiks and Saul Weiss	463
Development of an Analytical Guidance Algorithm for Lunar Descent (AAS 08-065) Christina T. Chomel and Robert H. Bishop	471
Lunar Ascent and Rendezvous Trajectory Design (AAS 08-066) Ronald R. Sostaric and Robert S. Merriam.	491
H-II Transfer Vehicle (HTV) GN&C Design and Verification Results from the Prototesting (AAS 08-067) Hirohiko Uematsu, Toru Kasai, Satoshi Ueda, Keiichi Wada, Noboru Motoyama and Shigeki Hotta	511
Challenges of Roll Orientation with Respect to Vehicle Heading at Touchdown for the Orion Command Module (AAS 08-068) Robert S. Gay and Brian D. Bihari	529
Event Triggers in Linear Covariance Analysis with Applications to Orbital Rendezvous (AAS 08-069) David K. Geller, M. Ben Rose and David C. Woffinden	551

	Page
SECTION VI:	
RECENT EXPERIENCES IN GUIDANCE AND CONTROL	573
Orbital Express: Accomplishments and Lessons Learned (AAS 08-071) Fred G. Kennedy, III.	575
Three Year Orbital Trim Maneuver Performance of the Cassini Spacecraft Attitude Control Subsystem (AAS 08-072) Brett A. Smith	587
NASA Sounding Rocket Program Attitude Control Systems (AAS 08-073) Philip J. Eberspeaker.	597
Manual GN&C Redundancy Management Techniques during ISS Russian Computer Failures (AAS 08-074) Roscoe Lee and Gregory W. Vajdos	617
Pioneering Technologies of the TacSat-2 Attitude Determination and Control Design (AAS 08-075) Timothy J. Rood and Jason A. Wynn	627
Navigation System for Reusable Launch Vehicle (AAS 08-076) Markus Schlotterer	645
INR Performance of the GOES-13 Spacecraft Measured in Orbit (AAS 08-077) James L. Carr, Bruce Gibbs, Houria Madani and Nate Allen.	663
SECTION VII: SPACE SITUATIONAL AWARENESS	683
A System for Predicting Close Approaches and Potential Collisions in Geosynchronous Orbit (AAS 08-086) Miquela C. Vigil and Richard I. Abbot.	685
SECTION VIII: TECHNICAL EXHIBITS	703
Generic Drag Free Control Simulation - Lessons Learned from Gravity Probe B (AAS 08-011) Ivanka Pelivan, Sara Smoot, David Hipkins and Stephan Theil	709
Integrated Navigation System for the second SHarp Edge Flight Experiment (SHEFEX-2) (AAS 08-012) Stephan Theil, Markus Schlotterer, Michael Conradt and Marcus Hallmann	721
Satellite Test of the Equivalence Principle - Control and Simulation (AAS 08-013) S. Smoot, A. Walsh, I. Pelivan, M. Maat and J. Mester	733
2007 with the Shazbots (AAS 08-015) Jennifer Frazier, Divya Arcot, Max Clark-Rabinowitz, Matt Eastman, Paul Guidas, Scott Kliethermes, Zach Oligschlaeger and Ryan Smith	743

	Page
APPENDICES	751
Appendix A:	
Program: 31st Annual AAS Guidance and Control Conference, February 1-6, 2008, Breckenridge, Colorado	753
Appendix B:	
Publications of the American Astronautical Society	767
Advances in the Astronautical Sciences	768
Science and Technology Series	777
AAS History Series	785
INDICES	787
Numerical Index	789
Author Index	793