DISTINGUISHED SPEAKER SERIES

2023-2024

AIAA
SHAPING THE FUTURE OF AEROSPACE

Table of Contents

Distinguished Speaker Series Introduction and FAQs

What is the Distinguished Speaker Series?
The Distinguished Speaker Series offers AIAA Professional Sections and Student Branches the opportunity to select a speaker from a prescreened AIAA list. The speakers are considered experts on a specific topic, and oftentimes have won national awards. Since 1969 this program has been a resource for section and student branch officers to provide an expert in a particular area of interest to their members.

When is the Distinguished Speaker Series available?
The program runs all year. Speakers are updated in the listing in the fall.

Is this program in person or virtual?
The program is virtual only. However, if a section or branch wishes to host the speaker in-person, it is the responsibility of the section or branch to coordinate the logistics of the event and work directly with the speaker on a travel reimbursement arrangement.

What online platform does AIAA recommend for this program?
AIAA recommends using Zoom to host these speaking engagements, as it is a preferred vendor of AIAA. However, platforms like Microsoft Teams, Webex, and other platforms are fine to use, as long as it works for the speaker.

Does my section/student branch need to fund the speaker?
Virtual speaking events do not require funding. If a section or branch chooses to host an in-person speaking engagements, sections/student branches will need to fund the speakers' travel expenses.

How many speakers can my section/student branch host from this program?
There is no limit.

What is the process for requesting a speaker through this program?

1. The section or student branch contacts the speaker they would like to invite, and they agree upon a date and time for the event, and whether it will be in person or virtual.
2. The section or student branch must then obtain authorization from AIAA Staff before the speaker is confirmed. For authorization, email Lindsay Mitchell at lindsaym@aiaa.org.
3. After approval is secured from AIAA, the section or student branch may confirm the speaker's invitation and schedule the meeting details. You may refer to the "Virtual Event Guidelines" on Page 4 to help you set up your virtual meeting.
4. Provide all event details and coordinate directly with the speaker.
5. Following the event, sections/student branches must provide a summary of the event to Lindsay Mitchell and include information on number of attendees, how the presentation went, and any concerns, or technical difficulties that occurred.

Virtual Event Guidelines

Any online platform the speaker is comfortable with may be used. However, AIAA recommends using Zoom to host the events. If you have not used Zoom, you can find tutorials and tips at the Zoom Help Center. AIAA will also share the promotion of your virtual events to AIAA members so the program can receive maximum visibility.

Below are some guidelines to keep in mind for your virtual Distinguished Speaker events.

Before Your Meeting

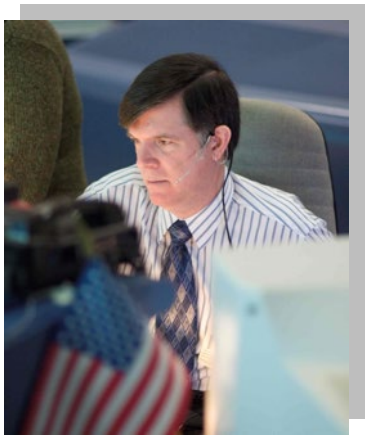
- AIAA recommends using a Zoom "meeting" versus a "webinar" to make the event more interactive.
- We encourage you to record the meeting so that your section or student branch has a record and if you want to share with members following the event.
- Once you have scheduled the Zoom meeting with the speaker, please notify Lindsay Mitchell at lindsaym@aiaa.org with details and the completed and signed speaker release form.
- AIAA encourages you to post the event on Engage. However, do not post the Zoom URL, as this can be a security risk. Only share the link with those that RSVP or request the link. You can do this by creating an event on Engage and selecting "Free event/Meeting including ability to RSVP but no payment" where people can RSVP to the event. Once individuals RSVP, you may provide them with the link.
- Check with the speaker to see if they plan on using slides or visuals as part of their presentation and be sure to collect them ahead of the meeting or allow them to screenshare during the event.
- Establish who from your section/student branch will be the "Host" of the meeting and introduce the speaker. Additionally, designate someone to be the "Cohost" of the meeting to monitor activity on Zoom in case there is anything inappropriate that occurs.
- The maximum capacity for a Zoom meeting is 500 participants. Once your meeting reaches 500, no more participants will be allowed to enter the meeting.

During Your Meeting

- When the meeting begins, designate the speaker and the individual who is monitoring participant activity as a "Co-Host."
- Begin the event a minute or two past the start time to allow participants to log into the meeting.
- Before recording the meeting, please let participants know you are recording and that it will be shared with AIAA.
- At the beginning of the meeting, the moderator should set expectations of the event format and to remind participants to save Q&A until the end. This is to prevent participants from interrupting the speaker or talking over one another. Participants may ask questions using the "Raise Hand" feature or in the Chat.
- The "Host" should use "screenshare" if the speaker has slides or a visual presentation.
- Lock the meeting 10-15 minutes after it begins.

After Your Meeting

- Send a note to your speaker thanking them for their presentation and any positive feedback from attendees.
- Contact Lindsay Mitchell at lindsaym@aiaa.org with the link to the recording (if applicable) and any feedback received from participants or the speaker. AIAA will use the recording and your feedback for archival purposes.



DANIEL R. ADAMO

Email: adamod@earthlink.net

Biography:
Daniel Adamo is an astrodynamics consultant focused on space mission trajectory design, operations, and architecture. He works with clients primarily at NASA and in academia.

Until retirement in 2008, Mr. Adamo was employed by United Space Alliance as a trajectory expert, serving as a "front room" flight controller for 60 Space Shuttle missions. Along with console duties during simulations and missions, this job entailed development of trajectory designs, software tools, flight rules, console procedures, and operations concepts. Mr. Adamo began his career at the Perkin-Elmer Corporation where he developed and operated proof-of-concept software for computer-controlled polishing of optical elements. He has degrees in Physical Sciences and Optical Engineering from the University of Houston and the University of Rochester, respectively.

Mr. Adamo is an AIAA Associate Fellow and the author of many publications (ref. http://www.aiaahouston.org/adamo_astrodynamics/). He has received numerous awards, including 14 NASA Group Achievement Awards.

Abstract: "Interplanetary Cruising with Earth-To-Mars Transit Examples"
This 1.5-hour lecture introduces the fundamentals of orbit motion and applies them to designing a realistic Mars mission by solving the *Lambert boundary value problem* for sun-centered trajectories. The *patched conic* technique is then applied to a sun-centered transit from Earth to Mars, producing geometric constraints on Earth departure as an example. Summarizing this process, the fundamental design trade between minimal time-of-flight and minimal propulsion is made apparent for missions to the moon, near-Earth asteroids, and Mars. By listening to this lecture, anyone with an understanding of high school physics will become familiar with the challenges of interplanetary spaceflight, particularly when human factors are considered.

