American Institute of Aeronautics and Astronautics
Houston Section

Presents

Annual Technical Symposium 2019

NASA/JSC Gilruth Center
Houston, Texas
Saturday, June 1, 2019

PROGRAM

General Chairs

Patrick Rodi
Wanda Sigur

Organizing Committee

Svetlana Hanson
Irene Chan
Jackelynne Silva-Martinez
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 2019 Annual Technical Symposium at NASA/JSC Gilruth Center on June 1, 2019.

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. All presentations will take place on the second floor of the Gilruth Center in the Lone Star Room.

SYMPOSIUM INFORMATION

REGISTRATION

Registration is $20 for AIAA Members, $25 for non-members, and $15 for students and retirees. All registrations include a light breakfast and lunch. Registration begins at 8:30 AM. Advance reservations are recommended but not required. Advance registration is easy to do on the web at www.aiaahouston.org. The registration desk is located on the second floor, outside of the Lone Star Room. Registration is paid online. There is no additional fee for the buffet lunch, the cost is included in the registration fee.

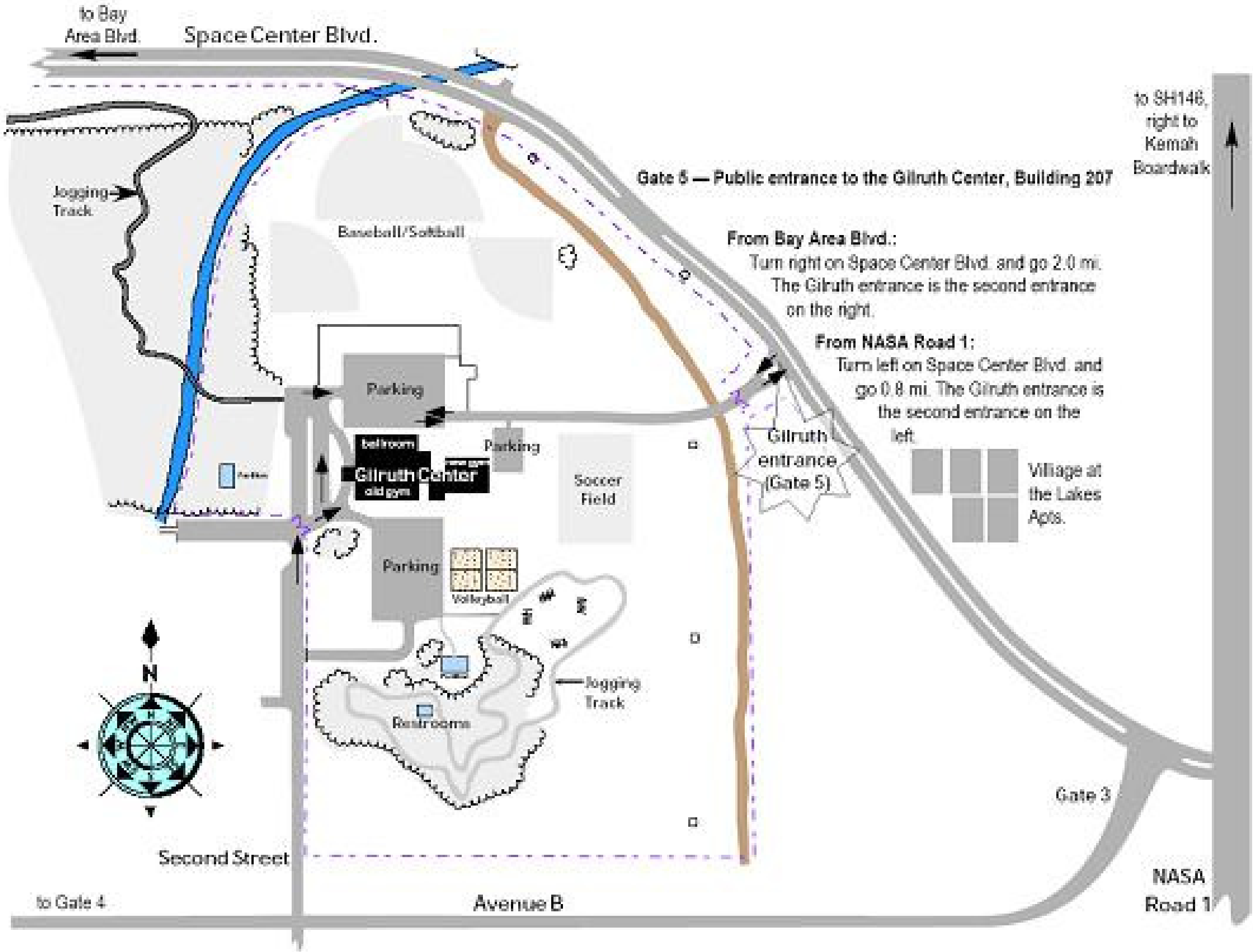

Figure 1. JSC Gate 5 Public Entrance Map

Figure 2. Gilruth Center First Floor

(Follow red arrow to second floor.)

