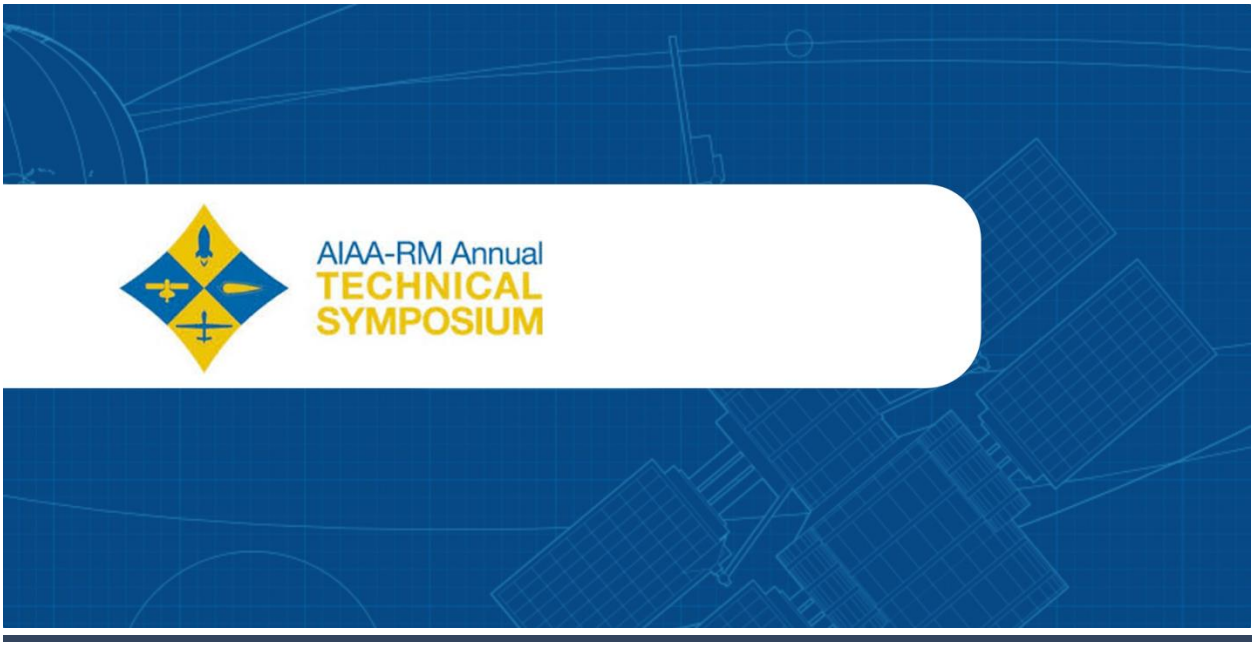

9th Annual Technical Symposium
September 29th, 2021

University of Colorado, Boulder

University Memorial Center

SYMPOSIUM AGENDA

	Glenn Miller Ballroom (Capacity 400)	Aspen Rooms (18 Vendor Tables)	UMC 247 (Capacity 60)	UMC 235 (Capacity 156)	UMC 245 (Capacity 40)	UMC 380 (Capacity 120)	UMC 415-417 (Capacity 80)
7:30	Check-in / Vendor Setup *Light Breakfast*	Vendor Showcase 7:30 am - 3:00 pm					
8:00	**Welcoming Remarks:** AIAA Chair *AIAA-RM 2021-22 Chairperson* **Opening Address:** Dr. Brian Argrow *CU Aerospace Smead Faculty Chair* *Introduction by Jay Lindell*						
8:30	**Morning Keynote:** Timothy Cichan *Space Exploration Architect* *Lockheed Martin Space Systems*						
9:00	**Session 1 Panel** Space Weather and the Near-Earth Space Environment ***Moderator: Dr. Thomas Berger (CU)***		**Session 1** **Astrodynamics and Satellite Navigation Systems (ASN): Space Missions** 3 x 15 min	**Session 1** Emerging Technologies for SmallSats 3 x 15 min	**Session 1** Autonomous Systems (AUT) Vehicle Systems 3 x 15 min	**Session 1** **Bioastronautics (Bio)** 3 x 15 min	Poster Session A 9:00-11:00 am
9:30							
10:00	**Morning Keynotes on Startups in Aerospace** *Bradley Cheatham: Advanced Space* *Alan Ruth: Ruth Precision* 2x20 min		**Session 2** Supersonics, Hypersonics, and Re-Entry Vehicles	**Session 2** **Remote Sensing, Earth and Space Science (RSESS)** 3 x 15 min	**Session 2** Autonomous Systems (AUT) Human-Autonomy Interaction 3 x 15 min	**Session 2** Space Medicine and Human Performance 3x15 min	
10:30							
11:00	**Feature Panel** Space Domain Awareness and Space Traffic Management ***Moderator: Dr. Marcus Holzinger (CU)***		**CU Aerospace Info Session**	**Feature Presentations** **Advanced Aerospace Manufacturing** 3x15 min	**Feature Presentations** Applications of Unmanned Aircraft Systems 3x15 min		
11:30							
12:00	**Lunch**						
12:30	Luncheon Keynote Address: **Maj General Tim Lawson** *USNG Mobilization Assistant to the Commander, USSPACECOM*						
13:00	Open Networking		**Session 3** Astrodynamics and Satellite Navigation for Spacecraft Operations 3 x 15 min	**Session 3** Space Domain Awareness 3 x 15 min	**Session 3** Aircraft Safety and Design 3 x 15 min	**Session 3** NASA's Artemis Program Moon to Mars 3x15 min	Poster Session B 1:00-3:00 pm
13:20	**Vendor Presentations:** New Developments in Space Systems Technologies						
14:00	**Session 4 Panel** Machine Learning in Aerospace Systems ***Moderator: Dr. Nisar Ahmed (CU)***		**Session 4** Astrodynamics and Satellite Navigation Methods/Technology for Exploration 3 x 15 min	**Session 4** Space Systems Technologies 3x15 min	**Session 4** **Fluids, Structures and Materials (FSM)** 3 x 15 min	**Session 4** **Mining Resources from Space** 3 x 15 min	
14:30							
15:00	**Afternoon** Feature Presentations Human Spaceflight 3 x 15 min						
15:30							
16:00	**Afternoon Keynote:** Dr. Jeanne Atwell *VP, Chief Engineer at Ball Aerospace*						
16:30	**Closing Remarks (5 min) / Cleanup**						

