American Institute of Aeronautics and Astronautics
Houston Section
in collaboration with
JSC Human Systems Integration Employee Working Group

Present

Annual Technical Symposium 2017

NASA/JSC Gilruth Center
Houston, Texas
Friday, May 5, 2017

PROGRAM

General Chair

Justine Wiles
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Organizing Committee

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Technical Committee Chairs

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PROGRAM SUMMARY

SYMPOSIUM LOCATION

The American Institute of Aeronautics and Astronautics (AIAA), Houston Section, welcomes you to the 2017 Annual Technical Symposium at NASA/JSC Gilruth Center on May 5, 2017.

Enter Gilruth Center using JSC Public Access on Space Center Boulevard if you do not have a JSC badge. The morning and afternoon technical sessions will all be located in the Alamo Ballroom. The Engineers as Educators Workshop will be held in the Lone Star Room (second floor). The keynote speeches, continental breakfast and luncheon are on the first floor in the Alamo Ballroom.

SYMPOSIUM INFORMATION

REGISTRATION

Registration is $20 for AIAA Members, and $25 for non-members. All registrations include a light breakfast and lunch. Registration begins at 7:45 AM. Advance reservations are recommended but not required. Advance registration is easy to do on the web at ww.aiaahouston.org. The registration desk is located leading into the Alamo Ballroom. Registration is paid online. There is no additional fee for the buffet lunch, the cost is included in the registration fee.

