

# 34<sup>th</sup> Annual Guidance and Control Conference



**Breckenridge, Colorado  
Beaver Run Conference Center  
February 4-9, 2011**

# **PROGRAM**

*Friday, February 4, 2011*

**Room Check-In at the Beaver Run Resort  
Front Desk 4:00 pm Daily**

**Conference Registration  
6:00 – 10:00 am and  
4:00 – 6:00 pm, Daily**

**Registration questions during the  
Conference?**

**Please Contact**

**Carolyn O'Brien 720-277-5851**

**Lis Garrett 303-931-7622**

**Wine & Cheese Reception  
6:00 – 9:00 pm**

*Saturday, Feb 5 – Wednesday, Feb 9*

***Technical Sessions:  
7 am – 10 am and 4 pm – 7 pm***

*Saturday, February 5, 2011*

**Technical Exhibits: 5 pm – 8 pm**

*Sunday, February 6, 2011*

**Super Bowl Party 4:15 pm - ??**

*Monday, February 7, 2011*

**Featured Banquet Speaker**

**Joe Tanner**

**Former NASA Astronaut**

**Instructor, Aerospace Engineering Sciences**

**University of Colorado, Boulder**

**Global Navigation Satellite Systems**

Since becoming operational, Global Positioning System (GPS) has ushered in a wave of new technologies, capabilities, and products taking advantage of precise timing and navigation signals. The GPS receiver industry was born, and GPS revolutionized military and commercial business, affecting everything from aviation and spacecraft, to cell phone technology and automobile navigation, to ship navigation and container tracking. Recent advances in GPS products, along with developments in other Global Navigation Satellite Systems (GNSS), further continue to push state of the art advances in a host of applications while striving to meet new requirements. Examples include Accuracy Improvements Initiatives (AII) by GPS, new military and civil signals in the latest generation of GPS IIR-M, and GPS IIF satellites, and new receivers. Development of the next generation of spacecraft and control systems is already underway for GPS, the European Galileo system, and others. This session is intended to discuss advances in GPS products including new capabilities and signals, advances in other GNSS systems (Galileo, GLONASS, COMPASS, etc), advances in GNSS receiver technology, and space applications of GNSS.

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11-011 **GPS Program Update**, Col. Stephen Steiner (SMC)

11-012 **The Evolution of GPS Capabilities**, Chuck Frey (LMSSC)

11-013 **GPS Control Segment**, Richard Canty (Raytheon)

11-014 **Recent Developments in GPS Performance and Operations**, William Marquis (LMSSC)

11-015 **An Overview of Space Applications of Global Navigation Satellite Systems (GNSS)**, Penina Axelrad (University of Colorado)

11-016 **Launch Vehicle Range Safety – A GPS Application**, John Reed (ULA)

11-017 **LION-Navigator, Multi-Frequency, Multi-Constellation Receiver for Spacecraft Navigation**, Christopher Köhl, Hannes Filippi, Andrés Barrios-Montalvo, Peter A. Krauss, Jens Heim, and Evaline Gottzein (Astrium)

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**Session II**

**5:00 – 8:00 pm**

**Technical Exhibits**

The Technical Exhibits Session is a unique opportunity to observe displays and demonstrations of state-of-the-art hardware, design and analysis tools, and services applicable to advancement of guidance, navigation, and control technology. The latest commercial tools for GN&C simulations, analysis, and graphical displays are demonstrated in a hands-on, interactive environment, including lessons learned and undocumented features. Associated papers not presented in other sessions are also provided and can be discussed with the author. Come enjoy and excellent complimentary buffet and interact with the technical representatives and authors. This session takes place in a social setting and family members are welcome!

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**Participants in Technical Exhibits**

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Astro- und Feinwerktechnik Adlershof GmbH
Ball Aerospace
BEI Precision Systems & Space Division
EADS Astrium
EADS Sodern
Emergent Space Technologies Inc.
Galileo
Jena-Optronik GmbH
Lockheed Martin SSC
MathWorks, Inc
Microcosm Astronautics Books
MIT
Rockwell Collins
Servo Corp of America
Sierra Nevada Corporation
SimuLogix
Surrey Satellite Technology US LLC

*Sunday, February 6, 2011*

**Session III**

**7:00 – 10:00 am**

**Advances in GN&C**

Many programs depend on heritage, but the future is advanced by those willing to design and implement new and novel architectures, technologies, and algorithms to solve the GN&C problems. This session is open to papers with topics ranging from theoretical formulations to innovative systems and intelligent sensors that will advance the state of the art, reduce the cost of applications, and speed the convergence to hardware, numerical, or design trade solutions.