UMC 425 Open for quiet workspace or scheduled breakout sessions 7am-5pm
Open public Wifi available throughout the UMC

AIAA Rocky Mountain Section
Annual Technical Symposium

Table of Contents

Enjoy a light breakfast 7:30 - 8:30 am *Glenn Miller Ballroom*

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

Vendor Showcase – *Aspen Conference Room 7:30 am - 3:00 pm*

Welcome Remarks: Alexandra Dukes — *AIAA-RM Chair Lockheed Martin Space*
Alexandra Dukes is Chair of the AIAA Rocky Mountain Section and Software Engineer Senior at Lockheed Martin. She has a B.S. and M.S. in Aeronautics and Astronautics from Purdue University and has worked for NASA Jet Propulsion Laboratory, Gulfstream Aerospace Company, and NASA Kennedy Space Center before her role on the Orion program with Lockheed Martin. Alexandra is passionate about supporting the aerospace community and plans to bolster the Rocky Mountain Section's membership engagement and young professional leadership opportunities in her role as Chair.

Morning Address: Dr. Brian Argrow — *CU Aerospace Smead Faculty*

Ann and H.J. Smead Aerospace Engineering Sciences
UNIVERSITY OF COLORADO **BOULDER**

Professor, Department Chair, Director of IRISS Schaden Leadership, Chair Research and Engineering Center for Unmanned Vehicles (RECUV)

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.

Morning Keynote: Timothy Cichan *Space Exploration Architect — Lockheed Martin*

LOCKHEED MARTIN

Timothy Cichan (Chee-haan) is the Space Exploration Architect at Lockheed Martin, where he leads a multi-disciplinary team of engineers who figure out how to help astronauts and robots visit the Moon, asteroids, and Mars. He previously was the Orion System Architect. Timothy joined Lockheed Martin in 2002 and has worked for both human spaceflight and commercial communication satellite teams. He specializes in optimal trajectory design, mission analysis, subsystem development, and systems engineering. He has a Master's and Bachelor's degree in Aerospace Engineering from Penn State.

Session 1: 9:00 – 10:00 am

Vendor Showcase – *Aspen Conference Room 7:30 - 3:00 pm*
Poster Presentations A: 9:00 - 11:00 am – *UMC 415-417*

Astrodynamics and Satellite Navigation Systems (ASN): Space Missions – *UMC 247*
Chair: Dr. Penina Axelrad — Distinguished Professor University of Colorado

Designing Probe and Aerocapture Orbiter for a Single Entry Trajectory
Samuel Albert, University of Colorado Boulder

Deep Space Calibration Satellite Constellation
Nicholas Reid, USAFA, Department of Astronautics

CAPSTONE: Pathfinding for the Future of Cislunar Operations
Michael Thompson, Advanced Space

Emerging Technologies for SmallSats – *UMC 235 Conference Room*
Chair: Dr. Scott Palo – Professor, University of Colorado Boulder, (RECUV)

Mission Utility-Based SmallSat Design Considerations
Anna Lawitzke, Ball Aerospace & Technologies Corp.

A Situational Awareness and Ranging System for Distributed CubeSat Missions
Brodie T. Wallace – CU-E3 Project Manager University of Colorado Boulder

Autonomous Systems (AUT) Vehicle Systems – *UMC 245*
Chair: Dr. Eric Frew–Professor CU, Research and Engineering Center for Unmanned Vehicles

Advancing Position Estimation for Autonomous Flight
Grant, Appel United States Air Force Academy

Autonomous Operations Advancing Commercial Lunar Rover Capabilities in 2022 and Beyond
Andrew (AJ) Gemer, Lunar Outpost, Inc.

A Formal Approach to the Application of NASA Flight Software IV&V to Commercially Developed Spacecraft.
Michael Rubin, Red Canyon Software

Bioastronautics (Bio) – *UMC 380*
Chair: Dr. Allie Anderson – Assistant Professor University of Colorado, Bioserve

Quantifying the Performance of the Astro Space Suit
James Kirwan, Colorado State University

Attractive qualities of duckweed as a food source for space missions
Stephanie Polutchko, University of Colorado, Boulder

Crewed and Uncrewed Semi-autonomous Habitat for the Exploration of Deep Space
Marta Stepanyuk, University of Colorado, Boulder

COLORADO
Office of Economic Development & International Trade

Session 1 Panel: Space Weather and the Near-Earth Space Environment – *UMC Glenn Miller Ballroom*

This panel will discuss the future of space weather forecasting or nowcasting in the orbital environment and the technologies, and applications that will help us better understand the science of the earth-sun system and improve spacecraft and astronaut safety.

