

PROGRAM

40th ANNUAL AAS GUIDANCE & CONTROL CONFERENCE

February 2nd to
February 8th, 2017

Thursday, Feb. 2nd and Friday Feb. 3rd

7:00 AM Check in 8:00 AM Session

CLASSIFIED SESSION

Classified Advances in G&C and
Classified Recent Experiences

(TOP SECRET // SI//TK // NOFORN)

Pre-registration by Jan 18, 2017 is required and will be controlled (walk-ins will NOT be admitted). Contact a local chairperson for more information.

Location of Classified Session:

Ball Aerospace Broomfield Campus
10 Longs Peak Dr,
Broomfield, CO 80021

Local Chairpersons

Kyle Miller, Ball Aerospace
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Lisa Hardaway, Ball Aerospace
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Cheryl Walker, Lockheed Martin Space
Systems Company
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Shawn McQuerry, Lockheed Martin Space
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Traditional Conference Located at:

Beaver Run

Conference Center

Breckenridge, Colorado

Room check-in at the Beaver Run Resort
front desk at 4:00 PM daily.

Conference Registration

Friday 5:00 to 8:00 PM

Daily 6:30 to 10:00 AM and 4:00 to 6:00 PM

SATURDAY, February 4th

7am Conference Opening & Keynote
Address

by: General Greg Bowen

Session I

7:30-10:30 AM

Student Innovations in GN&C

This session embraces the wealth of research and innovative projects related to spacecraft GN&C being accomplished in the university setting. Papers in this session address hardware/software research as well as component, system or simulation advances. Papers submitted must have a student as the primary author and presenter. Papers will be adjudicated based on level of innovation, complexity of problem solved, perceived technical readiness level, applicability and fieldability to near-term systems, clarity of written and verbal delivery, number of completed years of schooling and adherence to delivery

schedule. The session will be limited to 8 papers with the top 3 papers receiving awards.

National Chairpersons

David Geller, Utah State University
david.geller@usu.edu

Lt. Col. David Richie, United States Air
Force Academy
David.Richie@usafa.edu

Local Chairpersons

Ian Gravseth, Ball Aerospace
igravseth@ball.com

David Chart, Lockheed Martin Space
Systems Company
david.a.chart@lmco.com

17-011 **Spacecraft Dynamics Employing
a General Multi-tank and Multi-
thruster Mass Depletion
Formulation**

P. Panicucci, C. Allard, H. Schaub
(University of Colorado/Boulder)

17-012 **Two-axis Stability Control of a
High-Altitude Balloon Bus**

M. Rogovin (US Air Force
Academy)

17-013 **Withdrawn**

17-014 **Vision-Based Navigation
Relative to Small Bodies Using
Mean Curvature Maps**

S. Haught, J. Christian (West
Virginia University)

17-015 **Optimal Guidance Trajectories
for Docking with a Non-
cooperative Resident Space
Object**

P. Patel (University of Southern California), B. Udrea (VisSidus Technologies, Inc)

17-016 Relative Orbital Motion Dynamics With Respect to a Rotating Spacecraft-Fixed Frame

N. Ortolano (Utah State University), A. Avery (Space Dynamics Lab), D. Geller (Utah State University)

17-017 Control of Active Pendulum for Contact Dynamics Simulation

A. Masher, et. al. (Texas A&M University)

17-018 Guidance, Navigation and Control of Multirobot Systems in Cooperative Cliff Climbing

(H. Kalita (Arizona State University))

10:30 AM-4:00 PM

AAS STEM-SCAPE Event

In 2017, we will be hosting our third STEM event for one hundred high school students of diverse background from across the Denver metropolitan area. The event, called AAS STEM-SCAPE for "Student Career Arcs to Professional Engineers," will trace the elements of a successful career journey in aerospace including High School and University education, initial employment and ultimately a rewarding profession. Our keynote speaker is Mike Gazarik, PH.D., Vice President of Engineering at Ball Aerospace, who will be followed by a STEM career panel. The event concludes with a short design project that will be co-led with student volunteers from the University of

Colorado. If you are interested in volunteering at the event, please contact our Education Committee planning POCs:

Local Chairpersons

Michael Drews
michael.e.drews@lmco.com

Meredith Stephens, Ball Aerospace
mstephen@ball.com

Special Event for Children of Conference Attendees and the Beaver Run Employees at 4 PM

NASA Astronaut Speaker

This presentation will inspire our next generation of engineers by offering kids the opportunity to interact with an astronaut!