Abstract: "*Aquarius*, a Reusable Water-Based Interplanetary Human Spaceflight Transport"
This 1.5-hour lecture reviews major challenges to interplanetary human spaceflight and suggests strategies by which they may be addressed. These strategies include pre-emplaced Earth return consumables at the interplanetary destination, water used as a high-efficiency/high-thrust propellant also serving as crew radiation shielding, and transport servicing in a distant retrograde orbit about the moon. Applied to a hypothetical transport christened *Aquarius*, the strategies are shown to enable routine and sustainable roundtrips between Earth and Deimos, the outer moon of Mars. Knowledge gaps pertaining to *Aquarius* are identified with the intent of motivating changes in current technology roadmaps. After listening to this lecture, anyone with interplanetary human spaceflight interests will be conversant with associated technology issues and plausible means by which they might be resolved.

Abstract: "Questioning the Surface of Mars as the 21st Century's Ultimate Pioneering Destination in Space"
This 1.5-hour lecture reviews historic earthly distinctions between exploring and pioneering before applying these distinctions to destinations in space. Although a case can be made for human and robotic *exploration* in space, there is as yet no compelling rationale for "putting down roots" to *pioneer* anywhere off Earth. Why then is the surface of Mars widely accepted as humanity's future "home away from home" to the extent some 200,000 people are willing to attempt forming a permanent colony there? There is no evidence suggesting humans can survive on the surface of Mars long-term,

let alone thrive there to produce viable offspring. A variety of evidence is presented to affirm the surface of Mars is a sociocultural destination whose suitability for human pioneering is based on more than a century of fictional literature and poorly informed research as the Space Age dawned. More current knowledge of the "unexplored country" in our Solar System suggests small bodies such as asteroids and the moons of Mars are humanity's best hope for pioneering off Earth this century.

Abstract: "Potential Propellant Depot Locations for Beyond Low Earth Orbit (LEO) Human Transport"

This 1.5-hour lecture first presents historic examples of transportation depots, including a propellant depot currently operating in LEO. Operational and geometric insights governing the utility of LEO depots are then developed for cislunar and interplanetary destinations. These insights lead to the assertion that a depot located near the end destination supports the most efficient human transport operations, particularly if relevant resources are available locally. Depot logistics provided by launch vehicles with contrasting lift capabilities are explored and found to produce different architectural challenges. Less capable launch vehicles tend to face challenges in space-based operations, while more capable launch vehicles tend to face challenges in ground-based operations.

Abstract: "Forty Years on the Bleeding Edge of Technology from an Aerospace Engineer's Perspective"

How did a kid living amid New Hampshire farm fields progress to serve on console in Houston's Mission Control during 60 Space Shuttle missions? This 1.5-hour autobiographic lecture follows an aerospace career from its roots in the 1970s to present-day freelance consulting on space exploration missions and architectures. Along the way, key lessons learned are debriefed with regard to developing, operating, and managing aerospace systems. The lecture concludes with experience-based advice on starting an aerospace career.

Abstract: "Exploring the Solar System Through Low-Latency Telepresence (LLT)"

Why would it make sense to send humans more than 99% of the way to an off-Earth exploration destination like Mars without putting "boots on the ground"? How can average speeds achieved by robotic Mars rovers, typically a leisurely 0.4 meters per hour, be dramatically increased? This 1.5-hour lecture will answer these questions by suggesting humans operate in synergy with nearby robotic systems as a game-changing space exploration strategy. When command/feedback delays between human explorers and their robotic proxies are reduced sufficiently, today's user interface technology can impart multi-sensory impressions of "being there," a state of cognizance called low-latency telepresence (LLT). Using LLT-based strategies, impressive exploration productivity gains are realizable, together with reduced programmatic cost and risk, when compared to more conventional exploration strategies based on the Apollo Program circa 1970. These benefits accrue regardless of whether humans orbit above or loiter on/beneath a nearby exploration region.

Vanessa V. Aubuchon

Email: vanessa.v.aubuchon@nasa.gov

Biography:
Vanessa Aubuchon has conducted research, guided development activities, and managed various aspects of projects and programs at NASA for over 18 years. She has an unfettered vigor for learning and development, solving problems, and improving processes. Thus, her career has been filled with experiences spanning space exploration to aviation, in multiple NASA organizations, including headquarters, in positions of researcher, project manager, systems engineer, and branch head. Currently, she manages the Revolutionary Aviation Mobility Sub-Project in the Transformational Tools and Technologies Project.

Ms. Aubuchon holds a Bachelor's degree from Mississippi State University and a Master's degree from Virginia Tech. She is pursuing a Ph.D. in Engineering Management from Old Dominion University. She has been the recipient of the AIAA Hampton Roads Section Mitcheltree Young Engineer of the Year Award, Orion Exceptional Contribution Award, NESC, and NASA Group Achievement Awards, and multiple NASA Team Awards.

She serves as honorary president of the Peninsula Engineers Council, AIAA HRS Council Member, and AIAA Region I Deputy Director for Career and Professional Development, among several other roles on boards and committees. Ms. Aubuchon is also a mother of two young boys and enjoys volunteering as judge and queuer at annual FIRST Robotics Competitions and various other local STEM events.

Abstract: "The Next Aeronautics Revolution"
Imagine going home from work in a pilotless aircraft that takes off vertically from a building rooftop and transitions to forward flight to carry you out of the city to a landing pad in the suburbs. When you get home, you're too tired to cook dinner, so you order your favorite Thai food from a restaurant three miles away and it lands in your driveway fresh and hot. Later that night, you get a stomachache and order some antacids from the pharmacy down the street, which is delivered via a drone to your home in a matter of minutes. Can you imagine a world of convenience and efficiency that is enabled by ubiquitous, autonomous air transportation? We are in the middle of an aeronautics revolution right now, where those scenarios are becoming a reality. This talk will discuss the "Third Wave of Aeronautics," which is bringing aviation to people's daily lives. NASA, alongside industry and the FAA, is developing the technologies and safety standards to enable faster local commutes, widespread package delivery, cost-effective cargo transportation to rural areas, and more routine connections between regional airports. Advanced Air Mobility targets safe, sustainable, affordable, and accessible aviation that will transform the world's transportation systems. Current manufacturer progress, new enabling technologies, and challenges to realizing this new paradigm will be described.

TODD BARBER

Email: toddjbarber@yahoo.com

Biography:
Todd Barber is a JPL senior propulsion engineer, spending two decades as lead propulsion engineer on the Cassini mission to Saturn, following part-time work on the Mars Exploration Rover (MER) mission, Deep Impact mission, and the Mars Science Laboratory (MSL) mission, which landed the large rover Curiosity on the red planet on August 5, 2012. Cassini was launched on October 15, 1997, on its two-billion-mile, seven-year journey to the ringed planet. It “took the plunge” into Saturn’s atmosphere in 2017 after thirteen years in orbit around Saturn. The MER team launched twin rovers to the red planet in June and July of 2003, and Spirit and Opportunity lasted six years and fourteen years, respectively, into their three-month missions. Todd also worked as the lead impactor propulsion engineer on Deep Impact, which successfully crashed into Comet Tempel-1 on July 4, 2005, at 23,000 miles per hour. Mr. Barber recently completed working on the Dawn mission, an ion propulsion mission to the two largest main-belt asteroids, Vesta and Ceres. He also recently began supporting the Soil Moisture Active Passive (SMAP) mission and was the Mars2020 propulsion lead engineer for operations. Much to his delight, he is now supporting the Voyager mission as well, more than 40 years after its launch.

