

## November 19th, 2019

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## AIAA Rocky Mountain Section Annual Technical Symposium

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#### SYMPOSIUM AGENDA

| Time           | Glenn Miller Ballroom  | Aspen Rooms        | UMC 235   | UMC 247  | UMC 382   | UMC 415-417   |
|----------------|--|--------------------|---|--|---|---------------|
|                | (Capacity 400)   | (Capacity 100)     | (Capacity 300)  | (Capacity 50)  | (Capacity 120)                                  | (Capacity 80) |
| 7:30           | Check-in / Vendor Setup<br>Light Breakfast   |                    |   |  |   |               |
| 8:00           | Wecoming Remarks:<br>Dr. Merri Sanchez<br>AIAA-RM 2019-202 Chairperson<br>Opening Address:<br>Dr. Marcus Holzinger<br>CU Aerospace Smead Faculty Fellow<br>Associate Chair for Graduate Studies<br>Introduction by Jay Lindell |                    |   |  |   |               |
| 8:30           | Morning Keynote:<br>Dr. Steven Harford -Ball Aerospace   | Vendor<br>Showcase |   |  |   |               |
| 9:00           | Session 1 Panel<br>Future Applications of Remote   | 8:00 - 11:30 am    | Session 2<br>Astrodynamics and<br>Satellite Navigation  | Session 1<br>Bioastronautics (Bio)                                   | Session 1<br>Fluids, Structures                 |               |
| 9:30           | Sensing Systems  |                    | Systems (ASN)<br>3 x 15 min   | 3 x 15 min   | and Materials (FSM)<br>3 x 15 min               |               |
| 10:00          | Session 2<br>Feature Presentations   |                    | Session 1<br>Remote Sensing, Earth<br>and Space Science   | Session 2<br>Space Resources<br>3 x 15 min                           | <b>Session 2</b><br>Autonomous<br>Systems (AUT) |               |
| 10:30          | 3 x 25 min   |                    | (RSESS)<br>3 x 15 min   |  | 3 x 15 min                                      |               |
| 11:00<br>11:30 | <b>Feature Panel</b><br>NASA's Return to Spaceflight Moon<br>and Mars and Artemis  |                    | Emerging Technologies<br>for Proliferated Low<br>Earth Orbit (pLEO)<br>Satellite Constellations |  |   |               |
| 12:00          | Lunch  |                    | 3 x 15 min  |  |   |               |
| 12:30          | Lunchon Keynote Address:<br>Corey Booker-Lockheed Martin   |                    |   |  |   |               |
| 13:00<br>13:30 | Open Networking  |                    | Feature Presentations<br>Human Spaceflight<br>3 x 15 min  | Session 3<br>Fluids, Structures<br>and Materials (FSM)<br>3 x 15 min | CU Aerospace Info<br>Session                    | Poster        |
| 14:00<br>14:30 | Session 3 Panel<br>Human-Machine Interactions in<br>Highly Automated Control Systems   |                    | Session 3<br>Remote Sensing, Earth<br>and Space Science<br>(RSESS)<br>3 x 15 min                | Session 3<br>Space Systems<br>Technologies<br>3x15 min               |   | 1:00-3:00 pm  |
| 15:00<br>15:30 | Afternoon<br>Feature Presentations<br>2 x 20 min   |                    |   |  |   |               |
| 16:00          | Afternoon Keynote:<br>Scott Anderson-SEAKR   |                    |   |  |   |               |
| 16:30          | Closing Remarks (5 min) / Cleanup  |                    |   |  |   |               |
| 17:00          |  |                    |   |  |   |               |
| 17:30          |  | CI                 | J Aerospace Building To   | ur   |   |               |





#### Morning Program: 8:00 – 9:00 am Glenn Miller Ballroom

#### Vendor Showcase–Aspen Conference Room 7:30-11:30am

#### Welcome Remarks: Dr. Merri Sanchez—AIAA-RM Chair

Dr. Merri Sanchez has over 37 years of space engineering, program management, and national-level policy experience. She currently serves as Principal Advisor to the senior leadership of the Aerospace Corporation. Previously she was the Chief Scientist for the Air Force Space Command, as a NASA Senior Executive, as well as advisor to the NASA Administrator on DoD space and the NASA Liaison to AFSPC, STRATCOM, NORAD, and NORTHCOM. She was the Senior Director for the Sierra Nevada Corporation Space Systems Group Dream Chaser Program. Merri is a lifetime Fellow of the AIAA.