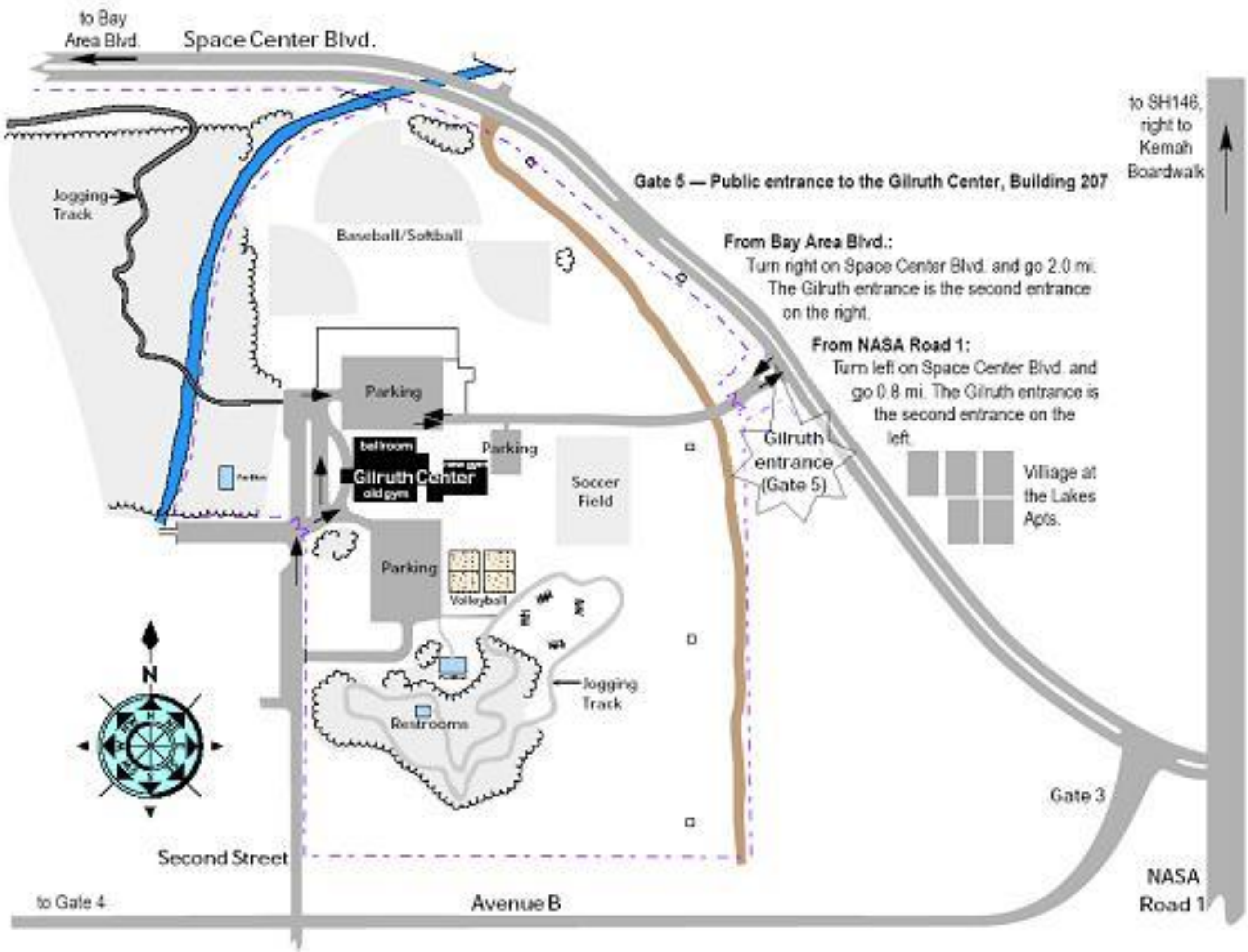

Figure 1. JSC Gate 5 Public Entrance Map

Figure 2. Gilruth Center First Floor

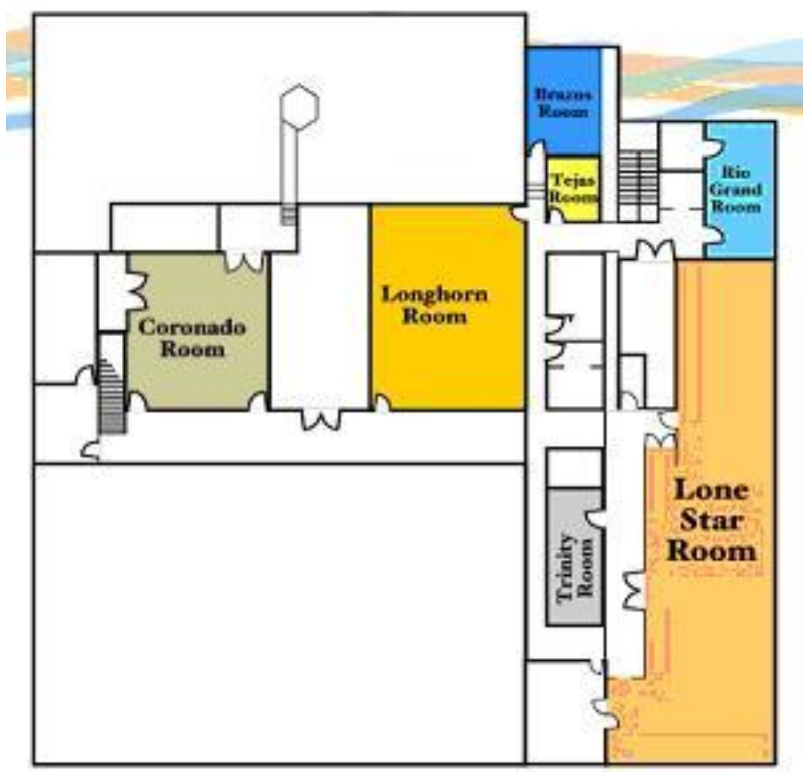

Figure 3. Gilruth Center Second Floor

Morning, 8:00-8:45 AM, Alamo Ballroom

Keynote Speaker: Astronaut Lee Morin

Overview of the Orion Cockpit

Complimentary coffee, bottled water, orange juice, and breakfast pastries provided

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Lunch, 12:00–1:30 PM, Alamo Ballroom

Professor André Droxler of Rice University

Human-Induced Climate Change Requires Urgent Action

Lunch buffet
Complimentary lemonade, bottled water, iced tea

TECHNICAL PROGRAM

TECHNICAL SESSIONS

Morning sessions start at 9:00 AM and end by 12:00 PM. Lunch program begins at 12:00 PM and lasts for about 1.5 hours. Afternoon sessions start at 1:30 PM and end by 5:00 PM.

PRESENTATIONS

Each presentation is allocated 30 minutes total time, including questions and any initial setup. Session chairs will maintain this pace to ensure that attendees can see presentations according to the posted schedule. Each room will be equipped with a laptop computer supplied by the Session Chair.