Mr. Barber worked on the Galileo project for over seven years and his primary responsibility was getting Galileo into Jupiter orbit on December 7, 1995. Todd also worked part-time on the Space Infra-Red Telescope Facility (SIRTF) mission and on the Stardust mission, as well as the Mars Sample Return mission and a Mars airplane study. Mr. Barber received NASA's Exceptional Achievement Award in 1996 for his work on Galileo. In 2018, he was also honored to receive NASA’s Exceptional Public Service Medal for heading up Cassini’s propulsion team for nearly two decades.

Mr. Barber is a native of Wichita, Kansas, and attended MIT between 1984 and 1990, obtaining B.S. and M.S. degrees in aerospace engineering, with a humanities concentration in music. He is also a composer of church choral music, with two pieces published to date. His hobbies include singing charitably and professionally, playing the piano, snagging degree confluences (exact integer latitude/longitude intersections), visiting all the U.S. tri-state corners and national parks, playing basketball (though it’s been a while), and amateur astronomy.

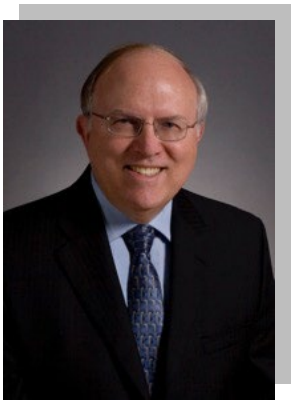
Abstract: “Red Rover, Red Rover, Send Curiosity Right Over”
Curiosity's mission to the red planet will be covered in detail. Topics to be discussed include a bit on the history of Mars rovers at JPL, the scientific motivation for Curiosity, and the preparations for launch two days after Thanksgiving 2011. The science suite on board this one-ton mega rover will be presented, as well as the engineering challenges involved in getting Curiosity to the launch pad, traveling 352 million miles to Mars over 8.5 months, and “sticking the landing” following the so-called “seven minutes of terror” on 5 August 2012. Early mission science results will be presented as well, followed by pop-culture reaction to the rover landing.

Abstract: “Lord of the Rings: Cassini Mission to Saturn”
Cassini’s mission to the ringed planet will be covered in detail. Topics covered include the Cassini spacecraft design, trajectory to Saturn, cruise science results, Saturn Orbit Insertion, and science results from the four-year prime mission. Discussions of the two-year extended mission (the Cassini Equinox Mission) and seven-year doubly extended mission (the Cassini Solstice Mission) will be covered as well. Images and videos highlighting Cassini results at Saturn will be presented, covering

Cassini’s five co-equal science objectives of understanding Saturn’s rings, magnetosphere, icy satellites, large moon Titan, and Saturn itself.

Abstract: “Voyager 1 & 2: Humanity's Most Distant Explorers”
The Voyager mission to the outer planets and interstellar space will be discussed in detail. Topics to be discussed include the incredible opportunity for a "grand tour" of the outer planets only encountered every 176 years and some true "postcards from the edge" at Jupiter, Saturn, Uranus, and Neptune. The interstellar mission and current status will also be highlighted as well, particularly the challenges of flying two geriatric spacecraft with a tiny flight team. Finally, the future of the mission and the Voyager Golden Record will be featured in some detail as well.

Abstract: “Putting the ‘P’ in ‘JPL’: The Past, Present, and Future of Propulsion at NASA Jet Propulsion Laboratory”
From modest beginnings in the era of early liquid rockets through state-of-the-art propulsion systems flown on 21st-century spacecraft, propulsion technologies have advanced dramatically through the decades. Over three quarters of a century of propulsion experience at NASA Jet Propulsion Laboratory will be discussed chronologically, including innovative practices in solid and liquid propulsion now considered the status quo. These propulsion advancements will be discussed in the context of early JPL propulsion history before NASA formed in 1958, along with a myriad of robotic lunar and planetary missions since the 1960s.



PAUL BEVILAQUA

Email: pbevilaqua@sbcglobal.net

Biography:

Paul Bevilaqua has spent much of his career developing Vertical Take Off and Landing aircraft. He joined Lockheed Martin as Chief Aeronautical Scientist and became Chief Engineer of the Skunk Works, where he played a leading role in creating the Joint Strike Fighter. He invented the dual cycle propulsion system that made it possible to build a stealthy supersonic VSTOL Strike Fighter, and suggested that conventional and naval variants of this aircraft could be developed to create a common, affordable aircraft for all three services. He subsequently led the engineering team that demonstrated the feasibility of building this aircraft.

Prior to joining Lockheed Martin, Dr. Bevilaqua was Manager of Advanced Programs at Rockwell International's Navy aircraft plant, where he led the design of VSTOL interceptor and transport aircraft. He began his career as an Air Force officer at Wright-Patterson AFB, where he developed a lift system for an Air Force VSTOL Search and Rescue Aircraft. He received degrees in Aeronautical Engineering from the University of Notre Dame and Purdue University.

He is an AIAA Fellow of and a member of the National Academy of Engineering. He is also the recipient of a USAF Scientific Achievement Award, AIAA and SAE Aircraft Design Awards, AIAA and AHS VSTOL Awards, and Lockheed Martin AeroStar and Nova Awards.

Abstract: "Inventing the Joint Strike Fighter"

This presentation will describe the technical and program challenges involved in developing the F-35 Joint Strike Fighter and show how an innovative idea became an international program with engineers from half a dozen countries developing a single replacement aircraft for multiple aircraft types. The F-35 Joint Strike Fighter was developed to meet the multirole fighter requirements of the U.S. Air Force, Navy, Marine Corps, and our allies. The Air Force variant is a supersonic, single engine stealth fighter. The Navy variant has a larger wing and more robust structure in order to operate from aircraft carriers, while the Marine Corps variant incorporates an innovative propulsion system that can be switched from a turbofan cycle to a turbo shaft cycle for vertical takeoff and landing. This propulsion system enabled the X-35 to become the first aircraft in history to fly at supersonic speeds, hover, and land vertically. The development team won the Collier Trophy, which recognizes "the greatest achievement in aeronautics or astronautics in America" each year, for this accomplishment.

NAYANAPRIYA BOHIDAR

Email: Bohidar.Nayan@aurora.aero

Biography:
Nayanapriya Bohidar is a research engineer and manager of the Propulsion engineering team at Aurora Flight Sciences. Joining Aurora Flight Sciences in 2018, she provides functional and technical leadership to the 10 direct reports of her Propulsion team while also supporting critical-path program roles on several advanced development programs involving powertrain architecture optimization.