Moderator: Dr. Thomas Berger *(Professor CU, Executive Director SWX TRECCU)*

Dr. Berger is the founding and Executive Director of the University of Colorado (CU) at Boulder's Space Weather Technology, Research, and Education Center (SWx TREC). He splits his time between running the Center and conducting independent research into solar magnetic fields and eruption triggering, applying deep learning technology to the problem of solar flare prediction. Prior to coming to CU, Tom was the Director of NOAA's Space Weather Prediction Center where he oversaw both daily forecasting operations and space weather research-to-operations transitions, working with NASA, academia, and the commercial space weather provider community. Tom started his career at the Lockheed Martin Solar and Astrophysics Laboratory in Palo Alto after obtaining his Ph.D. degree in Astrophysics from Stanford University in 1997. He was a Co-Investigator on the Japan/US/UK Hinode Solar Optical Telescope mission and the Project Scientist for the NSF's Daniel K. Inouye Solar Telescope, the world's largest solar telescope on Maui, Hawaii.

Panelists:

Dr. Nicole Duncan *Heliophysics Mission Area Lead — Ball Aerospace & Technology Corp.*
Dr. Nicole Duncan is the Heliophysics Mission Area Lead for Ball Aerospace's Civil Space business unit. In this role, she manages a portfolio of advanced technologies, instruments, spacecraft and mission concepts for heliophysics and space weather new business opportunities. Under Dr. Duncan's guidance, Ball recently developed concepts and won contracts for NOAA's Space Weather Follow On - Lagrange 1 (SWFO-L1) spacecraft, NASA's Global Lyman alpha Imager of the Dynamic Exosphere (GLIDE) spacecraft and NASA's Solar Cruiser sailcraft. Dr. Duncan holds a Ph.D. in Physics from the University of California, Berkeley and a B.S. in Engineering Physics from the University of Colorado, Boulder. Her graduate research included particle energization during solar flares, science operations for NASA's Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI) mission and hardware development for NASA's Gamma Ray Imager/Polarimeter for Solar flares (GRIPS) Antarctic Balloon mission.

Dr. Tzu-Wei Fang *Space Scientist — NOAA Space Weather Prediction Center*
Tzu-Wei is a space scientist at the National Oceanic and Atmospheric Administration Space Weather Prediction Center (NOAA/SWPC). Her expertise is in numerical simulation of ionosphere and thermosphere environment. She has been leading the development and the operational effort for the ionosphere-thermosphere forecast models at SWPC. She oversees the modeling plans within SWPC as well as directly interacts with customers and users to set requirements. She will be sharing more information about space weather and the details of their forecast model and products that are relevant to satellite drag.

Dr. Jade Morton *Professor • Helen and Hubert Croft Professor • Director of CCAR — CU Boulder*
Dr. Jade Morton is the Helen and Hubert Croft Professor and Director for Colorado Center for Astrodynamics Research (CCAR) in the Ann and HJ Smead Aerospace Engineering Sciences Department at the University of Colorado (CU), Boulder. Dr. Morton's research interests lie at the intersection of satellite navigation technologies and remote sensing of the Earth's space environment, atmosphere, and surface. She received her PhD in Electrical Engineering from Penn State. Dr. Morton is a fellow of IEEE, Institute of Navigation, and the Royal Institute of Navigation.

Dr. Jeffrey Thayer *Joseph T. Negler Professor • Director of SWx-TREC — University of Colorado Boulder*
Dr. Thayer is the Joseph T. Negler Professor in the Aerospace Engineering Sciences Department at the University of Colorado, Boulder. He is the Faculty Director of the Space Weather Technology, Research, and Education Center at CU. He is co-founder of the center whose purpose is to serve as the nation's premiere academic entity for advancing research into space weather phenomena and their impact on technological systems, developing new observing systems and data/model exploration tools, and transitioning those advancements into operations. Dr. Thayer has over 30 years of experience leading research in the near-space environment, advancing remote sensing technologies (US and EU patents), developing strategic plans for NASA and NSF, and publishing over 120 journal articles. Prior to CU, Dr. Thayer was a research physicist at SRI International and most notably PI of a US national radar observatory in Greenland. Dr. Thayer received his Ph.D. and MS in Atmospheric and Space Sciences from the University of Michigan, and a BS in Meteorology, from the State University of New York at Oneonta. Dr. Thayer is a member of AIAA, American Geophysical Union, and Optical Society of America.