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 an excellent complimentary buffet and interact with the technical representatives and authors. This session takes place in a social setting and family members are welcome!

Local Chairpersons

Jim Russell, Lockheed Martin Space Systems Company
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Scott Glubke, NASA Goddard Spaceflight Center
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SUNDAY, FEBRUARY 5th

Poster Session

Held in Break Room during Breakfast

The Poster Session offers a unique forum for authors and interested parties to discuss relevant topics. Posters do not require an accompanying written paper. However, authors who wish to have their work published in the proceedings can submit a written paper along with the poster. The Poster Session will be available for viewing every day in the main conference room.

Local Chairpersons

Cheryl Walker, Lockheed Martin Space Systems Company
cheryl.a.walker@lmco.com

17-170 Prediction of Satellite Motion under J2 and Drag Force in terms of KS-theory

M. Radwan (Al-Azhar University, Cairo, Egypt)

- 17-171 **Uncertainty Analysis for Initial Relative Orbit Determination Using TDOA Measurements**
S. Shuster (Utah State University)
- 17-172 **Reflector Identification in Flash LIDAR Imagery**
J. Christian (West Virginia University)
- 17-173 **The Opportunities and Challenges of GNC on a Europa CubeSat**
J. Thangavelautham (Arizona State University - SpaceTReX)
- 17-174 **GNC of the SphereX Robot for Extreme Environment Exploration on Mars**
J. Thangavelautham (Arizona State University - SpaceTReX)
- 17-175 **Guidance, Navigation and Control of a Bucket Wheel for Surface Mining of Asteroids and Small-Bodies**
J. Thangavelautham (Arizona State University - SpaceTReX)
- 17-176 **Combined Thermal Control and GNC: An Enabling Technology for Surface Probes and Small Robots**
J. Thangavelautham (Arizona State University - SpaceTReX)
- 17-177 **Precise Pointing of CubeSat Telescopes without Reaction Wheels**
J. Thangavelautham (Arizona State University - SpaceTReX)
- 17-178 **Entry, Descent and Landing System for CubeSat Sized Drop-**

off Payloads

J. Thangavelautham (Arizona State University - SpaceTReX)

- 17-179 **Optimal Observability Maneuvers & Trajectory Design for Constrained Spacecraft Translational Motion**
F. Franquiz (Embay-Riddle Aeronautical University)
- 17-180 **Optical Target Tracking with User Input for Autonomous Vehicle Guidance**
M. Anderson (United States Air Force Academy)
- 17-181 **Electrospray Propulsion for Precise Position and Attitude Control**
D. Courtney (Busek Co.)
- 17-182 **Speed-Constrained Three-Axes Attitude Control Using Kinematic Steering**
H. Schaub (University of Colorado)
- 17-183 **Low SWAP Torque Rods Including Cube Sat Sized Rods**
J. Krebs (Cayuga Astronautics)

Dual Morning Sessions

SESSION III 7:00-10:30 AM

Entry Descent & Landing GN&C

Entry, Descent, and Landing technologies have evolved in recent years, including new studies for landing on the Moon, Mars, and other celestial bodies, as well as new experiences for landing rocket stages after launch. This session offers a venue for

discussions about heat mitigation strategies for atmospheric entry, discussions about targeted descents, and G&C technology developments for landers.