Session A-1 **Alamo Ballroom**

GN&C

9:00 AM

COBALT Open-loop Flight Test Campaign

Carolina Restrepo

COBALT, or Co-operative Blending of Autonomous Landing Technologies, is a platform that combines NASA GN&C sensors and algorithms for autonomous, precise landing of future robotic or human exploration missions. The COBALT sensors include the NASA Langley Navigation Doppler Lidar and the JPL Lander Vision System and Terrain Relative Navigation System. A new navigation filter that processes information from these sensors provides a stand-alone navigation solution. COBALT's open-loop flight test campaign onboard the Masten Space Systems' suborbital rocket testbed was completed in April 2017. During the open-loop flights, the COBALT payload collected and shared data with the vehicle, but the vehicle flew a planned trajectory with GPS-based navigation. This presentation will discuss the open-loop flight testing of COBALT as preparation for its upcoming closed-loop flights during which the Masten rocket will fly with COBALT's navigation solution while using GPS only as backup.

Presenter Biography:
Carolina Restrepo is currently the deputy project manager of the COBALT (Co-operative Blending of Autonomous Landing Technologies) project. She works in the Integrated Guidance, Navigation and Control branch at the Johnson Space Center. Previous work includes GN&C design and analysis work as part of the Orion Orbit MODE Team, and development of precision landing sensors and algorithms as part of the ALHAT (Autonomous Landing and Hazard Avoidance Technology) Team. Carolina earned degrees in Aerospace Engineering at Texas A&M University (B.S. 2006, M.S. 2007, Ph.D 2011), and started working at the Johnson Space Center as a co-op student in 2003.

Human Systems Integration

9:30 AM

Progress of Crew Autonomous Scheduling Test (CAST) on the ISS

Jackelynne Silva-Martinez and Shelby Bates

The United States space policy is evolving toward missions beyond low Earth orbit. In an effort to meet that policy, NASA has recognized Autonomous Mission Operations (AMO) as a valuable capability. Identified within AMO capabilities is the potential for autonomous planning and replanning during human spaceflight operations. That is allowing crew members to collectively or individually participate in the development of their own schedules. Currently, dedicated mission operations planners collaborate with international partners to create daily plans for astronauts aboard the International Space Station (ISS), taking into account mission requirements, ground rules, and various vehicle and payload constraints. In future deep space operations, the crew will require more independence from ground support due to communication transmission delays. Furthermore, crew members who are provided with the capability to schedule their own activities are able to leverage direct experience operating in the space environment, and possibly maximize their efficiency. CAST (Crew Autonomous Scheduling Test) is an ISS investigation designed to analyze three important hypotheses about crew autonomous scheduling. First, given appropriate inputs, the crew is able to create and execute a plan in a reasonable period of time without impacts to mission success. Second, the proximity of the planner, in this case the crew, to the planned operations increases their operational efficiency. Third, crew members are more satisfied when given a role in plan development. This presentation shows the progress done in this study with a single astronaut test subject participating in five CAST sessions. CAST is a technology demonstration payload sponsored by the ISS Research Science and Technology Office, and performed by experts in Mission Operations Planning from the Flight Operations Directorate at NASA Johnson Space Center, and researchers across multiple NASA centers.

Presenters Biographies:
The CAST (Crew Autonomous Scheduling Test) Team are ISS flight controllers in the Ops Plan console. They are part of the Flight Planning and Procedures Branch, Operations Division, Flight Operations Directorate at NASA Johnson Space Center.

CAST Team: Matthew Healy, Jessica Marquez, Steven Hillenius, David Korth, Lauren Rush Bakalyar, Neil Woodbury, Crystal Larsen, Shelby Bates, Mikayla Kockler, Brooke Rhodes, William Moore, Ivonne Deliz, Bob Kanefsky, Jimin Zheng, Ashley Henninger, Mary Kate Smith, Isabelle Edhlund, Jackelynne Silva-Martinez

Session A-1 **Alamo Ballroom**

Space Commercialization

10:00 AM

Why return to the Moon?

John Cook

The moon has many valuable resources that can enable infrastructure buildup and aid exploration. This can be funded as a partnership between Government and Private Enterprise – commerce can fund exploration and science. The Gold Rush and the Transcontinental Railroad serve as excellent lessons learned for innovation and competition. Space is a new frontier, just as the West was. A lunar outpost can serve as a "dress rehearsal" for Mars (practice makes perfect). Hardware design, surface operational concepts and logistics can and should have commonality for the Moon and Mars, resulting in cost savings and system robustness. We have unfinished business on the Moon. The Apollo program was prematurely cancelled. Apollo just scratched the surface. There were many additional planned uses for hardware that were to be derived from Apollo hardware. We should endeavor to create a Moon/Mars exploration architecture that builds on lessons learned from Apollo and the International Space Station and should include as much commonality of hardware as possible. As much as possible, we should strive for simplicity and adaptation of proven hardware and operational concepts wherever possible and avoid the "Clean Sheet" tendency of reinventing the wheel. This presentation intends to explain the advantages and opportunities of using the Moon as a dress rehearsal for Mars.