#### Morning Address: Dr. Marcus Holzinger—University of Colorado Aerospace



CU Aerospace Smead Faculty Fellow Associate Chair for Graduate Studies

With Introduction by Maj. Gen. Jay Lindell USAF Ret. Jay Lindell is a retired Air Force major general and is currently serving as the Aerospace and Defense Industry Champion, Colorado Office of Economic Development and International Trade.

Aerospace Engineering

Sciences

#### Morning Keynote: Dr. Steven Harford Chief Technologist—Ball Aerospace



Steve Harford is the Chief Technologist at Ball Aerospace, where he is responsible for overall strategic and operational leadership of the internal research and development portfolio, which includes all disciplines of engineering, as well as manufacturing and test. Prior to this position, he served as the Chief Engineer for the company's tactical electro-optical portfolio, where he worked to align Ball's technology development with business development and growth strategies for cameras and mechanisms. Harford has more than 20 years of experience in the design and development of advanced aerospace systems. Prior to working in industry, Harford spent 16 years as a surface warfare officer in the U.S. Navy Reserve, with active duty assignments in both the Atlantic and Pacific oceans. Harford earned an A.B. in chemistry from Cornell University and a Ph.D. in inorganic chemistry from Stanford University.



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#### Session 1: 9:00 – 10:00 am

Vendor Showcase-Aspen Conference Room 7:30-11:30 am

#### Fluids, Structures and Materials (FSM)-UMC 382

Rapid Development of the Mach 2.2 inlet for Boom's supersonic demonstrator XB-1 Byron Young and Chandler Clifton, Boom Supersonic

An Analytical Optimization of Heatsink Thickness for Concentrated Heat Loads *Sean Cohen Ball Aerospace & Technologies Corp.* 

Efficient High-Fidelity Analysis of Composite Beam Structures *Qi Wang Siemens Wind Energy* 

#### **Bioastronautics (Bio)**–UMC 247

Space Veggies: Regenerative Life Support System, Food, and Inflammation-Fighting Micronutrients Barbara Demmig-Adams, Christine Escobar, Jared J. Stewart, Gabrielle Glime, Cedric M. Zeller, Naiara D. Garcia, William W. Adams III Department of Ecology & Evolutionary Biology; University of Colorado at Boulder

In-situ CO2 Utilization with a Supported Ionic Liquid Membrane James Nabity, Mitchell Woolever and Christine Escobar University of Colorado, Boulder

Benefits and Challenges in Developing a Passive Capillary Driven Growth Bed for Aquatic Plants in Microgravity *Brett Shaffer Space Lab Technologies, LLC* 

#### Astrodynamics and Satellite Navigation Systems (ASN) – UMC 235 Conference Room

A New Advanced Medium Accuracy Star Tracker from Ball Aerospace *E. Tchilian and S. Lutgring, Ball Aerospace & Technologies Corp.* 

CONFERS: The Consortium for Execution of Rendezvous and Servicing Operations *Fredrick Slane, Space Infrastructure Foundation* 

Colorado Boulder Earth Escape Explorer (CU-E3) student designed and built 6U CubeSat Brodie T. Wallace –CU-E3 Project Manager University of Colorado Boulder



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#### Session 1 Panel: Future Applications of Remote Sensing Systems-UMC Genn Miller Ballroom

This panel will discuss the future of remote sensing technologies, applications. New-Commercial markets offer the promise of profits while traditional government assets offer increases in performance through emerging technologies and miniaturization offers the prospect of both large constellations and cheaper access to space. Which trends will drive the industry and how will it impact our lives?

#### **Moderator: Marshall Lee**

Business Development Manager—Sypris Electronics, LLC



Marshall Lee is a Senior Business Development Manager for Sypris Electronics focused on contract manufacturing of high reliability electronics for the Space, Undersea and Military markets supporting GOES Weather Satellites, F-35 CNI, Hellfire missiles, Firefly's Alpha launch vehicle and trans-ocean, undersea cables. Prior to this, Marshall was with Lockheed & Martin Marietta, Thiokol, and Ball Aerospace as a structural engineer on Trident II FBM re-entry systems, Space Station proposal, MX Peacekeeper, SICBM, Tethered Satellite, Space Shuttle RCS Tanks, SICBM and the Teledesic Constellation. In the software world Marshall was the Director of Services and Program Manager at Spatial Corp (Dassault Systèmes) which provides 3D Modelling, Interoperability, and Visualization Component Software for the engineering and manufacturing industries. Marshall has a BS Degree in Aeronautical & Astronautical Engineering from

Purdue University. He currently is the Membership Chair for AIAA Rocky Mt Section.