National Chairpersons

Zach Putnam, University of Illinois,
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Miguel San-Martin

NASA Jet Propulsion Lab
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Local Chairperson

Tim Bevacqua, Lockheed Martin Space Systems Company
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Jeff Parker, University of Colorado
parkerjs@Colorado.EDU

James Pavik, University of Colorado,
james.pavek@gmail.com

- 17-031 **Guidance, Navigation and Control for the Entry, Descent, and Landing of the Mars 2020 Mission**

P. B. Brugarolas (JPL)

- 17-032 **Characterization of Guidance Algorithm Performance for Drag Modulation-Based Aerocapture**

M. Werner, R. Braun (Georgia Tech)

- 17-033 **Guidance Trades for High Ballistic Coefficient Mars Lander Trajectories**

T. Anderson, R. Braun (Georgia Tech)

- 17-034 **High-Ballistic Coefficient Mars EDL with Supersonic Retropropulsion**

C. Noyes, A. Wolf (JPL)

- 17-035 **An Assessment of Aerodynamic Flaps for Planetary Entry Trajectory Control**
J. Sepulveda, Z Putnam
(University of Illinois at Urbana-Champaign)
- 17-036 **The Lander Vision System for Mars 2020 Entry Decent and Landing**
A. Johnson, J. Chang, Y. Cheng, J. Montgomery, S. Schroeder, B. Tweddle, N. Trawny, J. Zheng
(JPL)
- 17-037 **Landing on Europa: Challenges, Technologies, and a Strategy**
E. Skulsky, M. San Martin, D. Kipp, A. Zimmer, G. Singh, F. Serricchio, N. Trawny, A. Katake
(JPL)
- 17-038 **The Intelligent Landing System for Safe and Precise Landing on Europa**
N. Trawny, A. Katake, M. San Martin, D. Skulsky, A. Johnson
(JPL)

SESSION IV

7:00-8:30 AM

GN&C Beyond The Space Industry

Much of the fundamental physics, industry practices, and technology common to GN&C in the space industry are directly applicable to science/engineering commerce and research beyond aerospace. This session explores GN&C algorithms, hardware and

applications beyond spacecraft and launch vehicles. Papers with application in the adjacent sectors of energy, transportation, medicine, and robotics are encouraged.

National Chairpersons

Tim Crain, Intuitive Machines
tim@intuitivemachines.com

Local Chairpersons

Meredith Stephens, Ball Aerospace
mstephen@ball.com

17-041 GN&C Outside of Aerospace

T. Crain, S. Stewart (Intuitive Machines)

17-042 Autonomous Decision Making with Disparate Input Data Using Fuzzy Inference Systems in a Hierarchical Mixture of Experts Topology

R. Bishop (University of South Florida)

17-043 Agile Autonomy: Vision Enable Navigation for Arial Robotics

M. Akella (The University of Texas at Austin), E. Almeida (NASA/JPL)

17-044 Combined Thermal Control and GNC: An Enabling Technology for Surface Probes and Small Robots

J. Thangavelautham, S. Rabade (Arizona State University)

SESSION XVI

9:00-10:45 AM

Scientific Discoveries Enabled by GN&C

This session looks at the scientific results that GN&C has helped deliver. From exoplanet detections to Martian habitability,

G&C engineering has played a significant role in enabling some of the most exciting scientific discoveries of our generation.

These findings not only add to the body of scientific knowledge, they light the public's imagination and inspire tomorrow's scientists and engineers.

National Chairpersons

Stephen Lee, NASA Jet Propulsion Lab
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James O'Donnell, NASA Goddard Space Flight Center
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Local Chairpersons

Michael Osborne, Lockheed Martin Space Systems Company
michael.l.osborne@lmco.com

17-161 LISA Pathfinder: First steps to observing gravitational waves from space

P. McNamara (ESA)

17-162 Mars Reconnaissance Orbiter: Continuing 10 Years of Discovery at Mars

R. Zurek (NASA JPL)

17-163 The Hubble Space Telescope Science Enabled by its Pointing Control System

E. Nelan (Space Telescope Science Institute)

17-164 Mars Volatile Evolution and Climate Change: Results From the MAVEN Spacecraft Mission