Ms. Bohidar co-led the capture of the NASA EPFD program, providing programmatic and hybrid-electric propulsion architecting. On the DARPA CRANE X-plane she supported engine integration and preliminary design trades for a novel application. She was the Mechanical Systems Lead on Boeing PAV, providing technical and programmatic leadership, value proposition, conceptual design trades, and rotor development and testing, as well as developing the path to certification for the eVTOL air taxi. Ms. Bohidar has been a technical contributor in leadership roles on the Future of Flight advanced development program, such as the Boeing TTBW and NASA D8 programs. She participates in the shaping and capturing of programs during proposal phases. Most recently, she is focused on technology roadmapping through strategic engineering, systems thinking, and multidisciplinary design optimization.

Prior to joining Aurora, Ms. Bohidar had nine years of experience with Rockwell Collins and Honeywell in R&D and New Product Development teams. She holds a degree in Aeronautical and Astronautical Engineering from Purdue University, as well as in Honors Physics from Delhi University. She has been active in AIAA forums and events since 2017. She is an advocate of Diversity & Inclusion and passionate about STEM outreach, including working with SAE and SWE for over a decade.

Abstract: "Sustainability and Technology Roadmapping"
Sustainability initiatives are currently at the forefront of aviation, with the goal to reduce the industry's contribution to climate change through new practices and radical innovation. This presentation will start by introducing industry goals and the diverse technologies that will get us there. A few public initiatives will be discussed, such as highly efficient aircraft designs and energy-optimized flight operations, with a focus on novel propulsion systems. Using examples from the speaker's own 12+-year career in Propulsion R&D across the areas of academic research, power generation, automotive, motorsports and aerospace, attendees will get an overview of the career opportunities in this field, as well as the holistic approach needed to solve the challenges ahead of us. At the discretion of the organizers, specific future concepts can be focused on as the speaker serves on the business development team at Aurora Flight Sciences.

Abstract: "Building a Career Through Uncertainty"
Building a career in aerospace and aviation requires a lot of skills beyond just technical acumen, including a multitude of factors outside of one's control. Attendees of this interactive presentation will learn how to identify the roles they want and target the specific skills they need. The speaker will discuss how to identify opportunities for growth and build your brand. The talk will particularly focus on non-traditional routes with examples of the speaker's own 12+-year career as an immigrant and

non-U.S. citizen, and her professional journey across the areas of academic research, power generation, automotive, motorsports, and aerospace.

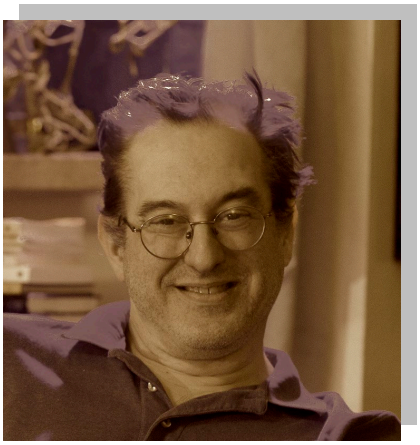
ALICE BOWMAN

Email: Alice.Bowman@jhuapl.edu

Biography:
Alice Bowman is a member of the Principal Professional Staff at the Johns Hopkins Applied Physics Laboratory (APL) in Laurel, Maryland. She is the Space Mission Operations Group supervisor and the NASA New Horizons Mission Operations Manager (MOM). She supervises approximately 50 staff members who operate deep space and Earth-orbiting spacecraft, including NASA's TIMED, STEREO, New Horizons, and Parker Solar Probe. As the New Horizons MOM, Ms. Bowman leads the team that controls the spacecraft that made a historic flyby of the Pluto system in July 2015. And on New Year's 2019, just after midnight, New Horizons made history again with a flight past the Kuiper Belt object Arrokoth – the most distant flyby ever conducted, 4 billion miles from Earth. Prior to operating spacecraft, she worked in the fields of computer modeling, drug research, and long-wave detector research.

Ms. Bowman has a degree in chemistry and physics from the University of Virginia and has more than 30 years of experience in space operations. She is an AIAA Associate Fellow and has served on the International SpaceOps Committee since 2009.

Abstract: "New Horizons: NASA's Mission to Pluto & the Kuiper Belt"
This presentation will give an overview of NASA's historic mission to Pluto and the Kuiper Belt– which culminated with the first flight past the distant dwarf planet on 14 July 2015 and the first encounter with a Kuiper Belt object (KBO) on 1 January 2019. This continuing journey will be discussed through the eyes of the APL mission operations team and some of the technical, scientific, and personal challenges of piloting the New Horizons spacecraft across the solar system on its voyage to the farthest reaches of the planetary frontier will be described.



JIM CAVERA

Email: j_cavera@yahoo.com

Biography:
Jim Cavera is a senior engineer with Blue Origin. He has undergraduate degrees in optical engineering and physics, and his graduate work was in nuclear engineering and aerospace engineering, during which he explored the use of dense plasma focus devices for interstellar travel. He has served for many years on AIAA's Nuclear and Future Flight Technical Committee and is currently its vice chair. His current research is in neutronics and MHD codes for fusion device simulation.

Abstract: "Future Propulsion: Nuclear Fission, Fusion, and Beyond"
Nuclear propulsion promises performance many orders of magnitude better than chemical propulsion. Chemical propulsion can give us the moon, but nuclear propulsion can give us the solar system and even the stars. In this talk, the theoretical underpinnings of nuclear propulsion, the historical experiments, and the prospects for the future will be discussed. At the discretion of the organizers, fission, fusion, or other future concepts can be focused on.

MICHELLE EVANS

Email: mach25@sbcglobal.net or x15gal@gmail.com

Biography:
Michelle Evans is the founder and president of Mach 25 Media (www.Mach25Media.com) and is a writer, photographer, and communications specialist in aerospace. She has written the book *The X-15 Rocket Plane, Flying the First Wings into Space,* published by the University of Nebraska Press in 2013 as part of their *Outward Odyssey, People's History of Spaceflight* series.

Ms. Evans has written articles that have appeared in numerous publications, including *Air & Space Smithsonian*, *Ad Astra*, and *The New York Times*. She has had feature stories about her life in both *Time* and *Newsweek* magazines. Michelle was a technical consultant on the Neil Armstrong biopic "First Man," and has consulted with National Geographic television for the documentary "The Real Right Stuff."

Abstract: "The X-15 Rocket Plane: Flying the First Wings into Space"
With the Soviet Union's launch of the first Sputnik satellite in 1957, the Cold War soared to new heights as Americans feared losing the race into space. This presentation tells the enthralling yet little-known story of the hypersonic X-15, the winged rocket ship that met this challenge and opened the way into human-controlled spaceflight.

This remarkable research aircraft held the world's altitude record for 41 years, and still has no equal to match or better its speed of more than 4,500 mph. Beyond the X-15 are the stories of the 12 men who guided it into space, and all the people who kept the rocket plane flying for nearly a decade. This is the story that has never been told of the vehicle that was the true precursor to the Space Shuttle by being the first piloted and winged vehicle to exit Earth's atmosphere, and make a controlled reentry to a landing on hard-packed dry desert lakebeds.