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11-031 **Robotic Lunar Lander GN&C Concept Design and Analysis**, James Kaidy, Timothy McGee, Thomas Criss, Christopher Dong, and Wen-Jong Shyong (JHU/APL)

11-032 **Guidance, Navigation, and Control Development for a Robotic Lander Testbed**, Timothy McGee (JHU/APL), James Kaidy (JHU/APL), Thomas Criss (JHU/APL), Doug Reid (JHU/APL), Gail Oxtan (JHU/APL) and Mike Hannan (NASA/MSFC)

11-033 **Autonomous Thruster Failure Recovery using Model Predictive Control**, Christopher M. Pong, Avar Saenz-Otero, and David W. Miller (MIT)

11-034 **Design and Integration of an All-Magnetic Attitude Control System for FASTSAT-HSV01's Multiple Pointing Objectives**, Brandon DeKock, Devon Sanders, Pedro Capolugo, Tannen Vanzwieten (SAIC, NASA/MSFC)

11-035 **One-Arcsecond Line of Sight Pointing Control in a 3U Cubesat**, Christopher M. Pong, Matthew W. Smith, Matthew W. Knutson, Sungyung Lim, David W. Miller, Jesus S. Villasenor, Sara Seager and Shawn D. Murphy (MIT, Draper)

11-036 **The European Silicon MEMS Rate Sensor Takes to Space**, Mark Hartree, Patrick Hutton, Ben Oliver and Daniele Temperanza (SELEX-Galileo, ESA, SEA)

11-037 **Systems “on chip” Activities Delivered the First Sun Sensor Prototype**, F. Boldrini, P. Fidanzati, E. Monnini, W. Ogiers, A. Pritchard, and S. Airey (SELEX-Galileo, CMOSIS, BAE, ESA)

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**Session IV** **2:00 – 4:00 pm**

### **Commercial and Civil Overhead Imagery Systems**

The commercial and municipal overhead imagery market has historically been met with airborne sensors while government intelligence demands have been met with large, space-based assets. Commercially-owned high-resolution space-systems now globally augment commercial, civil, and military imagery requirements leading to cross-market growth and a strong demand for high-performance imaging satellites. In this session, leading remote sensing contractors provide summaries of related GN&C requirements, solutions, and challenges.

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11-041 **Line of Sight Pointing and Control of Electro-Optic Space Systems—An Overview**, Michael Santana, Kevin O’Keefe, and Eric Falangas (Boeing)

11-042 **Vertically Integrated GN&C Architectures for Low-Cost Commercial Imagery Solutions**, Jonathan Chapman and Jeanne Atwell (Surrey)

11-043 **Withdrawn**

11-044 **Geolocation Accuracy Evaluations of Commercial Satellite Imagery: Challenges and Results**, Paul. C. Bresnahan (Observera)

11-045 **Constructs for the Next Generation of Commercial Imagery**, Joshua Hartman (Center for Strategic Space Studies) and Eric Sundberg (Col, USAF Ret.)

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*Monday, February 7, 2011*

**Session V**

**7:00 – 10:00 am**

**Small Body Proximity Operations**

Spacecraft proximity operations in the vicinity of small bodies such as asteroids and comets represent a challenge to traditional operations, mission design and navigation scenarios. Short orbital periods about small bodies coupled with the required small response times and long round-trip light times drive autonomy and robust mission designs. The mission design problem is greatly complicated by distended shapes that ultimately drive chaotic trajectories with sensitivities to initial condition errors, perturbations and gravity field errors. Navigation strategies must rely upon traditional radiometric data types coupled with optical imaging and landmark tracking. This session explores the current progress in trying to meet these challenges as mission enablers for future efforts.

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11-051 **Initial Considerations for Navigation and Flight Dynamics of a Crewed Near-Earth Object Mission**, Greg Holt, Joel Getchius, and William Tracy (NASA/Johnson, Jacobs, ULA)

11-052 **Mission Operations at NEA Asteroids**, Julie Bellerose (NASA/ARC)

11-053 **Small Body Surface Gravity Field Estimation from Orbit Determination**, Yu Takahashi and D.J. Scheeres (University of Colorado)

11-054 **Small Body Proximity Sensing with a Novel HD3D Ladar System**, John Junkins, Majii Manoranjan, Brien Flewelling, and Brent Macomber (Texas A&M)