Poster Presentations A: 9:00-11:00 am – *UMC 415-417*

An Autonomous System for Persistent Surveillance in GPS-Denied Environments
Michael Anderson, United States Air Force Academy

Aerodynamics Development of a 500 MPH Bonneville Land Speed Record Vehicle
Ioan Feier, United States Air Force Academy

LEO Orbit and Clock Estimation with Two-Way Optical Inter-satellite Links
Christopher Flood, University of Colorado Boulder

Student Thermal Energetic Activity Module (STEAM)
Mary Hanson, University of Colorado Boulder, Colorado Space Grant Consortium

IMUFDIR Tuning in Response to Pressure Induced Ballooning of Orion Capsule
Nicholas Rahaim, Lockheed Martin Space

Leadership performance single-pilot executive transport: Ryzen 3500 concept
Aidan Sesnic, University of Colorado Boulder

Artemis II Guidance & Targeting – Lessons Learned
Ryan Stewart, Lockheed Martin Space

Definition of a Close Approach – Rendezvous Proximity Operations in LEO
Kaiser Tan, United States Air Force Academy, Department of Astronautics

Researching Model-Based Systems Architecture Process Methodology to Synchronize with High-Fidelity Live-Virtual-Constructive Simulations Tools
Roy Tsui, Colorado State University

Operations Research Approach to Asteroid Mission Astronaut Selection
Lynnane George, University of Colorado, Colorado Springs AIAA Student Branch

Overview of the Highly Advanced Distributed Exploration Spacecraft (HADES) Mission
Lynnane George, University of Colorado, Colorado Springs AIAA Student Branch

Overview of a Mars Ascent Vehicle
Lynnane George, University of Colorado, Colorado Springs AIAA Student Branch

Particle Model Predictive Control for Partially Observable Motor Faults
Zakariya Laouar, University of Colorado Boulder

Structural Properties Identification of an Adaptive Wing with Distributed Bleed Flow Control
Luca De Beni, University of Colorado Boulder

A Comparison of POMDP and MDP Algorithms for In-Flight Contingency Management
Benjamin Kraske, University of Colorado Boulder

Session 2: *10:00 – 11:00 am*

Morning Keynotes on Startups in Aerospace – *UMC Glenn Miller Ballroom*

Bradley Cheetham *Co-Founder and CEO – Advanced Space*
Bradley Cheetham is an engineer, and 3x entrepreneur. He is the co-founder and CEO of Advanced Space where he leads company operations and strategy to deliver flight dynamics and operations software and services. Cheetham earned a degree in Aerospace and Mechanical Engineering from the State University of New York, Buffalo and received his Masters in Aerospace Engineering Sciences from CU Boulder, where conducted significant research on spacecraft navigation towards a PhD. He serves as instructor for a graduate level course in Commercial Spaceflight Operations at CU Boulder. He serves on the Board 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 Students for the Exploration and Development of Space (SEDS).

Alan Ruth *Founder, Entrepreneur, Executive Business Leader, Mentor and Educator – Ruth Precision CNC*
A lifelong learner, educator, leader and mentor. A results-oriented, inclusive and forward-thinking senior business development executive with a proven global and domestic track record of increasing accomplishments in P&L leadership. An enterprising marketer with a background in developing talent and creating, refining, and improving the power of diverse teams/individuals/communities, and executing successful "protect and grow" strategies to achieve share, revenue, and profit growth. Astute negotiator and intuitive decision maker who engages target customers to help close deals and solve complex problems. Resourceful innovator who simplifies business processes, organization structures, and product lines to fund and enable growth while partnering with all levels, across the entire organization and globe.

Supersonics, Hypersonics, and Re-Entry Vehicles – *UMC 247*

Chair: Dr. Robyn Macdonald – Assistant Professor, University of Colorado Boulder, AMREC)

Breaking Down Design Silos: Multiphysics Simulation for High-Speed Systems
Elliot Haag, ATA Engineering, Inc.

Bernard Kutter's LOFTID , Engine Reuse and the Mars Highlands
Mike Holguin, ULA

Shock-capturing operators and their effect on thermal nonequilibrium regions
Joseph Pointer–University of Colorado Boulder

Remote Sensing, Earth and Space Science (RSESS) – *UMC 235*

Ball Aerospace Small Spacecraft Capabilities for Remote Sensing, Earth and Space Science
Dr. Nicole Duncan – Ball Aerospace and Technologies Corp.

CubeSat Deployable Booms for Observing Space Weather
Brad Hensley – Redwire Space

Infrasound Sensing for Planetary Exploration
Eliot Young, Southwest Research Institute

Autonomous Systems (AUT) Human-Autonomy Interaction – *UMC 245*

Chair: Dr. Eric Frew – Professor CU, Research and Engineering Center for Unmanned Vehicles

Model-Based Deep Reinforcement Learning for Autonomy of Unmanned Aircraft Systems
Aastha Acharya, University of Colorado, Boulder

The Future of Human-Autonomy Interaction in Commercial Space Operations
Justin Corneau, Sierra Space

Architecting Manual Operations into Increasingly Complex Autonomous Vehicles
Nicole Demandante, Lockheed Martin

Space Medicine and Human Performance – *UMC 380*

Chair: Dr. Allie Anderson – Assistant Professor University of Colorado, Bioserve

Integration of Machine Learning with Biomarker Sensors for PTSD
Jennifer Huwe, Colorado State University

The influence of perceived stress on the microbiome
Austin Almand MS, University of Colorado - School of Medicine

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

Vendor Showcase – *Aspen Conference Room 7:30 am - 3:00 pm*

CU Aerospace Info Session – *UMC 247*

Feature Presentations: Advanced Aerospace Manufacturing – *UMC 235*

Chair: Mark Yoss – Director, Advanced Manufacturing Sciences Institute, MSU Denver

Additive Manufacturing of Niobium C103 for In-Space Propulsion Systems
Dr. Prashanth Bangalore Mechanical Engineer, Agile Space Industries

Prototype Aircraft Structure at the Extreme Limits of Design
Ryan Manning, Big Metal Additive

Usage of Biomimetic Parameters and Principals in Multi-Physics Shape Optimization of Lattice Geometry for Space Structures
Eric Miller, Co-Owner & Principal PADT, Inc..