In her research, Ms. Evans interviewed nearly 70 people, including 9 of the 12 pilots, including Neil Armstrong, Scott Crossfield, and Robert White, with family representatives for the remaining pilots. Others she spoke with include managers, flight planners, and the technicians and engineers who made the X-15 ready to fly its next research mission at high altitude and high Mach. With this extensive background, her talk focuses on the human side of the story that made the X-15 the most recognized research aircraft to ever take to the skies.

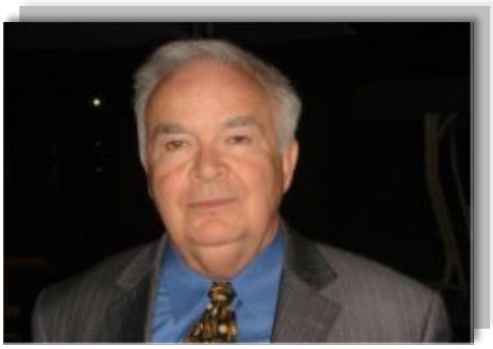
Abstract: "In the Line of Duty: Michael Adams and the X-15"
The X-15 rocket plane was America's premier research X-plane. It became the first aircraft to reach hypersonic velocities, and to create a new class of astronauts, ones who flew wings into space rather than rockets. The twelfth and final of these pilot/astronauts was Major Michael Adams from the U.S. Air Force.

As soon as the first group of American astronauts was announced in 1959, Adams knew where his career would take him. He was twice forestalled in his attempts to reach space. First by losing a slot in the second group of American astronauts because of injuries sustained in an F-104 ejection, then by being chosen for the Air Force's Manned Orbiting Laboratory, which was canceled when politics entered the fray.

Adams saw the X-15 as his new pathway to space, and was quickly accepted into that elite group, which included such legendary test pilots as Scott Crossfield, Robert White, and Neil Armstrong. Mike Adams was the only X-15 pilot to lose his life while flying the program. Because of this, few people

know of him today.

Michelle Evans' research for her book, *The X-15 Rocket Plane, Flying the First Wings into Space* led her to interview nearly 70 people connected to the program, including Adams' wife, children, brother, and friends. Her unique perspective has been able to honor Major Michael J. Adams, and to bring him to life as one of the X-15 astronauts in her fascinating presentation.



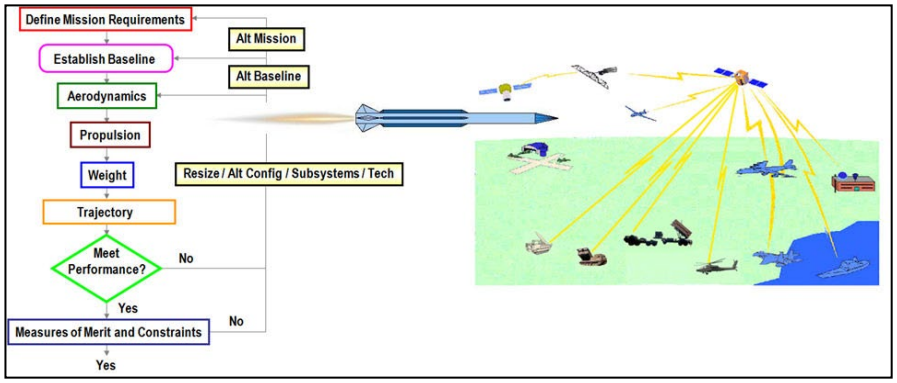
EUGENE L. FLEEMAN

E-mail: GeneFleeman@msn.com
Website: https://sites.google.com/site/eugenefleeman/home

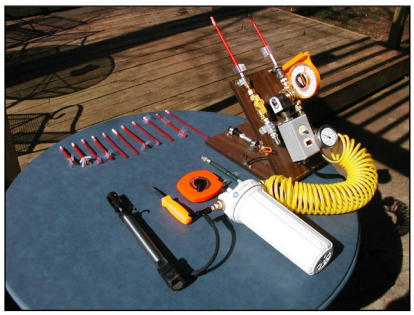
Biography: Eugene Fleeman has 50+ years of government, industry, academia, and consulting experience in the design, development, and system engineering of missile systems. Formerly a manager of missile programs at the U.S. Air Force Research Laboratory, Rockwell International, Boeing, and Georgia Tech, he is an international lecturer on missiles and the author of 200+ publications, including the AIAA textbook *Missile Design and System Engineering*. His textbooks and short courses on Missile Design, Development, and System Engineering emphasize physics-based prediction methods, for enhanced insight, speed, and accuracy to the conceptual design process. He has taught 100 short courses that have been held in 15 countries and five continents.
Mr. Fleeman is an AIAA Associate Fellow, an AIAA Distinguished Speaker, an AIAA short course instructor, and a former chair of the AIAA Missile Systems Technical Committee.

Abstract: "Overview of Missile Design, Development, and System Engineering"

This one-hour presentation addresses the fundamentals of missile design, development, and system engineering. It is oriented toward AIAA luncheon and dinner meetings. Included is a discussion of the broad range of alternatives in satisfying missile cost, performance, and risk requirements. The methods presented are generally simple closed-form analytical expressions that are physics-based, to provide conceptual design insight into the conceptual design primary driving parameters. Typical values of missile parameters and the characteristics of current operational missiles are discussed, as well as the enabling subsystems and technologies for missiles and the current/projected state of the art. Videos illustrate missile development activities and performance.



Abstract: "My Career in Aerospace Engineering and a Soda Straw Rocket Science Design, Build, and Fly Competition"



This two-part presentation consists of a summary of my career in aerospace engineering, followed by a soda straw rocket design, build, and fly competition. It is oriented toward AIAA Student Branches and AIAA STEM outreach.
The presentation begins with examples of my 50+ years of work experience as a government aerospace engineer, industry aerospace program manager, university teacher of aerospace engineering, author of aerospace engineering textbooks, short course instructor in aerospace engineering, and STEM educator in aerospace engineering.

The Soda Straw Rocket Science Design, Build, and Flight Competition is an aerospace engineering project to demonstrate the physics of flight using small air rockets. Each attendee will design, build, and fly a small air-powered rocket. The competition provides an appreciation of the impact of design

parameters such as weight, length, center-of-gravity, nose geometry, surface geometry, chamber pressure, and launch angle on the flight range and dispersal. Students are introduced to the physics of thrust, total impulse, boost velocity, drag, flight stability, and flight trajectory. These can be predicted with the physics-based methods of the AIAA textbook *Missile Design and System Engineering*. The lecture requires about 60-to-90 minutes of time, depending upon the size of the class.