B. Jakosky (CU LASP)

17-165 Science from the Lunar Reconnaissance Orbiter

**Mission enable by Guidance,
Navigation and Control**
J. Keller (NASA GSFC)

TUTORIAL SESSION 11:00 AM-1:00 PM

Beyond the Textbook: Embedded Code
Speaker: Sam Siewert, Embry Riddle

TUTORIAL SESSION 1:00 PM-2:00 PM

**Beyond the Textbook: Introduction to
Control Structure Interaction**
**Speaker: Davin Swanson, Aerospace
Corp.**

Dual Afternoon Sessions

Session V 2:00-4:00 PM

Control Structure Interaction

Advanced space based instrument systems rely on increasingly stable and ever more accurate positioning platforms to continue to expand their science capabilities. Systems range from inertially fixed systems to orbiters, deep space explorers, landing systems, robotic exploration systems on primitive bodies, etc. In addition, instrument systems can range from simple body fixed sensors to complex articulated instruments that are increasingly larger and structurally softer. All of the above include Guidance, Navigation, and Control systems for attitude

control and, in some cases, fine boresight control, and/or articulation control systems. The interaction of these controls systems and their associated structures, sensors and mechanisms, and the impact this interaction has on the performance of the underlying mission is the focus of this session. The session organizing committee invites authors to submit papers that explore Control Structures Interaction related architectures, design methodologies, advanced analytical techniques, integrated modeling and simulation advances, verification and validation methodologies, and other related topics.

National Chairpersons

Jack Aldrich, NASA Jet Propulsion
Laboratory

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James Allison, University of Illinois Urbana-
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Soon-Jo Chung, Caltech
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Local Chairpersons

Oscar Alvarez-Salazar, NASA Jet
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**17-051 Evaluation of non-minimum
phase notch filter for
spacecraft structural mode
stabilization**

D Putman (Ball Aerospace)

**17-052 High Fidelity Multi Body
Deployment Dynamics Model
and Control strategy for NISAR**

A. Kumar (Indian Space
Research Organization)

**17-053 Boresight pointing analysis
and control design for NISAR
with large reflector**

A Kumar (Indian Space
Research Organization)
**17-054 Models for NISAR Pointing
Performance Prediction**

D Bussalis (JPL)

**17-055 Narrowband Rejection of
Reaction Wheel Induced Line of
Sight Disturbances for the
WFIRST Mission**

J. Shields (JPL)

**17-056 Identification of the Instrument
Spin Rate Controller on the Soil
Moisture Active Passive (SMAP)
Mission**

R. French (JPL)

Session VI

2:00-4:00 PM

GN&C Challenges of Space Mining

In recent years, the identification, acquisition and use of space resources has gained a great deal of attention across the industry. The success of this endeavor: reaching, extracting, utilizing (in-situ) and/or returning those resources, directly depends on the ability to guide, navigate and control the robotic systems needed to meet the challenges. This session will highlight the Guidance, Navigation and Control aspects of the many initiatives under consideration for the coming decade.

National Chairpersons

Angel Abbud-Madrid, Director – Center for
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Mines

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Local Chairpersons

Dan Kubitschek, University of Colorado/Boulder LASP

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Alex May, Lockheed Martin Space Systems Company

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17-061 **OSIRIS-REx Launch Orbit Determination Analysis and TCM-1 Reconstruction**

J. Leonard, P.G. Antreasian, E. Carranza, B. Page, D. Stanbridge, D. Wibben (KinetX), M. Moreau (NASA GSFC)

17-062 **Early Operational Maneuvers for OSIRIS-REx: Design and Early Performance Assessment**

D. Wibben, K. Williams, D. Stanbridge, P. Antreasian (KinetX), M. Moreau, B. Barbee, R. Qureshi (NASA GSFC)

17-063 **OSIRIS-REx Dynamics Supporting Asteroid Surface Properties Science**

W. Hafer (Lockheed Martin SSC)

17-064 **Attitude Determination and Control of the Asteroid Origins Satellite 1 (AOSAT 1)**

