PROGRAM

40th ANNUAL AAS GUIDANCE & CONTROL CONFERENCE

February 2nd to February 8th, 2017

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

Thursday	**7:30 AM – 4:00 PM**
Friday	**7:30 AM - Noon**

CLASSIFIED SESSION
Classified Advances in G&C and Classified Recent Experiences

Location of Classified Session:

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

Beaver Run Resort
Breckenridge, CO
Room check-in at front desk
4pm Daily

Conference Registration
Friday 5:00 – 8:00 PM
Daily 6:30 – 10:00 AM and 4:00 – 6:00 PM

Registration Questions

Carolyn O'Brien	720-277-5851
Lis Garratt	303-931-7622
Amy Delay	303-884-5728

40th Annual AAS Guidance, Navigation & Control Conference Chairperson

Reuben Rohrschneider
Ball Aerospace
720-201-3957
rrohrsch@ball.com

Wireless Access in Conference Area

Username:	AAS2017
Password:	beaver

PAPER LOCATION:

AAS RMS has invited you to view the following shared folder for 2017 conference papers:

https://goo.gl/GqVCGh

Conference Schedule Overview

Thursday, February 2nd

Registration and Breakfast	7:30 – 8:30 AM
Classified Session	8:30 AM – 4:00 PM

Friday, February 3rd

Classified Session	8:30 AM – 12:00 Noon
Conference Registration	5:00 – 8:00 PM
Wine & Cheese Reception	6:00 – 9:00 PM

Saturday, February 4th

Conference Opening & Keynote Address at 7:00 AM

Morning Session	7:30 – 10:30 AM
AAS STEM SCAPE Event	10:30 AM – 4:00 PM
Mars Talk for Children	4:00 – 5:00 PM
Technical Exhibits	5:00 – 9:00 PM

Sunday, February 5th

Posters Session	During Morning Break
Morning Sessions	7:00 – 10:00 AM
Beyond the Textbook Tutorials	11 AM – 2 PM
Afternoon Sessions	2:00 PM – 4:00 PM

Superbowl party sponsored by Surrey

4:15 PM in Imperial Ballroom

Monday February 6th

Morning Sessions	7:00 – 10:00 AM
Beyond the Textbook Tutorial	10:30 AM – 3:30 PM
Afternoon Sessions	4:00 – 6:00 PM
Networking Event	6:30 PM
Presentation of Student Awards	7:00 PM

Tuesday February 7th

Morning Sessions	7:00 – 10:00 AM
Beyond the Textbook Tutorial	10:15 AM – 12:15 PM
Afternoon Sessions	4:00 – 7:20 PM

Wednesday, February 8th

Morning Session	7:00 – 10:00 AM

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

Wine and Cheese Reception

6:00 – 9:00 PM in Imperial Ballroom

SATURDAY, February 4th

7am Conference Opening & Keynote Address

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

Room: Peak 5

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)

Special thanks for sponsoring the student paper competition prizes goes to:

Intuitive Machines

Adcole

Blue Canyon Technologies

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

Room: Peak 14

NASA Speaker on Mars Exploration

This presentation will inspire our next generation of engineers by offering kids the opportunity to interact with Miguel San-Martin, a leader in the US Mars exploration program!

Session II **5:00-8:00 PM**

Technical Exhibits

Room: Peaks 1-5

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
james.f.russell@lmco.com

Scott Glubke, NASA Goddard Spaceflight Center
scott.e.glubke@nasa.gov

Technical Exhibit Participants

Airbus
Ball Aerospace
BEI Precision Systems & Space Company
Blue Canyon Technologies
Cayuga Astronautics
Jena-Optronik GmbH
Lockheed Martin Space Systems Company
NewSpace Systems
Northrup Grumman
Sierra Nevada Corp.
SODERN
Surrey Satellite Technology
Univ. of Colorado Aerospace Eng. Sciences
Utah State University Space Dynamics Lab

SUNDAY, FEBRUARY 5th

Poster Session

Authors will be present in Break Room for morning session break (8:30 – 9AM).