Walter Gordon

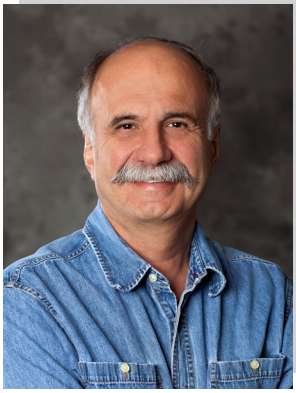
Email: c130h3driver@gmail.com

Biography:
Walter Gordon worked as an engineer in Western New York from 1979 to 2020 at four different aerospace firms, retiring recently as a business development manager in the Moog Space and Defense Group. He is also retired from a parallel 30-year career in the Air Force Reserve, serving as commander of the 328th Airlift Squadron and 914th Airlift Wing in Niagara Falls, New York. He is a veteran of Operations Desert Storm and Iraqi Freedom and has over 2,000 hours flying time in the C-130.

Mr. Gordon has a long time interest in aerospace and aerospace history, joining AIAA at age 17 and currently serving as chairman of the Niagara Frontier Section and deputy chair of the History Committee. He is also the chairman of the Niagara Frontier Aviation and Space Hall of Fame nominating committee and a past president of the Niagara Aerospace Museum and Aero Club of Buffalo. Mr. Gordon has B.S. and M.S. degrees in Aerospace Engineering from the University at Buffalo and an M.S. in Strategic Studies from the U.S. Air Force Air War College.

Abstract: "Once There Was an Arrow"
Avro Canada completed and flew five prototypes of the CF-105 Arrow supersonic interceptor before the program was terminated by Prime Minister John Diefenbaker on February 20, 1959. Known ever since as Black Friday, on that day over 14,000 employees lost their jobs and the Canadian aerospace industry changed forever, never again to produce a state-of-the-art military aircraft. One of the most advanced fighter aircraft in the world at the time, the Arrow was an almost inconceivable achievement by a company that only 13 years earlier was manufacturing Lancaster bombers under license during World War II. To this day an aura of conspiracy surrounds the demise of the aircraft, fostered by the Canadian government's subsequent order that all completed and partially completed Arrows be cut up and sold for scrap. This talk will discuss the development of the Arrow from the genesis of Avro Canada during World War II to the political and military pressures that led to its cancellation.

Abstract: "Project Gemini: Unsung Hero of Neil Armstrong's One Small Step"
Think of Project Mercury and what comes to mind? Alan Shepard, the first American in space, and John Glenn, the first to orbit the Earth. Probably *The Right Stuff*. How about the Apollo program? Apollo 11, of course. Neil Armstrong. "One small step for a man…" Apollo 13. "Houston, we've had a problem." But how about Project Gemini, the U.S. space program between Mercury and Apollo? When did it take place? Who flew on Gemini and what did it accomplish? In fact, 10 of the 12 men that eventually walked on the moon during Apollo flew Gemini first, and the other two were Gemini backup crew. Even though its first launch was only three years after John Glenn's five-hour orbital flight in Friendship 7, Project Gemini demonstrated technologies and techniques critical to the Apollo program and was key to fulfilling President Kennedy's pledge, "…before this decade is out, of landing a man on the moon and returning him safely to the Earth." This talk will discuss the ten Gemini missions from March 1965 to November 1966 and how they paved the way for Apollo



MIKE GRUNTMAN

Email: mikeg@usc.edu
Website: astronauticsnow.com

Biography:

Mike Gruntman is professor and chair of astronautics at the University of Southern California (USC). His life journey took him from a child growing on the Tyuratam (Baikonur) missile and space launch base during the late 1950s and early 1960s to an accomplished space physicist and engineer to joining USC in 1990 and founding a major educational program in space engineering. Today it is a nationally recognized unique astronautical engineering department at USC.

Dr. Gruntman is actively involved in R&D programs in space science and space technology. He served as a co-investigator (Co-I) on NASA missions and is a recipient of three NASA Group Achievement Awards. He has authored and co-authored 300 scholarly publications, including four books. His *Blazing the Trail: The Early History of Spacecraft and Rocketry* (AIAA, 2004) won the International Academy of Astronautics book award. More than two thousand graduate students have taken Dr. Gruntman's courses in space systems and rocket propulsion at USC. He also teaches short courses (AIAA and ATI) for government and industry.

Dr. Gruntman is an AIAA Associate Fellow and Member (Academician) of the International Academy of Astronautics.

Abstract: "The Road to Space: The First Thousand Years"
This 70-80 minute lecture presents the fascinating history of early rocketry and subsequent developments that led to the space age. It introduces visionaries, scientists, engineers, and political and military leaders from various lands who contributed to this endeavor. The development of rocketry and spaceflight is traced from ancient times through many centuries to the breakthrough to space. The story concludes with the launches of first artificial satellites in the late 1950s. Based on an award-winning AIAA-published book.

Abstract: "Intercept 1961: From Air Defense SA-1 to the Birth of Soviet Missile Defense"
This 70-80 min lecture focuses on Soviet strategic missile defense. On 4 March 1961, a guided missile intercepted and destroyed the approaching warhead of an intermediate range ballistic missile (IRBM) SS-4 at the Saryshagan test site in the Kazakhstan desert. This event led to the emergence of a powerful political, military, scientific-technological, and industrial missile defense complex in the Soviet Union, a major factor in shaping U.S. defense programs and technologies during the Cold War. A new chapter in the eternal competition between protecting and avenging, between the sword and the shield, has begun. The lecture tells a little-known story, based on an AIAA-published book, of the first Soviet antiaircraft system SA-1 and the first intercept of an IRBM, leading to the birth of Soviet missile defense and deployment of the first operational missile defense system A-35.

NAHUM MELAMED

Email: nahum.melamed@aero.org

Biography:
Nahum Melamed is a project leader in the Embedded Control Systems Department in the Guidance and Control Subdivision at The Aerospace Corporation. He joined Aerospace in 2003. As a technical lead in Launch Vehicle Software, Dr. Melamed coordinates and guides a team of interdepartmental technical experts, and supports validation and mission readiness certification of the flight software and mission parameters for NASA's Artemis missions. He conducts planetary defense technical and policy studies, co-chairs planetary defense conferences, serves on exercises exercise organizing committees, and speaks at these venues. He earned a Ph.D. in Aerospace Engineering from Georgia Tech.

Planetary Defense from Asteroids and Comets
Near-Earth objects (NEOs) are asteroids and comets that pose local, regional, or continental impact threat. The realization that asteroid impacts are a modern-day possibility followed analyses proving that many of the craters on Earth were caused by cosmic impacts rather than by gradual geological process or volcanic eruptions. In the 1980s researchers discovered that the demise of the dinosaurs some 65 million years ago coincided with a major asteroid impact, and in 1994 observers recognized similar-sized impacts when fragments of comet Shoemaker-Levy 9 smashed into Jupiter. If such an object were to hit Earth today, it could cause widespread devastation and profoundly affect life on Earth. Although major cosmic collisions with Earth are infrequent, their consequences could be severe. Hence, advanced planning is critical to mitigating future asteroid threats. And the best time to start preparing is now—well before any actual threat is detected.