R. Teja Nallapu, E. Asphaug, J. Thangavelautham (Arizona State University), S. Shah (United Launch Alliance)

17-065 **Optimal Aerobraking Trajectories in the Cis-Lunar Economy**

N. Campbell, T. Bennett, B. Argrow, J. Ralph (University of Colorado)

MONDAY, FEBRUARY 6th

Parallel Morning Sessions

Session VII

7:00-10:00 AM

Autonomous Rendezvous & Docking

The future of NASA and commercial space missions hinges greatly on increased autonomous rendezvous, proximity operations and docking GN&C technologies as more visiting vehicles interact to complete increasingly complex missions. This session seeks to explore the latest advancements in GN&C related to relative navigation through new sensor suite technologies such as image based optical navigation and LIDAR sensing technologies, relative guidance and automated docking. Rendezvous and docking refers to GN&C technologies which permit cooperative or uncooperative vehicle mating and which have additional applications to upcoming asteroid missions.

National Chairpersons

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John Christian, West Virginia University
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Local Chairpersons

Ellis King, Charles Stark Draper Laboratory
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John Bendle, Lockheed Martin Space Systems Company
john.r.bendle@lmco.com

17-071 **The RVS3000 and RVS3000-3D LIDAR Sensors**

F. M. Kolb, C. Heilmann, B. Linhart, C. Schmitt, M. Schwarz, M. Windmüller (Jena-Optronik GmbH)

17-072 **Hardware Experiments for Uncooperative Rendezvous During Debris Removal Mission**

T. Woodbury, A. B. Probe, C. K. Moody, B. Janisch, J. E. Hurtadoy (Texas A&M University)

17-073 **Reduced-Dynamics POSE Estimation for Non-Cooperative Spacecraft Rendezvous Using Monocular Vision**

S. Sharma, S. D'Amico (Stanford University)

17-074 **Real-Time Optimal Trajectory Planning for Orbital Rendezvous, Satellite Inspection, and Docking Based on Convex Optimization**

N. Ortolano (Utah State University), A. Avery (Space Dynamics Lab), D. K. Geller (Utah State University)

17-075 **Performance of the Seconds Generation Detector for the Vision Navigation Sensor (VNS)**

R. R. Rohrschneider, M. S. Bradley, J. Funderburg, and S.M. Lutgring (Ball Aerospace)

17-076 **The Development and Testing of Visual Odometry for Proximity Operations and Docking Using ISS Selfie**

D. Woffinden (Charles Stark Draper Laboratory), S. Robinson (NASA JSC)

17-077 **Paper Withdrawn**

17-078 **Restore-L Rendezvous and Proximity Operations Overview**

E. Skelton (Lockheed Martin Space Systems Company), M. A. Vavrina (a.i. Solutions)

Session VIII**7:00-10:00 AM****Small Satellite GN&C**

Cubesats and smallsats range in mass from less than 1kg up to 180kg, and are gaining in popularity and utility. At the high end of this mass range, 100 to 180kg ESPA-class spacecraft are now trusted platforms for scientific and defense missions and offer pointing accuracy, pointing stability, and position knowledge that is compatible with Earth science missions. For cubesats, the GN&C capabilities are advancing quickly in an effort to support science and technology development missions. Both classes are now pushing the envelope to provide features that were previously only available on much larger class satellites, such as autonomous RPO and docking as well as significant on-board mission data processing capabilities. This session is open to papers covering both hardware and software aspects of smallsat and cubesat GN&C. Papers on technology development for GN&C and mission GN&C experience are welcomed.

National Chairpersons

Chuck Clagett, NASA
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Jason Westphal, Applied Defense
JWestphal@AppliedDefense.com

Local Chairpersons

Jake Griesbach, Ball Aerospace & Technologies Corp.
jgriesba@ball.com

17-080 SmallSat Capabilities Overview

M. Gazarik (Ball Aerospace)

17-081 High-Performance SmallSat GN&C – A Commodity Realized

D. Hegel (Blue Canyon)

17-082 BCP-100 Small Satellite**Guidance Navigation and Control on the Green****Propellant Infusion Mission**

C. McLean, B. Marotta (Ball Aerospace)

17-083 CubeSat Proximity Operations Demonstration

C. Roscoe, J. Westphal (Applied Defense Solutions), J. Bowen (Tyvak)

17-084 Augmented CubeSim Tests for the IlliniSat-2 Bus

Vedant, E. Kroeker, P. Haddox, A. Ghosh (University of Illinois at Urbana-Champaign)