Posters will be available for viewing throughout conference.

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

17-171 **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)

17-184 **Effects of uncertainties in the atmospheric density on the probability of collision**
C. Bussy-Virat, A. Ridley, J. Getchius (Univ. of Michigan)

SUNDAY, FEBRUARY 5th

Dual Morning Sessions

SESSION III **7:00-10:30 AM**

Room: Peak 5

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, zputnam@illinois.edu
Miguel San-Martin, NASA Jet Prop. Lab alejandro.m.sanmartin@jpl.nasa.gov

Local Chairperson

Tim Bevacqua, Lockheed Martin Space Systems Company timothy.bevacqua@lmco.com

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)

SUNDAY, FEBRUARY 5th

Dual Morning Sessions

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
mlstephe@ball.com

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
steven.w.lee@jpl.nasa.gov

James O'Donnell, NASA Goddard Space Flight Center
james.r.odonnell@nasa.gov

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

Room: Peak 4

17-041 **GN&C Outside of Aerospace**
T. Crain, S. Stewart (Intuitive Machines)

17-042 **Withdrawn**

17-043 **Agile Autonomy: Vision Enable Navigation for Arial Robotics**
M. Akella, M. Almeida (The University of Texas at Austin)

17-044 **Combined Thermal Control and GNC: An Enabling Technology for Surface Probes and Small Robots**
J. Thangavelautham, S. Rabade (Arizona State University)

Break

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 **Withdrawn**

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.

SUNDAY, FEBRUARY 5th

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
Jack.B.Aldrich@jpl.nasa.gov

James Allison, University of Illinois Urbana-Champaign
jtalliso@illinois.edu

Soon-Jo Chung, Caltech
sjchung@caltech.edu

Local Chairpersons
Oscar Alvarez-Salazar, NASA Jet Propulsion Laboratory
oscar.s.alvarez-salazar@jpl.nasa.gov

Room: Peak 5

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)

SUNDAY, FEBRUARY 5th

Dual Afternoon Sessions

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 Space Resources, Colorado School of Mines
aabbudma@mines.edu

Local Chairpersons
Dan Kubitschek, University of Colorado/Boulder LASP
daniel.kubitschek@lasp.colorado.edu

Alex May, Lockheed Martin Space Systems Company
alexander.j.may@lmco.com

Room: Peak 4

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)

Superbowl Party

Sponsored by Surrey

4:15 PM in the Imperial Ballroom

Family members of conference attendees are welcome!

Sandwiches and appetizers will be served.

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

Jack Brazzel, NASA Johnson Space Center
jack.p.brazzel@nasa.gov

John Christian, West Virginia University
john.christian@mail.wvu.edu

Local Chairpersons

Ellis King, Charles Stark Draper Laboratory
eking@drapercom

John Bendle, Lockheed Martin Space Systems Company
john.r.bendle@lmco.com

Room: Peak 5

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 **Receding Horizon Control 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)

MONDAY, FEBRUARY 6th

Parallel Morning Sessions

Session VIII **7:00-10:00 AM**

Room: Peak 4

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
charles.e.clagett@nasa.gov

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 **Moved to Tuesday Evening**

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)

MONDAY, FEBRUARY 6th

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
stephen.airey@esa.it

Steeve Kowaltschek, ESA
steeve.kowaltschek@esa.int

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

Room: Peak 5

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

In the Imperial Ballroom

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
paul.a.mason@nasa.gov

Albert Bosse, MDA
Albert.Bosse.ctr@mda.mil

Local Chairpersons

Jastesh Sud, Lockheed Martin Space Systems Company
Jastesh.sud@lmco.com

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

Room: Peak 4

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)

TUESDAY, FEBRUARY 7th

Parallel Morning Sessions

Session XI **7:00-10:00 AM**

Room: Peak 5

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
william.e.frazier@jpl.nasa.gov