Given this reality: What are the current risks? How would we deflect or destroy an asteroid or comet on a collision course with Earth? What are the technical and political risks? What are the obligations and strategic interests that would drive a decision to act? This talk describes results from recent international planetary defense conferences and tabletop exercises addressing these global questions through scientific studies and hypothetical scenarios. The talk also highlights evolving public and educational outreach, new simulation tools, recent space missions, and actions taken by the United Nations to support Planetary Defense.

Asteroid Deflection Teaming
NEOs, or Near-Earth Objects, are asteroids and comets that can collide with and damage the Earth. To understand how an approaching NEO can be deflected away from the Earth when it is still in deep space, a physics-based NEO Deflection App, or NDA, was developed jointly by The Aerospace Corporation and NASA JPL and applied in classes, workshops, and exercises. The talk describes the NDA and demonstrates its use in a hypothetical scenario where participants engage in a friendly asteroid deflection contest. Asteroid deflection teacher and student teaming workshops were held to help engage and excite students about STEM careers. A synopsis of a workshop is as follows:

Do you have what it takes to defend Earth? Find out by attending a Game On! Asteroid Deflection Challenge. During this interactive session you will work together in teams to divert an asteroid from colliding with Earth through the Near-Earth Object (NEO) application, developed by Aerospace in partnership with NASA/JPL.

The Teaming NEO Deflection App is fully web-based and does not require any programming skills. Lesson plans providing teachers with a multi-layered experience, and the NEO Deflection App are accessible here:
https://planetary-defense.aerospace.org/
https://aerospace.org/asteroids

Applying GN&C Solutions to the Problem of Asteroid Interception for Planetary Defense
The impact consequences of Near-Earth Objects (NEO) require proactive measures to eliminate or reduce them when lead times are too short for effective deep space deflection/destruction operation. To expand mitigation beyond deep space, ground-based pre-built interceptors launched minutes before atmospheric entry can respond to detection times from minutes to months before impact with Earth. The disruption of a small NEO prior to its atmospheric entry could potentially eliminate or reduce damage to life and property on the ground by dispersing its kinetic energy over a wider area.

The Guidance and Control Subdivision at The Aerospace Corporation has applied interceptor techniques to engage an incoming NEO at high altitude minutes before its atmospheric entry. The objective is to disrupt the object and deposit its kinetic energy at a higher altitude and disperse it over a wider footprint on the ground. A Monte Carlo simulation applied fireball statistical properties from NASA database to correlate flight time and altitude of intercept with interceptor requirements. Preliminary results show that exoatmospheric intercept altitudes are attainable even when detection and launch occur minutes before impact. Local, regional, or national objectives determine the number of systems and response time requirements. Hydrocode modeling demonstrated the amount of disruption caused to the asteroid by several kinetic kill vehicles. Detection technology, terminal guidance capability, disruption analysis, and debris reentry analysis are key areas of future work.

Intercept and Engagement of the PDC 2019 Comet with Solar Sailcraft
Planetary defense for comets has not been given much attention to date because their estimated collision frequency with Earth is two orders of magnitude lower than asteroids. However, a comet entering the inner solar system is generally larger and faster than an asteroid thus has a greater potential for damage. Moreover, since comets originate from the outer regions of the solar system, they are discovered about a year or two before their potential impact, and they can approach Earth on highly inclined orbits with respect to the ecliptic plane. Accordingly, assessments made at recent Planetary Defense Conferences (PDC) place the risk from comets on par with that from asteroids.

To help understand possibilities and limitations in addressing the comet threat, NASA Jet Propulsion Laboratory (JPL) has constructed a fictitious comet threat that puts a comet on a collision course with Earth. This new threat has been added to those available on the NEO Deflection App (NDA, https://cneos.jpl.nasa.gov/nda/) developed jointly by The Aerospace Corporation and JPL. Chemical rockets are shown to be incapable of intercepting NEOs approaching Earth from such high declinations with respect to the ecliptic plane until a few weeks before impact. Aerospace has shown that the EXCALIBRS (Expeditionary Comet/Asteroid Lander Interceptor BDA and Reconnaissance Sail) solar sail concept can intercept the comet three to six months before impact when it is at a distance of several astronomical units from Earth.

Beth Moses

Email: Beth.moses@virgingalactic.com

Biography:

Beth Moses is a twice-flown professional suborbital astronaut and the Chief Astronaut Instructor at Virgin Galactic. She most recently served as the cabin lead on the Unity22 test flight, Virgin Galactic's first fully crewed spaceflight, and is now assigned to her third spaceflight. On February 22, 2019 she became the first female to work in space as a member of the flight crew on a commercial vehicle; Virgin Galactic's VSS Unity flight VF01. She earned her Commercial Astronaut Wings from the Federal Aviation Administration in April 2019.

During her first spaceflight Ms. Moses became the first human to ever unstrap, become completely still, and view the Earth from space inside a spacecraft while it also came to a standstill - a unique facet of suborbital spaceflight. Ms. Moses described the experience as "indescribable", timeless, and fundamentally transformative. In addition to instructing all astronauts who fly in Virgin Galactic's customer cabin she leads Virgin Galactic's cabin test program.

Ms. Moses was formerly the Extravehicular System Manager for the International Space Station at NASA where she led the human-in-the-loop testing which verified the systems used to assemble ISS in orbit. ISS received the 2009 Robert J Collier trophy for "successful design, development, and assembly of the world's largest spacecraft, an orbiting laboratory, promising new discoveries for mankind and setting new standards for international co-operation in space".

Ms. Moses received her bachelor's and master's degrees in Aeronautical and Astronautical Engineering from Purdue University where she won the National Science Foundation's Microgravity Research Award to conduct materials research in parabolic flight. She is the recipient of Chicago's Adler Planetarium annual Women in Space Science Award and was previously a Google Science Fair judge. Ms. Moses is also a proud Boilermaker who was honored as an Outstanding Aerospace Engineer by Purdue University in 2018, before her first spaceflight, and serves on Purdue's Aeronautical and Astronautical Engineering Industrial Advisory Council.

Abstract: "Virgin Galactic's Unity22 Spaceflight"

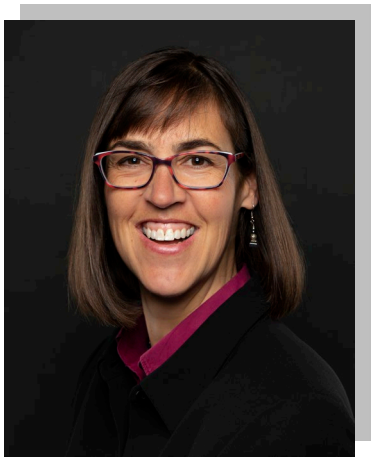
This talk will give a professional overview of the work accomplished by two pilots and four mission specialists during the first fully crewed spaceflight of VSS Unity on July 21, 2021 as part of Virgin Galactic's ongoing flight test program. It will review the mission objectives, training, and operations associated with the customer cabin through the eyes of the speaker who constructed the cabin test, trained the mission specialists, and flew to space as the Cabin Lead alongside Sirisha Bandla, Colin Bennett, and Sir Richard Branson on the Unity22 test flight with pilots David Mackay and Michael Masucci.