Presenter Biography:
John Cook worked as an engineer on the International Space Station and space shuttle programs from October 1995 to May 2014. He recently completed an internship under the Exploration Science Summer Intern Program at the Lunar and Planetary Institute in Houston. There he created detailed flight plans for a notional lunar exploration campaign and provided engineering and operational insight from his ISS and space shuttle experiences.

Session A-1 **Alamo Ballroom**

Space Commercialization

10:30 AM

Wing Design for Designers! Solutions Applied to the Stellar-J Launch Vehicle

Wes Kelly

The Stellar-J partially reusable launch vehicle design employs horizontal take-off and landing for delivery of small satellite payloads to low Earth orbit. This implies runway operations, jet engines and – very significantly – low aspect ratio delta wings. In an earlier presentation, we identified aero and thermal loads associated with a range of 1st stage trajectories – and earlier studies identified upper stage payload delivery capabilities. But all of this depends critically on wing strength constrained to a structural design weight. The complexity of delta wing design obliges us to examine wing internal structure based on the elastic grid-work, connecting it with what we know about the rest of the vehicle so far. For most aerospace students of structural mechanics, it is possible to complete entire semesters without finding a wing model in a textbook elaborated beyond one bending beam – and yet a typical 1960s delta wing aircraft will have half a dozen spars or more with intersecting ribs – as do the Shuttle and the Concorde SST. Could the knowledge that went into these configurations built with primitive computers now be buried under desert sands? We searched for it and found answers, examined some methods and developed some of our own to proceed to with our own designs, varying rib and spar parameters and integrating them with airfoils and surface controls, cut-outs, hardware and aerodynamic loads. Equations of elastic deformation with wing parameters are devised in support of trades and optimization issues of multi-discipline nature.

Presenter Biography:
After serving with the USAF from 1966-70, Wes Kelly attended the University of Michigan in Ann Arbor where he obtained a BS in Aerospace Engineering in 1973, and a subsequent MS in Aeronautics and Astronautics from the University of Washington (Seattle) in 1978. He has worked in flight mechanics, trajectory analysis and design projects in varying phases in Seattle, Houston, New Orleans and Denver. Many of these projects were related to the Shuttle, the space station, launch vehicles, payloads and upper stages. In 2004 he founded Triton Systems, LLC a small engineering firm which has done engineering work at the NASA Johnson Space Center and is a partner with ORBITEC supporting the NASA Glenn Research Center propulsion technology program (RTAPS 1 and 2). Mr. Kelly and his Triton associates have been working for over a decade to develop a family of reusable launch vehicles. Their efforts have obtained several letters of intent from small satellite manufacturers and the interest of the Ellington Space Port. In recent years he has also served as an adjunct professor teaching metallurgy and physics at San Jacinto Community College; also as a free-lance Russian translator during the ISS assembly program.

Session A-1 **Alamo Ballroom**

Space Exploration

11:00 AM

Hyperbolic Rendezvous at Mars: Risk Assessments and Mitigation Strategies (R. Jedrey, D. Landau, R. Whitley)

Richard Jedry

Given the current interest in the use of flyby trajectories for human Mars exploration, a key requirement is the capability to execute hyperbolic rendezvous. Hyperbolic rendezvous is used to transport crew from a Mars centered orbit, to a transiting Earth bound habitat that does a flyby. Representative cases are taken from future potential missions of this type, and a thorough sensitivity analysis of the hyperbolic rendezvous phase is performed. This includes early engine cut-off, missed burn times, and burn misalignment. A finite burn engine model is applied that assumes the hyperbolic rendezvous phase is done with at least two burns.

Presenter Biography:
Richard Jedrey is an aerospace engineer and team lead within the Flight Mechanics and Trajectory Design Branch at Johnson Space Center. His work focuses on orbital mechanics and trajectory design for Orion and advanced missions. Richard received his Bachelor's and Master's Degrees in Aerospace Engineering at The Ohio State University. He started working for NASA as a cooperative education student in 2007, and began working in the Flight Mechanics and Trajectory Design Branch in 2011.