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

Local Chairpersons

James McQuerry, Ball Aerospace (Retired)
mcquerrydj@comcast.net

Mike Beda, Lefthand Design Corp.
mbeda@lefthand.com

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. Haarlammert, 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)

TUESDAY, FEBRUARY 7th

TUTORIAL SESSION 10:30 AM-12:30 PM

Beyond the Textbook: General Mission Analysis Tool (GMAT)

Speaker: Steve Hughes, NASA Goddard Space Flight Center

Parallel Afternoon Sessions

Session XII 4:00-7:20 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
william.e.frazier@jpl.nasa.gov

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

Local Chairpersons
James McQuerry, Ball Aerospace (Retired)
mcquerrydj@comcast.net

Mike Beda, Lefthand Design Corp.
mbeda@lefthand.com

Lee Barker, Lockheed Martin Space Systems Company
lee.a.barker@lmco.com

Room: Peak 5

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 **Withdrawn**

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)

TUESDAY, FEBRUARY 7th

Parallel Afternoon Sessions

Session XIII **4:00-7:20 PM**

Room: Peak 4

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 **Human Exploration of the Solar System by 2100**
R. Litchford (NASA)

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)

17-082 **BCP-100 Small Satellite Guidance Nagivation and Control on the Green Propellant Infusion Mission**
C. McLean, B. Marotta (Ball Aerospace)

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
rachel.dudik@usno.navy.mil

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

Room: Peak 5

17-151 **Dawn Spacecraft Performance at Ceres: Results of Hybrid Control for Ceres Mapping**
B. Smith, M. Salami, R. Lim, A. Feldman (NASA/Jet Propulsion Laboratory)

17-152 **Late mission experiences of the Kepler Space Telescope**
D. Putnam, D. Wiemer, K. McCalmont-Everton (Ball Aerospace)

17-153 **CryoSat-2: In-Orbit Star Tracker Improvements**
E. Maestroni (ESA), D. Fornarelli (Rhea Group), N. Mardle, P. Davidsen (Terma AS), S. Airey, M. Krassenburg (ESA), N. Duske (Airbus DS)

17-154 **Reaching New Heights in Intern Programs**
G. Arend, J. Reed (United Launch Alliance), K. Ackerman, N. Beale, J. Cole, J. Davis (Ball Aerospace)

17-155 **Dynamic Control System Performance during Commissioning of the Space Technology 7 – Disturbance Reduction**
O. Hsu, P. Maghami, J. O'Donnell, C. Dunn, J. Ziemer (NASA Goddard Space Flight Center)

17-156 **On-Orbit Performance of the XACT GN&C Subsystem**
M. Baumgart, D. Hegel, B. Rogler, D. Sanders (Blue Canyon Technologies)

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

2017 Conference Planning Committee

John Abrams	Analytical Mechanics Assoc.
Oscar Alvarez-Salazar	NASA/JPL/CIT
Lee Barker	LMSSC
Mike Beda	Left Hand Design
John Bendle	LMSSC
Tim Bevaqua	LMSSC
Jim Chapel	LMSSC
David Chart	LMSSC
Michael Drews	LMSSC
Bill Frazier	NASA/JPL/CIT
Lis Garratt	Ball Aerospace
Larry Germann	Left Hand Design
Ian Gravseth	Ball Aerospace
Jake Griesbach	Ball Aerospace
Lisa Hardaway	Ball Aerospace
Ellis King	Draper
Dan Kubitschek	Univ. of Colorado
Meredith Stephens	Ball Aerospace
Alex May	LMSSC
James McQuerry	Ball Aerospace (Retired)
Shawn McQuerry	LMSSC
Kyle Miller	Ball Aerospace
Carolyn O'Brien	LMSSC
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Jastesh Sud	LMSSC
Cheryl Walker	LMSSC

41st Annual AAS Guidance & Control Conference
February 1st – 7th, 2018

Chairperson:
Cheryl Walker, LMSSC
cheryl.a.walker@lmco.com