17-085 Choosing Filter States and Models for Small Satellite Attitude Determination

A. Dianetti, J. Crassidis (University of Buffalo)

17-086 Opportunistic Navigation for CubeSats Using Adaptive Filtering with Increased Time Resolution

J. Runnels, D. Gebre-Egziabher (University of Minnesota)

17-087 Optical Navigation Technology for Interplanetary CubeSats: Target Phobos

S. Ichikawa, R. Nallapu, E. Asphaug, J. Thangavelautham (Arizona State University)

TUTORIAL SESSION 10:30 AM-3:45 PM**Beyond the Textbook: Commercial SSA****By AGI****Session IX****4:00-6:00 PM****European Technology Demonstrations**

European demonstration missions past, present and future. This session will present an overview of the AOCS and GNC aspects of European In-Orbit Demonstration missions as run by the European Space Agency and National Agencies in Europe. IOD missions have played a key role in the development of technology and continue to become even more important as a way to derisk future missions, demonstrate and finalize the testing of new sensors and actuators and to gain experience of environments, new design approaches and new operational concepts. The session will focus not only on current IOD missions, but also showcase key past missions with the lessons learned from them and potential future missions.

National Chairpersons

Stephen "Phil" Airey, ESA TEC-ECC
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Steeve Kowaltschek, ESA
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Local Chairpersons

Stu Schimkat, Airbus North America
Stu.Schimkat@airbusna.com

17-091 The PRISMA Formation Flying Mission: Retrospective and Legacy of GNC Experiments

Per Bodin (OHB Sweden)

- 17-092 **Flight Demonstration of Re-Entry GNC in the Intermediate Experimental Vehicle (IXV)**
Rodrigo Haya-Ramos (SENER)
- 17-093 **The PROBA family: successful platforms for the in-orbit demonstration of innovative and autonomous GNC techniques**
Stefano Santandrea (European Space Agency)
- 17-094 **Proba-3: High precision Formation Flying in HEO**
Rafael Contreras (SENER)
- 17-095 **LIRIS flight data exploitation and comparison to ATV**
Olivier Mongrard (European Space Agency)

SOCIAL NETWORKING EVENT

6:00 to 7:30 PM

Opportunity for conference attendees and guests to network with others. The winners of student competition will be announced; and continued networking after the formal event is encouraged!

TUESDAY, FEBRUARY 7th

Parallel Morning Sessions

Session X **7:00-10:00 AM**
Precision Pointing

The level of pointing performance required by modern applications is unprecedented. Greater and greater pointing accuracy is

sought across a variety of terrestrial and orbital systems. Many photometric applications require an arc-second or better performance to accomplish their mission objectives. Our Precision Pointing session will examine the current state of the art in observatory (spacecraft, instrument and antenna) pointing solutions that satisfy the needs of the industry.

National Chairpersons

Paul Mason, NASA Goddard Space Flight Center

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Albert Bosse, MDA

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Local Chairpersons

Jastesh Sud, Lockheed Martin Space Systems Company

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Larry Germann, Left Hand Design Corp.
germannl@lefthand.com

- 17-111 **Robustness of ASTRIX Optic Gyros in Space Radiative Environment**
A. Paveau (Airbus)
- 17-112 **A Comparison of Thruster Selection That Enables Precision Pointing**
N. Davis (GSFC)
- 17-113 **Precision Pointing of a GEO-Hosted Imaging Spectrometer**
H. Gutierrez (Ball)
- 17-114 **High Accuracy, Low SWaP Interferometric Star Tracker for Space Applications**
M. Jacoby (OPCI)
- 17-115 **Precision Pointing for the Wide-Field Infrared Survey Telescope (WFIRST)**
E. Stoneking (GSFC)

- 17-116 **Leonardo Fine Guidance Sensor: sub-arcsecond pointing accuracy for the Euclid European Observatory**
F. Boldrini (Leonardo)
- 17-117 **Precision Pointing in Space using Arrays of Shape Memory Alloy based Linear Actuators**
J. Thangavelautham (ASU)
- 17-118 **Inflight Performance of the SDO Fine Pointing Science Mode**
P. Mason (GSFC)

Session XI

7:00-10:00 AM

Advances in GN&C (Part 1)

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.