Session A-1 **Alamo Ballroom**

Space Exploration

11:30 AM

Exploration with Quantum Computation: Mars Drone

Alex Monchak and Samina S. Masood (faculty sponsor)

Quantum computation is envisioned as the evolution of a system from an initial state to a final state by a unitary transform operator varying with time and the states are the form of a q-bit. Anything able to be expressed as at least two states in the form of a q-bit may be used as the hardware for quantum computation. Examples include photon phase, photon intensity, two atomic states, spin-half particles which are fermions entailing quarks and leptons consisting of electrons and neutrinos, polarization of photon and an existing D-Wave Computer with electrons of Niobium at temperatures approximating absolute zero. The potential of quantum computation is in the application of quantum properties of superposition, interference, entanglement, and uncertainty. Problems of decoherence and absence of data compression may be addressed by topology of 2-D non-abelian anions and non-orthogonal states, respectively. There is success of verification and validation of flight software by Lockheed Martin and Boeing running D-Wave. Uncertainty is appropriate for Mars drones with quantum artificial intelligence as is entanglement of 2 atoms and 2 photon modes for communication, expandable to n-particle states. Machine learning of robotics will improve by verification and validation back testing of quantum algorithms with (1) increasing available data through the eMerge app concept to enable public participation and (2) using the quantum search in 2-D. Like the acceptance of new and existing physics equations and the eMerge app, Ease of use and Usefulness lead to quantum computation acceptance and associated acceleration.

Presenters Biographies:
Alex Monchak is a physics student at the University of Houston – Clear Lake (UHCL). See www.linkedin.com/in/alexmonchak

Samina S. Masood is the faculty sponsor, Associate Professor, and Program Chair of Physics at the University of Houston – Clear Lake (UHCL). See www.linkedin.com/in/samina-masood-25a8a919.

Life Sciences and Human Factors / International Activities

1:30 PM

The Scientific Society of Astrobiology of Peru (SCAP) & NatBio (Natural Biofilm Biotech) Mission of Team KillaLab: To Send biofilms to test endurance on lunar surface

Saul Perez and Ruth Quispe

SCAP: The Scientific Society of Astrobiology of Peru (SCAP) formerly called Peruvian Group of Astrobiology (GAP) started its activities in 2010 with motivated students from different universities in Peru. Since then the Society has been organizing academic activities motivating and teaching topics related to Astrobiology. Important national and international meetings in collaboration with astrobiologists have allowed creating a network of interdisciplinary research in several current and future projects. In the beginning, our goals were to explain the objectives of astrobiology and how our organization can contribute to improving science and technology in our country. As a result of it, a handful of young students from different disciplines have been joining and allowing us to reach a good number of members distributed on three local committees in Lima, Arequipa, and Trujillo. Dr. Julio Valdivia, our founder, and the current president has been publishing papers and books focus on the Pampas de la Joya Desert, which is one of the places considered as an analog to Mars. This work attracted the attention of the scientific community in Latin America, which resulted in important events such as The First Peruvian Space Week, the 1st Latin American Congress of Astrobiology (both of them in Lima), and The I International Forum of Geobiology (in Arequipa). Indeed, the work of SCAP is to improve the specific research in Pampas de la Joya desert. Our society intends to preserve this place for our next generations, and this effort has specific actions. We have been helping our scientific collaborators applying for internships and travel opportunities. In this context, SCAP looks for the understanding of the biochemistry of extremophile organism and the mineralogical and chemical composition of the soils, which have probably suffered some climatic changes due to ENSO effect.

NatBio: The Mission NatBio is an interdisciplinary research project of the Scientific Society of Astrobiology of Peru, selected to be sent to the spacecraft of the lunar mission of Team Indus. The research is focused on the effect of space factors on the Lunar surface, specifically the ionizing and non-ionizing radiation over the survival of biofilms.
A strong constraint on the establishment of humans in the Moon is the need to launch from Earth the consumables required to sustain crews, yet this need could be decreased by in situ resource utilization (ISRU). Some resources such as food, biomaterials, and drugs could be efficiently produced only by biological systems using cyanobacterias. Some cyanobacteria demonstrate significant resistance to gamma radiation and have been shown to survive the desiccating, freezing conditions of space in orbital experiments; these show greater resistance in the form of biofilms than in planktonic cells. These biofilms were selected from three different Peruvian sites and identified as biofilms conformed by cyanobacterias and microalgaes. Because aseptic conditions must be maintained throughout the mission, we have developed a biofilm holder with biocompatible materials and sensors that provide us with the required maintenance temperature and relative humidity information. The information to be sent from the Moon to Earth will be levels of incident radiation and transmitted radiation. We will know the radiation levels filtered by the cyanobacteria, as well as the information of the reflected radiation analyzed with a Nano spectrometer, and will be able to identify the states of the functional groups of photo protectors of biofilms. The mission will perform pre-experiments that will consist of simulations and validation for the design.