11-055 **A Homotopy Approach to Lambert Problem around Small Bodies: Applications to Close Proximity Operations**, Benjamin Villac (UC-Irvine)

11-056 **Small Body Landing Accuracy Using In-Situ Navigation**, Sumita Nandi and S. Bhaskaran (NASA/JPL)

11-057 **GN&C Trades for Touch-and-Go (TAG) Sampling at Small Bodies**, Al Cangahuala (NASA/JPL)

11-058 **Return of Hayabusa Spacecraft and Reentry of It's Capsule**, Jun'ichiro Kawaguchi (ISAS), Hitoshi Kuninaka (JSPEC) and Makoto Yoshikawa (JAXA)

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**Session VI**

**4:00 – 6:00 pm**

### **Microvibration**

Microvibration, with its effects on payloads and GNC systems, is becoming an ever more important consideration. As the sensitivity of missions has increased, requirements have tightened and the need for mitigation of microvibration has also increased. This has lead to challenges in design, characterization and testing. This 'semi-tutorial' style session is intended to use real-world examples as an introduction to the sources and negative effects of micro-vibration on spacecraft.

Additionally, this session will outline various techniques for mitigating and reducing the effects while also explaining the difficulties in measuring and testing for micro-vibration.

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**11-061 Microvibration Disturbance Fundamentals for Rotating Mechanisms**, Bill Bialke (Goodrich)

**11-062 MTG Microvibration Requirements and Associated Potential Impact on the Satellite Design**, Philippe Tanguy, E. Spalinger, M. Sghedoni and D. Guichon (Thales Alenia)

**11-063 Accurately Correlating Experimental and Computational Spacecraft Fuel Slosh Models Using Diaphragm-Implemented Propellant Tanks**, Brian A. Lenahan, Dillon J. Sances and Sathya N. Gangadharan (Embry-Riddle Aeronautical University), James E. Sudermann (NASA/KSC) and Brandon Marsell (NASA/KSC)

**11-064 Active and Passive Microvibration Mitigation System for Earth Observation and Space Science Missions**, Fabrice Boquet and Jean-Pascal Lejault (EADS Astrium)

**BANQUET ACTIVITIES**

**SOCIAL HOUR.....6-7 PM**

**DINNER.....7-9 PM**

**DINNER SPEAKER.....8-9 PM**

**Joe Tanner**

**Former NASA Astronaut  
Instructor, Aerospace Engineering Sciences  
University of Colorado, Boulder**

*Tuesday, February 8, 2010*

**Session VII**

**7:00 – 10:00 am**

**Space Servicing**

Extending the life of healthy on-orbit assets, repairing vehicles that have experienced failures, and safely disposing of vehicles that have suffered anomalies, all provide a compelling need to establish high-TRL space servicing capabilities. This session will explore the challenges and fundamental technologies of space servicing missions such as on-orbit refueling, replenishment or repair of payloads, installation of advanced instrumentation, in-situ assembly of large structures, and the capture of errant spacecraft for safe disposal.

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11-071 **Withdrawn**

11-072 **Satellite Servicing's AR&D Testbed on the International Space Station**, Bo Naasz, Matthew Strube and John Van Eepoel (NASA/GSFC)

11-073 **Optimal Level of Autonomy for Satellite Servicing Missions**, Josh Reitsema, Wendell Chun, and John Ringelberg (LMSSC)

11-074 **Enhancing On-Orbit Assets Through Servicing and Orbital Debris Cleanup**, Frank Teti and John Lymer (MDA Corp)

11-075 **Natural Feature Tracking for Rendezvous and Proximity Operations**, Kalle Anderson (LMSSC)

11-076 **Proximity Operations Using Low-Thrust Propulsion and Angles-Only Measurements in Geosynchronous Orbits**, Robert Gillis and David K. Geller (Utah State Univ)

11-077 **Falcon 9-2 and Dragon – First Flight Results**, Hans Koeningsmann, Jeffrey Tooley, Eric Hultgren, and Chris Wilkins (Space Exploration Technologies)

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**Session VIII** **4:00 – 7:00 pm**

### **Recent Experiences**

Lessons learned through experience prove most valuable when shared with others in the G&C community. This session, which is a traditional part of the conference, provides a forum for candid sharing of insights gained through successes and failures. Past conferences have shown this session to be most interesting and informative.