Feature Presentations: Applications of Unmanned Aircraft – *UMC 245*

Technologies and Procedures to Enable Routine BVLOS Operations
Dr. Jack Elston, Black Swift Technologies

Isolated Personnel Supply System UAS Flight Test
Lt. Col Nidal Jodeh, Assistant Professor Department of Aeronautics, U.S. Air Force Academy

Aircraft Survivability Modeling, Evaluation, and Optimization for Multi-UAV Operational Scenarios
Ian Lunsford, Colorado State University

Feature Panel: Space Domain Awareness and Space Traffic Management – *UMC Glenn Miller Ballroom*

As outer space becomes more congested due to the proliferation of satellites and orbital debris, the need for improved situational awareness is imperative. This panel will discuss technologies and systems that will enable the safety of civil and military assets into the next century.

Moderator: Dr. Marcus Holzinger *Assoc. Prof. Colorado Center for Asstrodynamics Reesearch (CCAR)*

Prof. Holzinger is an Associate Professor, H. Joseph Smead Faculty Fellow, Associate Chair for the Undergraduate Curriculum, and Associate Director of the Colorado Center for Astrodynamics (CCAR) Research in the Smead Aerospace Engineering Sciences Department at the University of Colorado Boulder. His research focuses on theoretical and empirical aspects of space domain awareness, in which he has authored or co-authored over 130 conference & journal papers and built several Raven-class telescope systems. Dr. Holzinger has made fundamental advances in cislunar space domain awareness, low signal-to-noise ratio detection and tracking, telescope tasking to resolve hypotheses, lightcurve inversion, and reachability theory. Dr. Holzinger is Chair for the AAS Space Surveillance Technical Committee (AMOS Conference) and an AIAA Associate Fellow.

Panelists:

Dr. Siamak Hesar: *Co-Founder and CEO — Kayhan Space*
Dr. Siamak Hesar is the co-founder and CEO of Kayhan Space. He holds a Ph.D. in Aerospace Engineering Sciences from the University of Colorado, Boulder. He has supported NASA missions in the past, including the OSIRIS-REx asteroid sample return mission. Prior to Kayhan Space, Siamak worked as Chief Scientist at SpaceNav, where he led several software development efforts focused on SSA, collision risk assessment and mitigation. Recently, he served as PI for the NASA Tipping Point program working on autonomous on-board navigation software for CubeSats at Blue Canyon Technologies. He is passionate about space and wants to do his part to ensure a sustainable Earth orbital environment for future generations.

Dr. Jacob Griesbach: *Chief Architect, Space Domain Awareness — Ball Aerospace & Technology Corp.*
Dr. Jacob Griesbach (PhD EE 2000, MSEE 1997, BSEE 1995, Univ. of Colorado at Boulder) has 20 years of experience supporting space protection and related efforts. Currently at Ball Aerospace, he oversees technical execution and internal research and development teams to lead Ball Aerospace's Space Domain Awareness business portfolio. Specific research and analysis thrusts include deep space and cislunar domain awareness. Previously, at Applied Defense Solutions (ADS), he developed image processing and orbit determination algorithms for ground-based optical space situational awareness. At SAIC, he helped to develop the early beginnings of space indications and warnings (I&W), and supported the early Space Protection Program (SPP). At Lincoln Laboratory, he developed space-time adaptive beamforming techniques for the Space-Based Radar (SBR) program.

Dr. Francis Chun: *Professor of Physics — United States Air Force Academy*
Francis Chun is a Professor in the Department of Physics and Meteorology at the United States Air Force Academy. He is also the Director of the Center for Space Situational Awareness Research which he created in 2010. He leads a team of faculty and research staff advising and mentoring cadet undergraduate research projects in ground-based optical signatures of non-resolved space objects. He is the PI for the USAFA Falcon Telescope Network and the new USAFA 1-meter telescope, and has participated in numerous satellite observational campaigns with US and international telescope owner/operators. Dr. Chun's research team focuses on combining observations collected simultaneously from multiple telescopes using multiple optical modalities (photometry, spectroscopy, and polarimetry). Dr. Chun is a retired Air Force officer and has been on the USAFA faculty since 1995; he is also an AIAA Associate Fellow.

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**

Major General Tim Lawson – *United States National Guard*
Mobilization Assistant to the Commander, United States Space Command (USSPACECOM)

Major General Tim Lawson is the Mobilization Assistant to the Commander, United States Space Command. In this position, he assists the Commander in shaping space policy, developing plans and conducting operations to ensure U.S. joint forces and allied partners are prepared to deter aggression, defend freedom of action and deliver space combat power in, from and through the space domain.
In his prior role as Deputy Commanding General for Operations at Space and Missile Defense Command he oversaw all operations within the command including oversight of two brigades, an Army astronaut detachment, satellite communications system experts, joint friendly forces tracking, radar support to space and intelligence operations and the operational command post when activated. Lawson was promoted to a brigadier general in June 2017. Maj. Gen. Lawson has served the military since 1988. He has served overseas in Germany, Kuwait, Iraq, and Saudi Arabia including being a veteran of Desert Storm. He has received nearly 2 dozen citations and medals for his service. Maj. Gen. Lawson holds a BS in Law Enforcement Administration from Western Illinois University and a MSS in Strategic Studies from the United States Army War College.