#### **Panelists:**

#### Dr. Carl Weimer

#### Chief Technologist Civil Space - Ball Aerospace



Dr. Carl Weimer is the chief technologist for the Civil Space business unit at Ball Aerospace, where he manages technology initiatives for the business unit and coordinates internal research and development. Previously, Weimer served as the technical manager for the lidar instrument aboard NASA's CALIPSO mission, for which he was awarded a NASA Distinguished Public Service Medal in 2008. He was also the system lead for integration and test for the Ralph instrument on NASA's New Horizons mission. Prior to Ball, Weimer was the Director of Research at Ophir Corporation and the principal investigator on several Small Business Innovation Research projects. Weimer also holds seven patents in optical remote sensing. He received his Ph.D. in physics from Colorado State University, performing his research at the National Institute of Standards and Technology in Boulder, CO, on single electron ion traps, and staying on in postdoctoral positions in nonneutral plasmas and frequency stabilized semiconductor lasers and nonlinear optics.

#### Dr. Brian Fleming

Research Professor—LASP University of Colorado Boulder

Dr. Brian Fleming is a Research Professor in the Astrophysics and Planetary Science (APS) department and a scientist at the CU Laboratory for Atmospheric and Space Physics (LASP). He has served as instrument lead or principal investigator on multiple NASA flight projects and studies focusing on ultraviolet spectroscopy. Dr. Fleming's current research interests include developing technologies for integral field spectroscopy, including etched silicon gratings, MEMS-based reconfigurable image slicers, and UV-guiding fiber optics. He is currently the PI of SPRITE - one of the first NASA funded astrophysics cubesats and the first to operate in the windowless UV.

#### Joe Hackel

Spacecraft Program Manager—Blue Canyon Technology

Joe Hackel has been an aerospace engineer for the last 18 years, and is an AIAA Senior member. He has worked on countless spacecraft projects for NASA and the Department of Defense, and blends those skills into program management at Blue Canyon Technology, where he is pushing the frontier of what can be done with small spacecraft. As a craft beer fan, he actively seeks ways to enhance the enjoyment of craft beer through a combination of passions: engineering and inventing. He has his own startup. Hackel, the inventor of Pop&Stop, developed this product out of personal exasperation at not finding this same product available for purchase in any store. He spends his leisure time at his rental house in Kauai, as well snowboarding and kayaking in Colorado.





#### **Christian Lenz**

Vice President of Engineering—Capella Space

Christian Lenz is the Vice President of Engineering at Capella Space. Drawing on 19 years of experience in aerospace engineering, small satellite design, high reliability avionics and company operations, Christian leads the integration of mechanical, electrical, and radar engineering disciplines into an effective deployment of the Capella SAR satellite constellation. Prior to joining Capella Christian held various positions at Broad Reach Engineering (sold to Moog in 2012). He subsequently was CTO at

PlanetiQ during the early years of operation. He holds a MS in Aerospace Engineering from Colorado University in Boulder (class of 2001), and a BS in Aerospace Engineering from Arizona State University. Christian splits his time between Capella offices in San Francisco and Boulder. Christian is an avid sailor, dive master, and trained EMT.

#### **Dr. Craig DeForest**

Principal Investigator of PUNCH-Southwest Research Institute

Dr. Craig DeForest (Southwest Research Institute) is the Principal Investigator for NASA's latest Small Explorer mission, the Polarimeter to UNify the Corona and Heliosphere (PUNCH). PUNCH is a constellation of four remote-sensing smallsats to determine how the solar corona gives rise to the solar wind and heliosphere, by photographing sunlight reflected from free electrons in the inner solar system. PUNCH is scheduled to launch in March of 2023 on a NASA-provided launch vehicle. DeForest has contributed to over a

dozen airborne and space missions to observe the Sun and the solar wind, including the SOHO, STEREO, and Parker Solar Probe missions that are in operation today, and the recent WB-57 campaign to observe the 2018 eclipse. He is a long-time advocate of smallsat, cubesat, and commercial space ventures, to reduce barriers to entry for new instrumentation and young investigators. DeForest also leads B-SSIPP, a re-flyable balloon-borne observatory to bring the ground-based style of solar telescopes to near-space.