Presenter Biography:
Saúl Perez-Montaño is Professor at Universidad Catolica San Pablo, Arequipa Peru, and head of research projects in science technology and innovation. He holds a Masters in Chemistry from San Jose State University (USA). He is president of the national chapter of the International Association for Geoethics (IAGETH) and coordinator of the Scientific Society of Astrobiology of Peru. He was selected by NASA / PBI (Planetary Biology Internship) to participate in research on the origins of life at SIO – University of California San Diego. He is currently a member of the Materials Science and Technology Research Group (CITEM) of the UCSP and is studying doctoral studies at the University of Seville in the area of materials science and technology.
NatBio - Team KillaLab: Cruz Simbrón R., Capcha Mansilla M., Rodríguez Venturo S. and Quispe Pilco R.

Session A-2 **Alamo Ballroom**

Astrodynamics

2:00 PM

Moon Age and Regolith Explorer (MARE) Mission Design and Performance

Gerald Condon

On December 11, 1972, Apollo 17 marked the last controlled U.S. lunar landing and was followed by an absence of methodical in-situ investigation of the lunar surface. The Moon Age and Regolith Explorer (MARE) proposal provides scientific measurement of the age and composition of a relatively young portion of the lunar surface near Aristarchus Plateau and the first post-Apollo U.S. soft lunar landing. It includes the first demonstration of a crew survivability-enhancing autonomous hazard detection and avoidance system. This report focuses on the mission design and performance associated with the MARE robotic lunar landing subject to mission and trajectory constraints.

Presenter Biography:
Gerald Condon is a senior engineer in the Aeroscience and Flight Mechanics Division at the NASA Johnson Space Center in Houston, Texas. He has expertise in mission and trajectory design and exo-atmospheric flight mechanics. He serves as senior division lead engineer for integration, mission design and analysis for a number of Orion related projects and organizations focusing on the NASA Proving Ground activity. He has led related studies including both human and robotic missions to the Moon and Mars as well as cislunar destinations. He also serves as project lead for the ongoing development of the Copernicus tool at JSC. Mr. Condon received his B.S. and M.S. in Aerospace Engineering from the University of Florida.

Session A-1 **Alamo Ballroom**

Structural Mechanics

2:30 PM

On the Influences of Observed Variability and Repeatability in Jointed Structures

Matthew Brake

With the increases in computational power and numerical methods, computer aided design has allowed engineers to study very large scale problems, including built-up structures (such as commonly found throughout aerospace, defense, and automotive applications). Inherent in these problems are nonlinearities, including frictional interfaces found in joints. Despite advances in computational ability, these nonlinearities are often neglected or linearized in analyses due to the significant computational cost and lack of numerical stability associated with modeling them in high fidelity. One of the principle roadblocks to high fidelity modeling of interfaces is our lack of understanding of the physics of how energy is dissipated in and transmitted through the joints. This talk will focus on experimental evidence for the variability (i.e. testing of different specimens) and non-repeatability (i.e. testing of the same specimen) observed in the dynamics of jointed structure. The influences of observed variability are multiscale in nature, ranging from the dynamics of the structure surrounding a joint to the distribution of grains along a contact interface. Despite this range of scales, however, several mechanisms have recently been identified that determine the strength of a nonlinearity in a jointed structure. Finally, the ramifications for these observations in the design and optimization of aerospace and defense applications is briefly discussed.

Presenter Biography:
Dr. Brake started at Rice University in 2016 after working at Sandia National Laboratories for nine years. Prior to Sandia, Dr. Brake graduated from Carnegie Mellon University in 2007. Dr. Brake has been elected to several leadership positions within the ASME, including as the secretary of the ASME Research Committee on the Mechanics of Jointed Structures, he has been a visiting academic at the University of Oxford, he has taught multiple classes at the University of New Mexico as an adjunct professor, and he has co-organized multiple international workshops and conferences. He recently received the 2012 Presidential Early Career Award for Scientists and Engineers, and he has also founded and directed both the Institute for Nonlinear Dynamics of Coupled Structures and Interfaces (ND-CSI) at Rice University and the Nonlinear Mechanics and Dynamics (NOMAD) Institute at Sandia National Laboratories. His primary research interests are in interfacial mechanics, model reduction theory, uncertainty propagation, and nonlinear dynamics.