Ann and H.J. Smead
Aerospace Engineering Sciences
UNIVERSITY OF COLORADO **BOULDER**

Session 3: 1:00 – 2:00 pm

Vendor Showcase – *Aspen Conference Room 7:30 am - 3:00pm*
Poster Presentations B: 1:00-3:00 pm – *UMC 415-417*

Vendor Presentations: New Developments in Space Systems Technologies - *Glenn Miller Ballroom 1:20 pm*

Fiber Optics & Ruggedized Photonics for Spacecraft
Mike Dabrowski, Glenair INC.

Experiences in Additive Manufacturing Technologies for Aerospace
David Waller, Ball Aerospace and Technologies Corporation

Astrodynamics and Satellite Navigation for Spacecraft Operations – *UMC 247*
Chair: Dr. Penina Axelrad – Distinguished Professor University of Colorado Boulder

Simulating Undocking with the Orion Spacecraft.
Alia Brown, Lockheed Martin Space

Constrained Attitude Maneuvering, State of the Art and Novel Applications
Riccardon Calaon, University of Colorado Boulder AVS Lab

Motivation and Development of Touchless Potential Sensing Methods for the Electrostatic Tractor
Julian Hammerl, University of Colorado Boulder

Space Domain Awareness – *UMC 235*
Chair: Dr. Marcus Holzinger – Assoc. Prof. University of Colorado Boulder, (CCAR)

Search for Pareto-Optimal Cislunar Space Domain Awareness Architecture with Heterogeneous Sensor Platforms and Orbit Diversity
Elvis Silva, Ball Aerospace & Technologies Corp.

Kayhan Space Autonomous Collision Assessment and Avoidance System
Shota Takahashi, Kayhan Space Corp

Maintaining a Safe Distance
Dr. Mark Vincent, Raytheon/JPL

Aircraft Safety and Design – *UMC 245*
Chair: Dr. Donna Gerren – Teaching Professor University of Colorado Boulder

Aircraft Structural Design for Attritable Assets
Drew Priest, United States Air Force Academy

Safe UAS Integration
Aidan Sesnic, University of Colorado Boulder

Unmanned Aerial Systems Detection and Warning for Piloted Aircraft
Richard Zelenka, Founder and CEO Drone Traffic

NASA's Artemis Program Moon to Mars – *UMC 380*
Chair: Dr. David Klaus – Professor University of Colorado Boulder, BioServe

Boots Around the Moon: Paragon's Contributions to Artemis and Beyond
Robert Aaron, Paragon Space Development Corporation

Orion Program Updates
Shelby Hopkins, Lockheed Martin

First Controlled Biological Experiments beyond the Van Allen Belts
Luis Zea, BioServe Space Technologies

Poster Presentations B: 1:00-3:00 pm – *UMC 415-417*

MMOD Protection through Orbital Additive Manufacturing.
Adam Broshkevitch, United States Air Force Academy

EyasSat GEN 5X Simulator
Genah Burditt, EyasSat LLC

Nano-Fabrication of Ceramic Composites for High Heat-Flux Gas Flows
Spencer Dansereau, University of Colorado Boulder

Qualifying and Reducing Neutral Density Uncertainty for Precise Orbit Determination using Physics-Based Data Assimilation
Nicholas Dietrich, University of Colorado Boulder

SPRITE: Big Astronomy with a Small Package; NASA's first 12U-CubeSat for Far-UV astronomy
Raymie Fotherby, University of Colorado Boulder, LASP

Reinforcement Learning for Autonomous Spacecraft Planning and Scheduling
Adam Herrmann, University of Colorado Boulder

Advances in Hypersonic Missile Defeat Technology
Mark Humphries, United States Air Force Academy

Solar eruptioN Integral Field Spectrograph (SNIFS)
Vicki Knoer, University of Colorado Boulder

New Daytime Meteor Shower Identified with Antarctic Meteor Radar
John Marino, University of Colorado Boulder

Autonomous Attitude Tasking for Surface Mapping of Large Bodies
Islam Nazmy, University of Colorado Boulder, Colorado Center for Astrodynamics Research (CCAR)

Using NASA Airborne HIWRAP Observations to Study Precipitation Spatial Variability
Christopher Williams, University of Colorado Boulder

VERITAS
Marcella Yant, Lockheed Martin

3D-printed Composites with Dicyclopentadiene and Short Carbon Fiber Reinforcements
Morteza Ziaee, Colorado State University

Space Weather Atmospheric Reconfigurable Multiscale Experiment (SWARM-EX)
David Fitzpatrick, University of Colorado Boulder

In-situ CT scanning and analysis of Ceramic Matrix Composites (CMCs) by Deep Learning image Segmentation
Aly Badran, University of Colorado Boulder

Session 4: 2:00 – 3:00 pm

Session 4 Panel: Machine Learning in Aerospace Systems – *UMC Glenn Miller Ballroom*

Machine learning is playing an increasingly important role in aerospace applications. Automated systems including space robotics and UAVs require novel approaches to address their unique technological challenges. This panel will explore the future of these systems and the technologies that are being developed to meet the needs of highly automated systems.