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> Procurement and Inventory Manager Technical Recruiter

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#### Session 2: 10:00 – 11:00 am

#### Vendor Showcase-Aspen Conference Room 7:30-11:30am

#### Session 2 Feature Presentations –UMC Glenn Miller Ballroom

Voyager Space Holdings Matthew Kuta President and Cofounder–Voyager Space Holdings

Airborne Drone Traffic Broadcasting and Alerting System *Rick Zelenka–CEO and Founder Drone Traffic* 

#### **Autonomous Systems (AUT)** –*UMC 382* Improved Reliability of UAS Through Machine Learning

Austin Anderson–Black Swift Technologies, LLC

Machine Learning and Data Aggregation for UAS Data Analysis Loren Anderson–Spectrabotics, LLC

Autonomous Planetary Landing Operations with the Vision Navigation Sensor (VNS) LIDAR. *R.R. Rohrschneider–Ball Aerospace & Technologies Corp.* 

#### **Space Resources** –*UMC* 247

Membrane Bioreactors for In-Situ Carbon Upcycling Johan Vanneste–Research Assistant Professor Colorado School of Mines/Advanced Water Technology Center (AQWATEC)

Thermal Mining of Celestial Bodies Curtis Purrington–Colorado School of Mines

Microwave Sintering: A low-cost, Method of Infrastructure Production on Planetary Bodies Liz Scott, PhD Student–Colorado School of Mines

#### Remote Sensing, Earth and Space Science (RSESS) - UMC 235

Remote Sensing with Geiger-mode Avalanche Photodiode (GmAPD) Single Photon LIDAR Receiver Technology Peter K. Kondratko, Ronda Irwin, Jeffrey Wilhite, Jacob Wilson, Leye Aina–Ball Aerospace & Technologies Corp.

Simplified Field Radiometric Validation Method for UAV Acquired Spectral Images Bogdan Lita, Innovation and Research 2u, Boulder, CO Alex Olsen-Mikitowicz, Kevin Yemoto, and Huihui Zhang, Wtr Management and Systems Research Unit, USDA-ARS, Ft Collins, CO, William Rock, Leah Bartnik, and Basil Desousa, Headwall Photonics, Inc., Bolton, MA

Task and View Satellite Imagery On-Demand from the Web with the Rapid Access Program *Nicholas Zinner–Maxar Technologies* 



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#### Feature Session: 11:00 am -12:00 pm

Vendor Showcase-Aspen Conference Room 7:30-11:30am

## UMC 235 – Feature Presentations: Emerging Technologies for Proliferated Low Earth Orbit (pLEO) Satellite Constellations

Development and Adaptation of Origami Folding Algorithms to Compact Deployable Ground Planes Kassi Butler–Mechanical Engineer, Roccor LLC

Improved Data Collection Using Model Predictive Control for Constellation Pointing *R.R. Rohrschneider, M. Leiber, and C. Weimer–Ball Aerospace & Technologies Corp.* 

RIPPLE- Providing Increased Temporal Resolution to Surface Wave Topography: JPL's Next Mission Augmentation CubeSat Hunter Singh–University of Colorado, Boulder

#### Feature Panel: NASA's Return to Spaceflight Moon and Mars and Artemis–UMC Glenn Miller Ballroom

This panel will discuss the future of NASA's human spaceflight program as it progresses beyond the International Space Station to Commercial Crew and the exploration of the Moon and Mars.

#### Moderator: William O'Hara

Principal Systems Engineer for Advanced Development programs—Sierra Nevada Corporation



William O'Hara is a Principal Systems Engineer at Sierra Nevada Corporation (SNC) in Louisville, Colorado. He has more than 20 years of experience in human spaceflight operations, engineering, test and crew training. Currently, Bill is SNC's technical lead for a human landing system decent element study and test lead for the deep space habitat prototype under NASA's Next Space Technologies for Exploration Partnerships (NextSTEP). Bill was chosen as a Spaceflight Analog participant in NASA's Human Exploration Research Analog (HERA) at NASA Johnson Space Center in 2014. In 2018, he traveled to Devon Island in the arctic circle to conduct studies at the Haughton Mars Project Research Station (HMPRS). Bill has applied his experience to a number of publications, including as a contributing author to the book *Dust in the Atmosphere of Mars and its Impact on Human Exploration*, published by Cambridge Scholars Publishing in 2018. Bill has a Bachelor of Science degree in aerospace engineering from the University of Cincinnati and a Master of Science in geophysics from the University of Houston.

#### **Panelists:**

#### **Bradley Chetham**

Manager for the Orion Launch Abort System Team— Advanced Space

Bradley Cheetham is an engineer, 3x entrepreneur and lifelong commercial space advocate. He is best known as the co-founder and CEO of Advanced Space where he leads company operations and strategy to deliver flight dynamics and operations solutions to clients across the space industry. Cheetham earned a degree in Aerospace Engineering and Mechanical Engineering from the State University of New York at Buffalo and received his Masters in Aerospace Engineering Sciences from the University of Colorado at Boulder, where he has also conducted significant research on spacecraft navigation in support of a Doctorate of Philosophy. He created and taught a graduate level course in Commercial Spaceflight Operations at CU Boulder for 7 years. As an advocate for the space industry, he serves as the Vice Chair on the Board of Directors for the Future



Space Leaders Foundation, is a member of the Entrepreneurship and Investment Committee of the International Astronautical Federation, and serves on the Board of Advisors and the Board of Trustees of Students for the Exploration and Development of Space (SEDS).