National Chairpersons

Bill Frazier, NASA/JPL
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Lt. Col. David Richie, United States Air Force Academy
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Local Chairpersons

James McQuerry, Ball Aerospace (Retired)
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Mike Beda, Lefthand Design Corp.
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Lee Barker, Lockheed Martin Space
Systems Company
lee.a.barker@lmco.com

17-121 **On the Automatic Generation of Recursive Attitude Determination Algorithms**
T. McClure (Uncommon Lab)

17-122 **Analytical Attitude Determination from a Specific Rate Profile**
P. Zentgraf (Rosenheim University)

17-123 **An Advanced Architecture for Optimizing Earth Science Data Collection Based Upon Model Predictive Control**
M. Lieber, C. Weimer, R. Rohrschneider, L. Ruppert, B. Bauer, J. Applegate (Ball Aerospace)

17-124 **Kinematic Steering Law Enabling Conically Constrained Spacecraft Attitude Control**
M. Ramos, H. Schaub (UC Boulder)

17-125 **ASTROgyro**
B. Pradarutti, D. Schödlbauer, U. Schmidt, F. Schuh, Th. Haarlammer, M. Rößler (Jena-Optronik)

17-126 **Time Domain Stability Margin Assessment Method**
K. Clements (NASA)

17-127 **Modeling Solar Radiation Pressure with Self-Shadowing Using Graphics Processing Unit**
P. Kenneally, H. Schaub (UC Boulder)

17-128 **Analytical Position and Velocity Partials for Conic and Non-Conic Trajectories**

R. Gottlieb (Odyssey), W. Fowler (UT Austin), T. Feagin (UH Houston)

TUTORIAL SESSION 10:30 AM-12:30 PM

Beyond the Textbook: General Mission Analysis Tool (GMAT)

Speaker: Peter Hughes, NASA Goddard Space Flight Center

Parallel Afternoon Sessions

Session XII 4:00-7:00 PM

Advances in GN&C (Part 2)

Due to an outstanding turnout for the Advances in GN&C session, this is a continuation of the morning session.

National Chairpersons

Bill Frazier, NASA/JPL
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Lt. Col. David Richie, United States Air Force Academy
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Local Chairpersons

James McQuerry, Ball Aerospace (Retired)
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Mike Beda, Lefthand Design Corp.
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Lee Barker, Lockheed Martin Space
Systems Company
lee.a.barker@lmco.com

17-131 **Yaw Steering Analysis for Tundra Orbits**
E. Sperber, D. Carter, P. Silversmith (Aerospace Corp)

17-132 **GOES-R GPS Receiver Airlink Testing Concept to Conclusion**
S. Winkler, A. Krimchansky, D. Freesland, G. Ramsey, K. Patel (Lockheed Martin)

17-133 **Auriga Star Tracker for Constellations & Small Satellites**
B. Gelin, L. Eychenne (SODERN)

17-134 **Moving Mass Actuator Control for Mars Entry Vehicles**
K. Lohan, Z. Putnam (UI Urbana)

17-135 **RGB-D Vision System Test-Bed for Landing Site Determination and Descending Control Experiments for a Spacecraft**
J. Ramos, D. Whitten, A. Probe, J. Hurtado (Texas A&M)

17-136 **Airbus DS CMG - An Enabler for High Pointing Accuracy Missions**
P. Faucheux (Airbus)

17-137 **Ground-Based Ephemeris Verification for the GOES Spacecraft**
D. Zanon (Relative Dynamics)

17-138 **Performance Characterization of GOES-R On-Orbit GPS Based Navigation Solution**
J. Gillette, M. Concha (Relative Dynamics)

Session XIII**4:00-7:00 PM****Advanced Propulsion for Space Systems**

The development of advanced propulsion technologies is critical for enabling more ambitious human and robotic space exploration missions. Innovative developments in chemical, electric, nuclear, and propellantless propulsion will provide higher performance and greater operability, enabling new approaches for launch and near Earth, cislunar, and deep space exploration. This session will highlight advanced propulsion technologies for launch vehicles and spacecraft being matured by NASA, DOD, industry, and academia.