Moderator: Dr. Nisar Ahmed: *Associate Professor (RECUV) University of Colorado Boulder*
Nisar Ahmed is an Associate Professor and H.J. Smead Faculty Fellow in the Smead Aerospace Engineering Sciences Department at the University of Colorado Boulder, and holds a courtesy appointment in the Computer Science Department. He is a member of the Research and Engineering Center for Unmanned Vehicles (RECUV) and directs the Cooperative Human-Robot Intelligence (COHRINT) Lab. He conducts research in modeling, estimation and control of intelligent autonomous systems, especially for problems involving human-robot interaction, distributed sensor and information fusion, and decision-making under uncertainty. He received his B.S. in Engineering from Cooper Union in 2006, and Ph.D. in Mechanical Engineering from Cornell University in 2012 through an NSF Graduate Research Fellowship. He was a postdoctoral research associate in the Cornell Autonomous Systems Lab from 2012 to 2014. He received the 2011 AIAA Guidance, Navigation, and Control Conference Best Paper Award; an ASEE Air Force Summer Faculty Fellowship in 2014; and the 2018 Aerospace Control and Guidance Systems Committee (ACGSC) Dave Ward Memorial Lecture Award. His work has been supported by the Army, Air Force, DARPA, Navy, NASA, Space Force, and multiple industry sponsors. He has also organized several international workshops and symposia on autonomous robotics, sensor fusion, and human-autonomy interaction. He is a Member of the IEEE and the AIAA Intelligent Systems Technical Committee and CU Co-Site Director of the NSF IUCRC Center for Unmanned Aerial Systems (C-UAS).

Panelists:

Dr. Jack Elston: *CEO/President and Co-Founder — Black Swift Technologies*
Dr. Jack Elston has been working on cutting edge applications for unmanned aircraft systems (UAS) for nearly 20 years, has hundreds of flight hours, and has been the technical lead for the development of several unique autopilot systems. Jack is also the CEO/President and co-founder of Black Swift Technologies, a company recognized for delivering reliable, robust, and highly accurate UAS capable of flying scientific, and by NASA to design a glider for observing the upper atmosphere of Venus.

Dr. Zachary Sunberg: *Assistant Professor — Ann and H.J. Smead Aerospace Engineering Sciences*
Zachary Sunberg is an Assistant Professor in the Ann and H.J. Smead Aerospace Engineering Sciences Department. He earned Bachelors and Masters degrees in Aerospace Engineering from Texas A&M University and a PhD in Aeronautics and Astronautics at Stanford University in the Stanford Intelligent Systems Lab. Before joining the University of Colorado faculty, he served as a postdoctoral scholar at the University of California, Berkeley in the Hybrid Systems Lab. His research is focused on decision making under uncertainty to enable safe and efficient autonomous vehicle operation with a recent emphasis on developing online algorithms for approximately solving partially observable Markov decision processes (POMDPs) with continuous or hybrid state, action, and observation spaces.

Courtney Mario: *Principal Member of the Technical Staff — Draper*
Courtney Mario is a Principal Member of the Technical Staff at Draper in the Perception and Autonomy Group. She has over 10 years of experience developing vision navigation systems for GPS-denied environments and is especially passionate about the challenge of developing robust solutions for fielded applications. She was a member of the Natural Feature Tracking team for OSIRIS-REx, which was the autonomous spacecraft navigation method used to collect an asteroid sample in October 2020. In that role, she provided image correlation expertise and led validation testing efforts across the navigation and science teams. She is currently leading the algorithm development for Draper's lunar precision landing capability. Prior work has included developing vision-inertial systems for GPS-denied applications for ground vehicles, UAVs, and pedestrians. She holds Bachelors and Masters degrees in Mechanical Engineering from Tufts University.

Dr. Nathan (Parrish) Ré: *Optimization and Machine Learning Lead — Advanced Space*
Dr. (Parrish) Ré is a subject matter expert in low-thrust trajectory optimization and has detailed experience in the application of this field. His PhD research leveraged neural network capabilities for operations in highly dynamic Earth-Moon three-body orbits for electric propulsion spacecraft. Dr. (Parrish) Ré completed his PhD at the University of Colorado Boulder in 2018 under Prof. Daniel Scheeres. His research was funded by a prestigious NASA Space Technology Research Fellowship (NSTRF) and by the Graduate Assistance in Areas of National Need (GAANN) Fellowship. Dr. (Parrish) Ré also holds an M.S. in Aerospace Engineering Sciences from the University of Colorado Boulder and a B.S. in Aerospace Engineering from California Polytechnic State University.