#### **Adam Escobar**

President & CEO — Space Lab Technologies

Adam C. Escobar is President and Chief Executive Officer of Space Lab Technologies, LLC (Space Lab). He co-founded Space Lab in January 2016, where he leads his team in Space Lab's primary mission to advance human space exploration. Adam provides his expertise as principal scientist and engineer for each of Space Lab's research areas. Recently, his work has centered on habitation systems specializing in environment control and life support systems (ECLSS), crop production systems, and crew accommodations. He currently serves as principal investigator for three different projects to include 1) Freezable Radiator for Efficient, Safe, and Robust (FRESR) Single Loop Thermal Control, 2) Smart Hybrid Ultrasonic Robust (SHUR) Flowmeter for Waste Processor Effluent Gases, and 3) Exploration Portable

Life Support System (xPLSS) O=O Flowmeter. Adam is also a current PhD Candidate under the Electrical Engineering and Computer Science Department at the Pennsylvania State University, where he is working towards completion of his dissertation titled, "An Insitu Noninvasive Plasma Diagnostic Instrument for the Mitigation of Hypersonic Communications Blackout". He developed new impedance probe relationships for accurately measuring electron density and electron-neutral collision frequency. Prior to his work at Space Lab, Adam worked as a Test Systems Engineer for high data rate RF and digital communications for SEAKR Engineering, Inc. He was also the Technical Lead for the Electrical Engineering Department for Orbital Sciences under the NASA Sounding Rocket Operations Contract II (NSROC II). He led the department specializing in new technology development, where he was the first to bring multisymbol modulation for sounding rocket telemetry. Adam also worked in the attitude determination and control department for Northrop Grumman under the NSROC. Prior to his commercial space experience, he was a project manager, project scientist, and engineer at the Pennsylvania State University for various payloads that include high altitude balloons, sounding rockets, and small satellites. These missions investigated multiple phenomena of the mesosphere and ionosphere. During these missions, he processed and correlated ground based radar data to these phenomena.

#### **Heather McKay**

Manager for the Orion Launch Abort System Team—Lockheed Martin Space

Heather McKay is the Manager for the Orion Launch Abort System Team. She is responsible for leading the day-to-day activities required to design, build, qualify, integrate, certify, and deliver the Launch Abort System module for flight. Heather's background is in Propulsion Engineering and Integration. She has held various roles on the Orion program and within Lockheed Martin throughout all phases of the program life cycle. Heather has a BS and MS in Mechanical Engineering from the Colorado School of Mines and an MBA from the University of Colorado. She is passionate about STEM and inspiring the next generation of engineers, scientists, and explorers.

#### **Barry Hamilton**

CEO/Founder-Red Canyon Engineering and Software

Barry Hamilton co-founded Red Canyon Software in 2000. Red Canyon is currently developing flight software (FSW) for Lucy at Lockheed and has been a member of Lockheed Martin's interplanetary spacecraft team for over 19 years conducting engineering, design, R&D and operations on 10 interplanetary satellites as well as the Orion vehicle. Barry is also the Co-Founder of 3DTAS which is an audio-based traffic alert system that interfaces with pilots through their headset while they visually scan for it outside. 3DTAS allows pilots to rapidly locate traffic through three-dimensional computational audio, take necessary action, mute the system, and return to flying.

#### Dr. David Klaus

Associate Chair for Undergraduate Studies—BIOSERVE SPACE TECHNOLOGIES University of Colorado Boulder

David Klaus is an aerospace engineer with an interest in human space habitat design and operations; he is a Professor and Associate Chair in the Smead Aerospace Engineering Sciences Department at the University of Colorado in Boulder.











#### Lunch Session: 12:00–1:00 pm Glenn Miller Ballroom

Buffet Style Lunch Served in the Glenn Miller Ballroom: 12-1:00 pm

#### Luncheon Keynote Address: 12:30 -1:00 pm

**Corey Brooker** 

Senior Staff Systems Engineer – Orion Launch Vehicle Integration at Lockheed Martin Space Systems