Abstract: "Virgin Galactic's Cabin Test Program"

This talk will cover Virgin Galactic's cabin test program which is underway to prepare Virgin Galactic's customer cabin for commercial service. The test program encompasses ground tests, parabolic tests, and component tests as well as un-crewed and crewed testing during glide flights and spaceflights. Of note are spaceflights that carried sensors and mannequins in the customer cabin prior to human occupancy and then two flights that included crewed cabin testing during which specialists unstrapped and evaluated the cabin in space. The talk will cover the framework and progress, to date, of the test series.

Abstract: “Virgin Galactic’s Cabin Astronaut Training Program”

This talk will discuss the astronaut training programs for all who fly in Virgin Galactic’s customer cabin, whether they be staff performing work or customers flying as researchers, private astronauts, or for professional training. The training program for each is slightly different depending on mission objectives and training is tailored to the astronaut-in-training’s background, desires, and group. The speaker is the Chief Astronaut Instructor for Virgin Galactic.



Angela Trego, PE, PMP

Email: angela@angelatrego.com

Biography:
Angela Trego, PE, PMP, FHEA, improves technical organizations' ability to retain employees and increase diversity, unlocking their unlimited potential through speaking, training, and coaching. In 2018, she was recognized as one of the top teachers at Utah Valley University and won the Faculty Excellence Award where she supported the development of both the mechanical engineering and project management programs. Dr. Trego was one of Utah Business's 2010 "30 Women to Watch" and won the "Rising Star" award at the 2009 Women Tech Council celebration. She had taught as an adjunct faculty member at Seattle University, Brigham Young University, and the Australian Defence Force Academy. As a senior manager at Varian Medical Systems, she led the research and development group.

Previously, Dr. Trego was a director of engineering at ATK Launch Systems developing new rockets and prior to that a principal engineer for Boeing Phantom Works working on corporate-wide structural health monitoring programs. Dr. Trego has two patents and is the author of over 80 publications and presentations ranging from the development of passive damping techniques using composites to the development of engaged teaching methodologies. She graduated from Brigham Young University with a B.S., M.S., and Ph.D. in Mechanical Engineering. Angela is both a licensed professional engineer (Washington State) and a certified project management professional. An AIAA Associate Fellow, Dr. Trego is on the executive board of directors for Empower Playgrounds Inc., executive board of SAMPE Utah Chapter, and advisory board for the Leonardo museum. She previously served on the executive board of the Women Tech Council and currently serves as a member of the Engineering Accreditation Commission and the Inclusion, Diversity and Equity committee for the Accreditation Board for Engineering and Technology. More information about Angela can be found on her website at www.angelatrego.com.

Abstract: "I've Got a Great Design…Now, How Do I Sell It?"
An engineer may have the greatest design or piece of analysis in the world but if you can't communicate it to the right people in the right way your design will never be realized. How do you do that? What happens if you need to present to a coworker? A manager? A CEO? A customer? Each of these require slightly different approaches. These skills will help you not only be a better engineer, but also help you in your career advancement as you learn how to present information in a more meaningful manner.

Abstract: "How to Have a 5-Course Meal at Dollar Menu Prices: Effective Time Management Strategies"
No matter what we do we only ever have 24 hours in a day. Time is one of our most precious commodities. How can we most effectively utilize those hours? What can we do to stretch our time? Learn 7 keys to managing your time to be the most productive person you can be — effectively making a five-course meal out of dollar menu items.

ROBERT C. “BOB” WINN

Email: rcwinn@engsys.com

Biography:
Bob Winn is a mechanical/aeronautical engineer and Principal Emeritus of Engineering Systems Inc. (ESi). ESI provides a wide range of technical support capabilities in essentially every engineering, scientific, and medical discipline. He has been with ESI since 1994 and during that time has reconstructed hundreds of aircraft accidents involving ultralights to airliners. Dr. Winn retired from the U.S. Air Force in 1991 after a 22-year career. He was an instructor pilot in four different Air Force aircraft, taught aeronautical engineering at the U.S. Air Force Academy, and served as Chief Scientist of the USAF European Office of Aerospace Research and Development in London, England. He is a Fellow of AIAA and a Fellow of the Royal Aeronautical Society and has served as a member of the SAE AC-9C Subcommittee on Aircraft Icing Technology. Dr. Winn has directed research; published over 70 technical papers, technical reports, and articles; and has given numerous presentations on a wide variety of technical and educational topics.

Abstract: “Animations versus Simulations”
Animations have become an important part of many litigations, particularly in the U.S. There are several good reasons to use an animation in the courtroom: (1) to convey a complex issue in an informative and entertaining way, (2) when time is an important issue in the issue, or (3) when the jury expects an animation (the other side has one). The big problem with (or perhaps advantage of) animations is that they do not have to obey the laws of physics; they are cartoons. As opposed to an animation, a simulation is an analytical solution of equations that are based in physics. A visual depiction of the results of a simulation may appear like an animation; conversely, there is no guarantee that an animation is the depiction of an activity that could actually happen. Some animations look so good that a jury will likely not be able to realize that the animation violates the laws of physics. In this presentation, the key features of a simulation are presented. In addition, examples of animations that violate the laws of physics and comparable simulations will be shown.

Abstract: “The Cold Truth about Aircraft Icing”
Aircraft in-flight icing has been an important factor in many aviation accidents, yet many pilots do not understand just what ice accretion can do to the performance of their airplane. This presentation briefly describes when and how ice can accrete on an airplane and discusses the changes in airplane performance that can result. In particular, some of the myths of aircraft icing will be dispelled. Examples of aircraft icing accidents that involved icing will be discussed.

Abstract: “Anatomy of an In-Flight Breakup”
A number of in-flight breakups occur every year. The fundamentals of in-flight breakups reveal that there are only three root causes: fatigue of a key structural element, flutter, and overload. Each of these causes will be discussed and explained. An example of an in-flight breakup in which the experts disagreed as to the root cause will be discussed in detail. The discussion will include analysis of the aircraft wreckage, fundamental airplane fluid dynamics, trajectory analyses, and airplane performance. The presentation is supported with videos, demonstrations, and high-definition animations.

Abstract: “Accident Reconstruction Needs Data – Where to Get It and How to Use It”
Almost every aviation accident gets reconstructed after, sometimes well after, the accident. The accuracy and completeness of that reconstruction depends on the amount and the quality of the data used in the reconstruction. The first accidents were reconstructed using the wreckage and any eyewitnesses that happened to see what happened. Eventually radar data, when available, were

used to describe the flight path the aircraft. In the mid-1970s, we learned how to extract airplane performance from the radar data. Flight data recorders added a lot of fidelity to the airplane performance analysis, but only airliners and a few business jets had flight data recorders installed. With the advent of electronic cockpit displays, a lot of data were used on even general aviation aircraft. Now, data are recorded on devices that didn't even exist just a few years ago. This presentation will show where we can find relevant data and how we can use it.