Session 4: 2:00 – 3:00 pm

Poster Presentations B: 1:00-3:00 pm – *UMC 415-417*
Vendor Showcase – *Aspen Conference Room 7:30-3:00pm*

Astrodynamics and Satellite Navigation Methods/Technology for Exploration – *UMC 247*
Chair: Dr. Penina Axelrad – Distinguished Professor University of Colorado Boulder

Orion's Use of Fine Trim Maneuvers for Rendezvous
Kyle Edson, Lockheed Martin

Development and Applications of the Physics-Informed Neural Network Gravity Model
John Martin, University of Colorado, Boulder

Application of Optical Lattice Based Inertial Sensors to Space Navigation
Margaret Rybak, University of Colorado, Boulder

Space Systems Technologies Presentations–*UMC 235*
Chair: Dr. Scott Palo – Professor University of Colorado Boulder, (RECUV)

Vulcan Centaur Development Status
Amanda Sterling, United Launch Alliance

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

Optical Crosslinks for Small Satellites
Ryan Kingsbury, Blue Cubed

Fluids, Structures and Materials (FSM) – *UMC 245*
Chair: Dr. Kenneth Jansen – Professor University of Colorado Boulder Director AMReC

Orion Reentry Venting: Anchoring Model with EFT-1 Data
Jeremiah Hall, Lockheed Martin Space

The Impact of Atmospheric Stability and Wake Turbulence on the Wind Turbine Blade Aerodynamics
Jaylon McGhee, University of Colorado Boulder

Low-Gravity Magnetohydrodynamics: Concept and Applications
Álvaro Romero-Calvo, University of Colorado Boulder

Mining Resources from Space – *UMC 380*
Chair: Dr. Angel Abbud-Madrid – Professor of Practice, ME Colorado School of Mines Director Space Resources Program

Moving Beyond Cislunar: A Path to our Post-Scarcity Future
John Reed, United Launch Alliance

Moon to Mars Oxygen and Steel Technology (MMOST)
Michael Riley, Pioneer Astronautics

SAMPLR: an Overview
Ben Thrift , Colorado School of Mines

Afternoon Feature Presentations: Human Spaceflight – *Glenn Miller Blrm 3:00 - 4:00 pm*

Chair: Dr. James Voss – Astronaut, Scholar in Residence University of Colorado Boulder

Architecting a Sustainable Lunar Infrastructure
Christine Edwards, Commercial Civil Space Deputy Exploration Architect Lockheed Martin

Autonomous Systems for Enhancing Human Performance and Vehicle Operations in Deep Space Habitats
Sophia Zaccarine, PhD Student University of Colorado at Boulder

Low Earth Orbit: The Future of Space
Dr. Janet, Kavandi, Astronaut, Executive Vice President Sierra Space

Closing Session: *4:00 pm – 4:45 pm* *Glenn Miller Ballroom*

Afternoon Keynote: Dr. Jeanne Atwell *VP, Chief Engineer — Ball Aerospace & Technologies Corp.*

Dr. Jeanne Atwell is the Vice President of Engineering at Ball Aerospace. In this role, Dr. Atwell engages across the company focusing on execution throughout the life cycle of Ball Aerospace programs, from proposal to final delivery. In her 20 years at Ball Aerospace, Dr. Atwell has served in widely diverse roles, including as a data scientist, systems engineer, technical manager and functional manager. She has supported programs in all phases of the program life cycle, from architecture studies to requirements development and post-delivery support, including serving as chief engineer on several programs and proposals. In addition, she directed the internally and externally-funded research and development portfolio for the National Defense business unit. Most recently, she served as the senior director of Advanced Mission Solutions, supporting the National Defense business unit. In this role, she oversaw programs and business development for critical national security space missions, including survivability and resiliency, advanced technology and missions and special programs. As a National Reconnaissance Office Technology Fellow in 2004, Dr. Atwell completed a government-sponsored research project focused on mission analysis. As part of her research, Dr. Atwell met with defense contractors around the world to learn firsthand how the aerospace industry serves the intelligence community. Dr. Atwell received a B.S. in mathematics from the University of North Carolina at Charlotte, a M.A. in mathematics from Oregon State University and a Ph.D. in applied mathematics from Virginia Polytechnic Institute and State University.

Closing Remarks: Alexandra Dukes — *AIAA-RM Chairperson*, *Lockheed Martin Space*

Thank You to Those Who Made ATS 2021 Possible:

Christopher Zeller—*RM-AIAA ATS Chair, Ball Aerospace*

Alan Ruth—*ATS Sponsor Dinner Coordinator, Ruth Precision*

Duncan Hills—*RM-AIAA Webmaster, Lockheed*

Dr. Taylor Lilly—*RM-AIAA Treasurer, Lockheed*

Gene Dionne—*RM-AIAA Member at Large*

Dr. Donna Gerren—*CU AIAA Student Advisor*

Dr. Lynanne George—*UCCS AIAA Student Advisor*

Kassadi Gabriel—*Event Coordinator CU Aerospace*

Claire Yang—*CU Aerospace Undergraduate Programs and Industry Relations Manager*

Thank you, to our 2021 Sponsors!

Diamond Sponsors

LOCKHEED MARTIN

SEAKR Engineering, Inc.

Ann and H.J. Smead Aerospace Engineering Sciences
UNIVERSITY OF COLORADO BOULDER

Platinum Sponsors

Advanced SPACE
Delivering Innovation to Orbit™

COLORADO
Office of Economic Development & International Trade

Ball

Astroscale
Secure long-term spaceflight safety

SIERRA SPACE

ULA
United Launch Alliance

Gold Sponsors

Black Swift TECHNOLOGIES

Red Canyon Engineering & Software

Glenair

APHELION AEROSPACE

KAYHAN SPACE
MAKING SPACEFLIGHT SAFER

PADT

SAS
WHO DREAMS WINS

Sponsor Partners

CSBR
COLORADO
space business roundtable

STUDIO SE

EyasSat, LLC
The Classroom Satellite

UAS COLORADO
UNMANNED AIRCRAFT SYSTEMS