Corey Brooker has been working on the Orion Multi-Purpose Crew Vehicle (MPCV) within the Commercial Civil Space Line of Business at Lockheed Martin Space for the past 12 years. He leads the Launch Vehicle Integration efforts between Orion and the Space Launch System (SLS) for both Artemis-1 and Artemis-2. Lead the technical management for the Orion Exploration Flight Test-1 between LM and United Launch Alliance. He is a graduate of the LM Executive Development & Growth Enhancement (EDGE) program. His recent efforts include closing on the Orion 2 CDR for all of Systems Analysis. In addition to his launch vehicle integration, he leads the Employee Engagement teams for Orion and the Commercial Civil Space Line of Business Previous work experience includes over 12 years of Loads & Dynamics analysis for the launch vehicle development and production flights on the Atlas V and Delta IV evolved expendable launch vehicles. He has been a part of 3 Orion missions, 10

Delta IV and 11 Atlas V successful mission flights. Corey holds a Bachelor's (1994) and Master's Degree (1995) in Aerospace Engineering from the University of Michigan. The proud father to 3 children: Alexis (19 at CU-Boulder), Isabella (16) and TJ (12), and husband of 25 years to my wife, Nikki.



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#### Poster Presentations: 1:00-3:00 pm-UMC 415-417

- GPS-Denied Exploration with Self-Healing Comm Network Dr Mike Anderson, United States Air Force Academy
- Aerial Resupply of Small Teams Using Remotely Piloted Aircraft Lt Col Eric Dittman, United States Air Force Academy
- Open Water Search, Rescue, and Recovery of Downed Aviators Lt Col Matt Obenchain, United States Air Force Academy
- The Power of Measurement and Prediction: Lessons Learned from Project Management Kari S. Sanders, Ruag Space
- Development and Design of an Innovative Mechanism for Increased Mobility in Air-to-Air Missiles Chris Hoppe, United States Air Force Academy
- Computationally Efficient Shape Modeling Techniques to Enable the Autonomy of Small Body Exploration Dahlia Baker, University of Colorado Boulder
- Laser Power Beaming Demonstration for CLPS Landers David Dickson, Colorado School of Mines
- Alternative Navigation Techniques for use in GPS-Denied Environments Cadet Jedd Lebrilla, United States Air Force Academy
- Distributed Planning for Communication-Aware Information Gathering by Small Unmanned Aircraft Systems (sUAS) Sangwoo Moon, University of Colorado Boulder
- Rover Wheel Designed for Maximum Payload Efficiency Claire Thomas Colorado School of Mines
- Mitigating Clandestine Cross-Border Small-Unnmaned Aerial Systems SUAS Operations Cadet First Class Adam Wilmer, United States Air Force Academy
- Gravitational Force-Model Aliasing with Non-Gravitational Force Coefficients in Dynamic Prediction Vishal Ray, University of Colorado Boulder
- Repeatable Tethered Aerobraking Maneuver Lluis Umbert and Dr. Steve Tragesser, University of Colorado, Colorado Springs
- Comprehensive Safety Risk Assessment Studies in UAS Chris Roseman University of Colorado, Boulder
- Aerodynamics and Performance of a 300 MPH Bonneville Land Speed Record Vehicle Ioan Feier, United States Air Force Academy
- Overview of the Operational Land Imager 2 (OLI-2) Jordan Marks, Edward J. Knight, Ball Aerospace & Technologies Corp.
- A New Method of Radiometric Calibration for the Ozone Mapping and Profiler Suite *Tyler McCracken, Ball Aerospace & Technologies Corp.*
- MARKUS (Multi-functional Autonomous Rover and Kinetic Untethered System) Joshua Ehrlich, Colorado School of Mines
- Hypersonic Flight In the Turbulent Stratosphere (HYFLITS) Andrew Mahon University of Colorado Boulder
- Design of a Lunar Surface Access Vehicle Dr. Lynnane George, Noble Kilman, Dylan Hansen; University of Colorado, Colorado Springs
- Duckweed: A Tiny Aquatic Plant with Enormous Potential for Bioregenerative Life Support Systems *Christine Escobar; Space Lab Technologies, LLC*
- Quantifying ECLSS Robustness for Deep Space Exploration Christine Escobar; Space Lab Technologies, LLC



#### Feature Presentations: Human Spaceflight-UMC 235

Smart Technology Infusion for Deep Space Exploration Habitats T.K. Clark, A.P. Anderson, J.A. Nabity, R. Braun, N.T. Banerjee, S.P. Eshima, J.R. Kintz, A.E. Rollock, S. Zaccarine, P.K. Pischulti, D.M. Klaus

Ensuring Each Breath: An Oxygen Compatible Flowmeter for the Exploration PLSS Adam Escobar President and CEO Space Lab Technologies, LLC.