Session A-2 **Alamo Ballroom**

Automation and Robotics

3:00 PM

Long Range VTOL Cargo Delivery via a Co-operating Robotic Aircraft Flock

Chris Y. Taylor

Achieving long range and VTOL cargo delivery by a single aircraft requires numerous design compromises. Using a flock of uncrewed aerial vehicles that cooperate in flight so that the long range and VTOL capability reside in different specialized aircraft offers an alternative to conventional cargo delivery. This presentation compares the performance of a cooperating UAV flock of heterogeneous aircraft with conventional UAV cargo delivery and examines how the composition of the flock affects its performance.

Presenter Biography:
AIAA Senior Member, Member of AIAA Nuclear and Future Flight Propulsion TC, former Houston Section Project Chair, Former Chairperson of NFFP TC, Former NFFP TC Congressional Visits Day rep., four-time former Houston ATS presenter. An independent consultant to energy organizations since 2004. Work includes designing a hydraulic walking system that moves fully erected oilrigs at roughly the same speed as the Apollo/Shuttle crawler for orders of magnitude less money, size, and hassle.

PUBLICATIONS:
Taylor, C.Y., “A 'Back of the Envelope' Look at Space Launch Vehicle Costs,” presented at the 2004 AIAA Houston Advanced Technology Symposium, NASA/JSC, 2004.
Taylor, C.Y., “In Defense of External Tanks,” presented at the 42nd AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, AIAA-2006-4784, Sacramento, CA, 2006.
Hansen, J. and Taylor, C.Y., “Curie-Montgolfiere Planetary Explorers,” presented at the 2007 Space Technology and Applications International Forum, Albuquerque, NM, 2007.
Taylor, C.Y., “Mass Produced Flock of Propulsion Units for Interplanetary and Interstellar Mission Cost Reduction,” presented at the 19th Adv. Space Propulsion Workshop, Huntsville, AL, 2012

EDUCATION:
Bachelor of Engineering in Mechanical Engineering, Vanderbilt University, May 1993
AIAA Professional Studies Course: Aircraft Conceptual Design, June 1994
AIAA Professional Studies Course: Liquid Rocket Propulsion, July 2000
AIAA Professional Studies Course: Elements of Spacecraft Design, April 2001
AIAA Professional Studies Course: Economics of Space Transportation, Oct. 2002
AIAA Professional Studies Course: Elements of Design of Experiments, Dec., 2005

Session A-2 **Alamo Ballroom**

Automation and Robotics

3:30 PM

Integrating Tests of Autonomy with both Software and People: Autonomy Requirements Tester (ART)

Carroll Thronesbery

The Autonomy Requirements Tester (ART) is a tool suite under development to assist the construction of requirements, the planning of tests, execution of tests, and the tracking of test results with a concentration on requirements for system autonomy. As an initial stage of development, we prototyped the Test Runner that executes a test script and records results in a fashion that enables users to see how well the autonomy requirements have been tested. The Test Runner portion of ART takes advantage of the Core Flight Software (cFS) publish-subscribe architecture so that the test can be plugged into the architecture along with the app being tested, thus no changes to the app are required to run the test. The Test Runner integrates with CFS software, and the data model for expected system behavior help to integrate with the human process of system engineering.

ART innovations include the following:

- Represent requirements and links with intended behaviors for testing the requirements
- Formal data models for requirements, behavioral expectations, test specifications, and test results
- Use of template to drive the elaboration of test specifications
- Support for test driven development
- Integration of the testing mechanism with the operational environment to support (CFS users)
  - Enabled by modular architecture w/ pub-sub communications scheme
  - No change to the unit under test between testing and operations
- Reporting of test results – similar appearance to specifications, still linked to requirements

Future efforts will include a prototype of the entire system concept after iterative prototype development with subject matter experts.