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11-081 **Solar Dynamics Observatory Launch and Commissioning**, James R. O'Donnell, Jr. (NASA/GSFC)

11-082 **Post-Flight Performance Assessment of the Mars Phoenix Terminal Descent Radar**, Erik. S. Bailey (NASA/JPL)

11-083 **First In-Orbit Results from PICARD**, Christine Fallet (CNES)

11-084 **GENIE Flight Test Results and System Overview**, T. Brady (Draper)

11-085 **The APS-Based Star Tracker After One Year of In-Flight Life**, R. Bettarini (SELEX-Galileo)

11-086 **Improved Star Tracker Instrument Magnitude Predictions from ICESat Flight Telemetry**, Noah Smith (Boeing)

11-087 **GLOBALSTAR Second Generation AOCS Design, Development, and First Flight Results**, O. Rouat (Thales Alenia)

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*Wednesday, February 9, 2010*

**Session IX** **7:00 – 10:00 am**

**Design Approaches for Precision Pointing  
(US Only – attendance at this session is restricted by  
ITAR to US-persons only)**

Various spacecraft mission requirements continue the push for improved vehicle pointing performance. Significant advancements have recently been made in sensors, actuators, isolation systems, and spacecraft design for precision pointing applications. This session examines design approaches for jitter suppression and control, thermal effects mitigation, in-flight calibrations, extended state estimation for instrument pointing, and flexible-body excitation and control.

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11-091 **Spacecraft Instrument Pointing Capabilities: Past, Present, and Future**, J. Lars Blackmore, Mimi Aung, David S. Bayard, Paul Brugarolas, Fred Y. Hadaegh, Bryan H. Kang,

Allan Y. Lee, Mark H. Milman, Emmanuell A. Murray, Samuel W. Sirlin, and Daniel P. Scharf (JPL)

11-092 **Precision Pointing of the Airborne Laser Testbed System**, Ken Billman and David Hatch (Lockheed Martin MDS)

11-093 **Withdrawn**

11-094 **Precision Pointing Performance of the James Webb Space Telescope**, Chunlei Rui, Henry Fu, Cameron Haag, Magdy Wahbah, Satya Anandakrishnan (NGAS), Landis Markley, Peiman Maghami (NASA/GSFC), Frank Liu (SGT)

11-095 **GOES-R Gyro Scale Factor Calibration**, Alan Reth, Donald Chu (Chesapeake Aerospace), David Lorenz (SGT), Douglas Freesland (ACS Engineering), Devin Stancliffe, Brian Clapp, Jim Chapel, David Cwynar (LMSSC), and Alexander Krimchansky (NASA/GSFC)

11-096 **Rapid Targeting Satellite G&C System**, Nazareth Bedrossian and Sagar Bhatt (Draper)

11-097 **JMAPS: On-board and Ground Algorithm Development and Mission Update**, B.N. Dorland, G.S. Hennessy, V. V. Makarov, D.R. Veillette and R.P. Dudik (USNO), C. Berghea (Computation Physics), B. Lane and B. Moran (Draper)

11-098 **High Precision Pointing for the Next Generation of Astrophysics Missions**, P. Brugarolas and J. Alexander (NASA/JPL)

**Poster Session  
Daily in the Breakfast Room**

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**11-101 Trajectory Control Dynamics for Path Following Vehicles** Vivek Ahuja, Kevin Albarado, Roy Hartfield, Jr. (Auburn University)

**11-102 Sensing the Earth with the SGR-ReSI Multi-Antenna Space GPS/GNSS Receiver**, Martin Unwin, Mark Brenchley, Reynolt de Vos van Steenwijk (SSTL), Christine Gommenginger (NOCS), Cathryn Mitchell (University of Bath), Steven Gao (Surrey Space Centre)

**11-103 Avoiding Dynamic Obstacles via Adaptive Estimation**, Venkatesh Madyastha (National Aerospace Laboratories, Bangalore, India)

**11-104 JASON-2 In-Flight Experience**, Dominique Guillon, Dominique Herve, Matthieu Beaumel, Philippe Jacob, Benoit Gelin (EADS-Sodern ), Pierre-Emmanuel Martinez (CNES), Patrick Insalaco (Alcatel Alenia Space)

**11-105 Spectral Compression Processing for Orbital Navigation and Science Applications with Signals of Opportunity**, Kenn Gold (Emergent Space Technologies), Peter F. MacDoran (Loctronix Corp.), Michael B. Mathews (Loctronix Corp.)

**11-106 The AOCS of the 5 Proteus satellites, a successful story**, David Brethé, Frank Majal (THALES ALENIA), Magali Tello, Philippe Landiech (CNES)

**11-107 Small Orbital Debris Mitigation Mission Architecture**, Bruce Wiegmann (NASA/MSFC)

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