Orion Ascent Abort 2 Flight Test Heather McKay, Roger McNamara, Sandy Mossman, Launch Abort System, Orion Program Lockheed Martin Space

#### Fluids, Structures and Materials (FSM)–UMC 247

The Role of Acoustics & Vibration in the Space Industry Dr. Indranil Dandaroy, LM Fellow, Lockheed Martin Space

Green Propellant Infusion Mission (GPIM) Technology Demonstration Mission (TDM) *Christopher McLean Ball Aerospace & Technologies Corp.* 

Folding Airfoil Structures through Utilization of High Strain Composites Zachary McConnel, Roccor LLC

#### CU Aerospace Info Session-UMC 382





#### Session 3: 2:00 – 3:00 pm

## Session 3 Panel: Human-Machine Interactions in Highly Automated Control Systems–UMC Glenn Miller Ballroom

Aerospace systems (not to mention, our cars) are becoming increasingly automated with the goal to increase safety and reduce operator workload. However, hybrid human/machine control systems have the inherent risks of ambiguities about what the other is doing, and who is "in command." In this panel we will discuss such human-machine interactions and how the aerospace community should adapt the technology development process to better develop, test and regulate emerging capabilities.



#### Dr. Mike Anderson

Director, Capstone Design Program, Department of Mechanical Engineering—United States Air Force Academy

Dr Michael Anderson is an Assistant Professor of Mechanical Engineering and Director of Capstone Programs at the US Air Force Academy. He has been studying autonomous systems and engineering design for fifteen years, writing on topics such as design of terrestrial and aerial robots, energy efficiency and perching for small UAS, and flight control of Micro Air Vehicles (MAV). Dr Anderson has worked in F-16 flight control actuation, design and control of quadruped robots, GPS-denied navigation for multi-agent autonomous systems and advanced munition design. Dr Anderson earned his PhD in Aeronautical Engineering from the Air Force Institute of Technology in 2011 where he studied the design and control of flapping wing MAVs. Dr Anderson recently retired from the Air Force. He is a registered Professional Engineer and an Associate Fellow of the

AIAA, where he serves on the Unmanned Systems Integration Committee.

#### **Panelists:**

#### Dr. Kevin Kuhlmann

Associate Chair of Aviation and Aerospace Science—Metropolitan State University of Denver

Professor Kevin Kuhlmann is Associate Chair of Aviation and Aerospace Science at Metropolitan State University of Denver. He is the faculty adviser for students pursuing Bachelor of Science degrees as professional flight officers. Professor Kuhlmann actively works with commercial airlines to establish career programs with MSU Denver to help aspiring pilots plan their transition from the classroom to the flight deck. Kevin Kuhlmann's expertise is in the area of commercial and military flight operations training, safety standards and human factors in flight operations. His research interest includes aviation safety, flight deck automation, and navigation systems. He holds multiple Federal Aviation Administration pilot certifications including Flight Instructor and Airline Transport Pilot, all with multi-engine and instrument ratings. Before

joining the faculty at MSU Denver in 1994, he worked as commercial airline pilots for Horizon Air, a regional airline partner within the Alaska Air Group. A 30-year Air Force enlisted and officer veteran, Lieutenant Colonel Kuhlmann spent seven years as an aircraft commander and instructor pilot for the F-111A/D/F Aardvark, which is a supersonic variable sweep wing tactical fighter aircraft. His service spanned the Cold War, Desert Storm, Operation Iraqi Freedom, and Operation Enduring Freedom. In 2009, Lt Col Kuhlmann deployed to serve at the Combined Air Operations Center on Al Udeid Air Base, Qatar. Lt Col Kuhlmann also served as a safety officer in the Air Force and conducted accident investigation duties. A professor with a passion for both aviation safety and technology, he holds a Master of Aeronautical Science degree from Embry-Riddle Aeronautical University and a Bachelor of Aviation Training and Management degree from Southern Illinois University.

#### **Austin Anderson**

Machine Learning Lead—Black Swift Technologies

Mr. Anderson received his B.S. in general engineering from Harvey Mudd College and his M.S. in Aerospace Engineering from the University of Colorado, Boulder. He spent several years working with radars and electronic warfare for MIT Lincoln Laboratory in the Air and Missile Defense division. His research in graduate school focused on software defined radios, unmanned aircraft, and machine learning. Since graduate school, Mr. Anderson has worked to develop spacecraft avionics and radios for various startups around Boulder. At BST he leads projects in machine learning and machine vision.