Presenter Biography:
Carroll Thronesbery has been developing intelligent systems and designing human computer interaction with intelligent systems since receiving his Ph.D. in cognitive psychology. He has written numerous articles and two NASA manuals on operational prototyping, spiral development, and software analysis techniques. He has designed and demonstrated a tool to support improved data flow diagram specifications by verifying specific scenarios with Petri net simulations, for which he received a NASA Space Act Award. He has investigated human factors engineering tools that can improve their interaction with systems engineers and other specialty engineers in the early analysis activities for the Crew Exploration Vehicle at NASA/JSC. Recently, he has developed a ConOps storyboard tool, a portfolio risk management tool that addresses space flight medical risks, and designed a fault management assistant tool to support system developers. He is an active member of the Houston Human Factors and Ergonomics Society and has belonged to the national Human Factors and Ergonomics Society since 1985.

Session A-2 **Alamo Ballroom**

Systems Engineering

4:00 PM

Integrating Fault Management Planning Tools with System Engineering: Fault Management Viewer (FMV)

Carroll Thronesbery

The Fault Management Viewer (FMV) is a tool with multiple visualization models (viewers) to assist with planning fault management (FM) development by providing new ways of visualizing FM concepts and data. Our team designed FMV to align with NASA's FM Handbook, a design reference mission, and our team's experiences with past FM development support projects. The benefits of developing this approach and tool include improved FM quality, efficiency in developing FM measures, and a more cost-effective expenditure of FM resources on failures that are most important to control.

We have begun an agile approach to developing FMV with an SBIR project. In Phase I, we designed FMV, developed a concept of operations, and created a feasibility prototype. We will continue the effort with a full-function FMV prototype and additional inputs from fault management engineers.

Innovations include the viewing options aligned to fit important FM development decisions and the use of a single data model of FM concepts that will drive all of the viewing options.

Key decisions include:

- What are the primary system goals for each mission phase?
- How well are my system capabilities protected?
- Which of my mitigation approaches are most effective?
- Where can I spend my FM development resources most effectively?
- How much resource would be required to bolster the protection of this system function?
- How much would it improve my risk profile to add a candidate FM measure?
- How much would my system function improve in dependability if we add this FM measure?

Presenter Biography:
Carroll Thronesbery has been developing intelligent systems and designing human computer interaction with intelligent systems since receiving his Ph.D. in cognitive psychology. He has written numerous articles and two NASA manuals on operational prototyping, spiral development, and software analysis techniques. He has designed and demonstrated a tool to support improved data flow diagram specifications by verifying specific scenarios with Petri net simulations, for which he received a NASA Space Act Award. He has investigated human factors engineering tools that can improve their interaction with systems engineers and other specialty engineers in the early analysis activities for the Crew Exploration Vehicle at NASA/JSC. Recently, he has developed a ConOps storyboard tool, a portfolio risk management tool that addresses space flight medical risks, and designed a fault management assistant tool to support system developers. He is an active member of the Houston Human Factors and Ergonomics Society and has belonged to the national Human Factors and Ergonomics Society since 1985.

Session A-2 **Alamo Ballroom**

Cybersecurity

4:30 PM

The Internet of Things, Overview

Svetlana Hanson

We live in a connected world surrounded by devices regardless of where we are: at home, at work, on the road, shopping or on vacation. These devices help us make decisions to improve the quality of products we make, how we meet customers' expectations or predict needed services – all of these come from devices that sometimes are not even visible or noticed by us. The advantage of using these devices also brings risk: risk of intrusion or data loss just to name a few. As more and more IoT (Internet of Things) devices come to market and become part of our daily activities, we look into incorporating them into solutions aimed at improvements both on Earth and in Space. This presentation provides an overview of the latest developments in this market with offerings to benefit a wide variety of industries.

The IoT market has become more competitive causing providers to make their solutions proprietary in order to retain their advantage. The standard method of operation, autonomous access via the internet, becomes an issue to implementers since there are no set standards to ensure secure authorized access. If unauthorized access is obtained, the device can be manipulated. As a result, there is the fear a device could potentially conduct internet communication without user knowledge.

Presenter Biography:
Svetlana Hanson is a senior software engineer at Tietronix. One of the projects she is involved with is an Internet of Things (IoT) project at Johnson Space Center. Svetlana Hanson has been an active member of AIAA for many years. At the section level Svetlana has served in the position of Pre-College (k-12) Outreach and was responsible for many programs dedicated to promoting early interest and increased involvement in STEM professions. On the regional level, Svetlana served as Deputy Director - Pre-College (k-12) Outreach (4 years), and is currently serving as Deputy Director– Membership in Region 4. Presently Svetlana Hanson is chair-elect of the Houston section.