National Chairpersons

Jeff Sheehy, NASA
jeffrey.sheehy@nasa.gov

Local Chairpersons

John Abrams, AMA
j.abrams@ama-inc.com

Christopher McLean, Ball Aerospace & Technologies Corp.
cmclean@ball.com

John Reed, United Launch Alliance
john.g.reed@ulalaunch.com

- 17-141 **Performance Characterization of a Cold Gas Propulsion System for a Deep Space CubeSat**
M. Sorgenfrei (NASA/ARC)
- 17-142 **Proposed Technology Demo Mission for the Phase II NIAC Electric Sail Investigation**
B. Wiegmann (NASA/MSFC)
- 17-143 **Advanced Thermal Insulations for Launch Vehicles**
G. Mills (Ball)

- 17-144 **Low Enriched Uranium Nuclear Thermal Propulsion Systems**
M. Houts (NASA/MSFC)
- 17-145 **HYDROS: High Performance Water-Electrolysis Propulsion for CubeSats and Microsats**
K. James (TUI)
- 17-146 **A Look at Deep Space Propulsion**
M. Millis (Tau Zero)
- 17-147 **Scalable High Power Hall Thruster Propulsion for Space Asset Transport into the 2030s and Beyond**
A. Hoskins (Aerojet Rocketdyne)
- 17-148 **Breakthrough StarShot – Humanity’s Interstellar Initiative**
P. Worden (Breakthrough Initiatives)

WEDNESDAY, FEBRUARY 8th**Session XIV****7:00-10:00 AM****Recent Experiences**

This session focuses on recent experiences in spaceflight GN&C, providing a forum to share insights gained through successes and failures. Discussions typically include GN&C experiences ranging from Earth orbiters to interplanetary spacecraft. This session is a traditional part of the conference and has shown to be most interesting and informative.

National Chairpersons

Rachel Dudik, United States Naval Observatory
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Sam Thurman, NASA Jet Propulsion Lab
Sam.W.Thurman@jpl.nasa.gov

Local Chairpersons

Jim Chapel, Lockheed Martin Space Systems
jim.d.chapel@lmco.com

- 17-151 **Dawn Spacecraft Performance at Ceres: Results of Hybrid Control for Ceres Mapping**
Brett Smith, Mana Salami, Ryan Lim, Antonette Feldman (NASA/Jet Propulsion Laboratory)
- 17-152 **Late mission experiences of the Kepler Space Telescope**
Dustin Putnam, Doug Wiemer, Katelynn McCalmont-Everton (Ball Aerospace)
- 17-153 **CryoSat-2: In-Orbit Star Tracker Improvements**
Nic Mardle, Elia Maestroni (ESA), David Fornarelli (Rhea), Peter Davidsen (Terma AS), Stephen Airey, Mike Krassenburg (ESA), Norbert Duske (Airbus DS)
- 17-154 **Reaching New Heights in Intern Programs**
Greg Arend, John Reed (United Launch Alliance)
- 17-155 **Dynamic Control System Performance during Commissioning of the Space Technology 7 – Disturbance Reduction**
Oscar Hsu, Peiman Maghami, James O'Donnell, Charles Dunn, John Ziemer (NASA Goddard Space Flight Center)
- 17-156 **On-Orbit Performance of the XACT GN&C Subsystem**
Matthew Baumgart, Daniel Hegel, Bryan Rogler (Blue Canyon Technologies)

17-157 **In-Flight Pointing Accuracy
Assessment and GNC
Commissioning Overview for
the Dual-Spinning SMAP (Soil
Moisture Active Passive)
Spacecraft**
Todd Brown, Tina Sung
(NASA/Jet Propulsion Laboratory)