#### **Byron Young**

Propulsion System Engineer—Boom Supersonic

Byron Young is an engineer at Boom Supersonic, a company working towards reviving supersonic commercial transportation. In this role he's supporting the design and integration of the propulsion system of their XB-1 demonstrator aircraft, which uses three J85-15 engines to accelerate to Mach 2.2. Since graduating from the University of Colorado, he's worked on many novel aircraft including Stratolaunch, SpaceShipTwo, the ICON A5, the Lightning Strike VTOL UAV, and an autonomous glider to resupply Marines at forward operating bases. Applicable to this discussion, he's worked as a test engineer on Boeing's autonomous A160 Hummingbird helicopter program, developed a UAV and ground station for a Y-Combinator startup, and was part of a team that converted a GA aircraft into a UAV. Byron also holds several patents related to manned and unmanned aircraft, is a private pilot, feels awkward writing about himself, and was a member of a team that set several FAI speed and time to climb records for electric aircraft.

#### **Dr. Eric Frew**

Professor and Director of the Autonomous Systems Interdisciplinary Research Theme (ASIRT) — Ann and H.J. Smead Aerospace Engineering Sciences Department at the University of Colorado Boulder Research and Engineering Center for Unmanned Vehicles (RECUV)

Dr. Eric W. Frew received his B.S. in mechanical engineering from Cornell University in 1995 and his M.S and Ph.D. in aeronautics and astronautics from Stanford University in 1996 and 2003, respectively. Dr. Frew has been designing and deploying unmanned aircraft systems for over twenty years. His research efforts focus on autonomous flight of heterogeneous unmanned aircraft systems; distributed information-gathering by mobile robots; miniature self-deploying systems; and guidance and control of unmanned aircraft in

complex atmospheric phenomena. He is currently the CU Site Director for the National Science Foundation Industry / University Cooperative Research Center (IUCRC) for Unmanned Aircraft Systems.

#### Lt Col Heidi Bucheit, USAF

Assistant Chief Pilot, 701st Airlift Squadron, Charleston AFB, SC-United States Air Force

Lt Col Bucheit is a current U.S. Air Force Instructor Pilot in the C-17 with more than 20 years of flight experience and over 3,000 flight hours. She has a degree from the U.S. Air Force Academy in Human Factors Engineering and a Masters in Psychology. She was also initial cadre in the RQ-4A Global Hawk. She was able to employ her expertise & degrees in this position as she helped develop the pilot to machine interface and compatibility while standing up a new aircraft system for the Air Force.

#### Poster Presentations: 1:00-3:00 pm-UMC 415-417

#### Space Systems Technologies Presentations-UMC 247

Mobile Autonomous Prospecting Platform (MAPP): A Robust, Adaptable Robotics Platform for Providing Commercial Lunar Prospecting and Surface Mobility Services *AJ Gemer Chief Technology Officer– Lunar Outpost, Inc* 

Aerospace Research Simulator (AReS) Cockpit Simulation Carlos Pinedo–University of Colorado Boulder

#### Remote Sensing, Earth and Space Science (RSESS)-UMC 235

Rosetta mission operations of the Alice Ultraviolet Spectrograph Instrument Jon Pineau Sr. Space Systems Engineer SwRI / Stellar Solutions

The Global Environmental Monitoring Systems (GEMS) Constellation of Passive Microwave Satellites Brian Sandrs VP of Space Systems, Co-Founder– Orbital Micro Systems

A Cubesat Infrared Imaging Radiometer with On-Board NIST-Traceable Calibration System for Earth and Planetary Science Applications *David Osterman, Ball Aerospace & Technologies Corp.* 

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#### Afternoon Feature Presentations: 3:00 –4:00 pm

#### Feature Presentations: Glen Miller Ballroom

Re-architecting the Systems Engineering Enterprise at Lockheed Martin Space to Meet the Challenges of DoD Mission Needs Calvin Craig–Systems Engineering Director Lockheed Martin Space

CRADLE-California Research Analog for Deepspace and Lunar Environments *Hunter Singh–University of Colorado, Boulder* 





#### Closing Session: 4:00 pm - 4:30 pm Glen Miller Ballroom

#### Afternoon Keynote: Scott Anderson President and Co-Founder—SEAKR Engineering



Scott Anderson is Co-Founder and President of SEAKR Engineering, Inc. Scott's combined technical oversight and operational leadership of 35 years is instrumental in SEAKR's modern footprint as the World's leading



supplier of Solid State Recorders, avionics and high-performance processing systems for space application. Scott lead engineering on SEAKR's early Solid-State Recorders having conceptualized and developed hardware design for several generations of SEAKR's Single Event Upset (SEU) immune, fault tolerant, Dynamic Random Access Memory (DRAM) based spacecraft Solid State Recorders. He is heavily responsible for SEAKR never having an on orbit failure with active time spent in company labs. Scott holds a Master of Science degree in Electrical Engineering from California State University, Long Beach and a Bachelor of Science Degree in Electrical Engineering from the University of California at Irvine.

#### **Closing Remarks: Dr. Merri Sanchez AIAA-RM Chairperson**



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