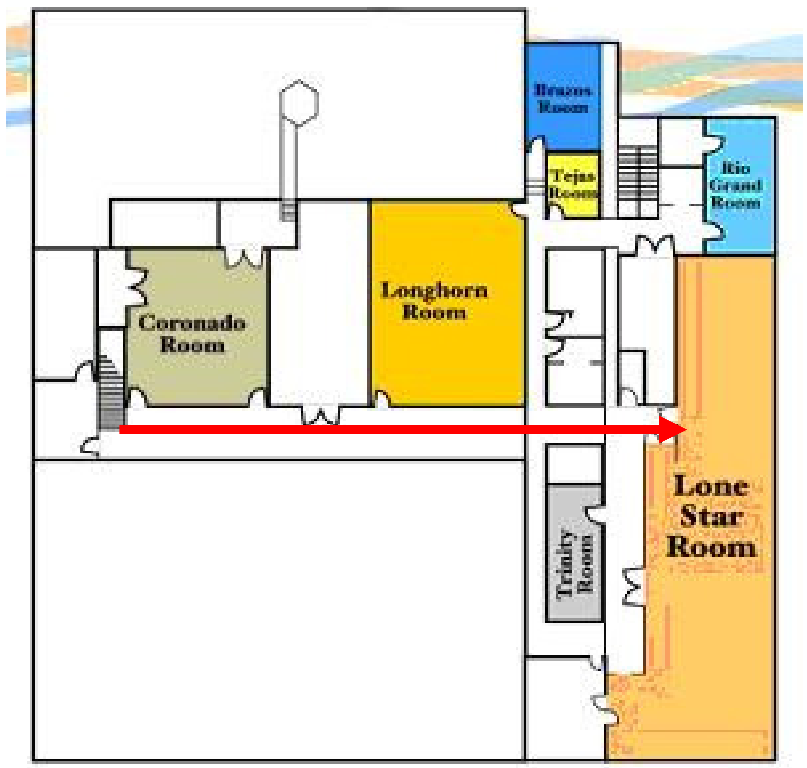

Figure 3. Gilruth Center Second Floor

(Follow red arrow to Lone Star Room.)

Special Events

Morning, 9:00-9:50 AM, Lone Star Room

Keynote Speaker: Mark Geyer, NASA-JSC Center Director

Forward to the Moon: NASA's Strategic Plan for Lunar Exploration

Complimentary coffee, bottled water, and breakfast pastries provided

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Lunch, 12:00–1:30 PM, Lone Star Room

Dayna Steele

The Rock Star Principles of Success

Lunch buffet
Complimentary lemonade, bottled water, iced tea

TECHNICAL PROGRAM

TECHNICAL SESSIONS

The morning session starts at 9:00 AM and ends at 12:00 PM. Lunch program begins at 12:00 PM and lasts for about 1.5 hours. The afternoon session starts at 1:30 PM and ends at 4:30 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. The room will be equipped with a laptop computer.

Session A-1 **Lone Star Room**

Life Sciences and Human Factors

10:00 AM

Apollo Crew Compartment Problems & Remedial Action, Post Apollo 1 Accident

Jerry R Goodman

This briefing discusses significant crew compartment baseline designs and remedial actions made to them subsequent to the Apollo 1 Accident. Efforts described enabled recovery from the Apollo 1 accident, and helped ensure safe and successful Apollo missions.

A number of these actions were initiated when the Borman Block II Redefinition Team was active for 4 months in 1967. Designs or areas covered are: use of pure oxygen; electrical wiring; cabin closeouts; use of flammable materials; stowage provisions; module side hatch; valve actuation with tool; crew couch; wet trash; and lack of adequate program design reviews and tools, and rigor.

Presenter Biography:
Head of the Apollo Suit Office from 1962-1965. Then worked on the Command Module in the Systems Engineering Division, Apollo Project Office. I was later assigned to be Crew Compartment Project Engineer on Command Module & later, also the Lunar Module. Lead on Apollo inflight EVA for contingency Command Module to Lunar Module EVA transfer, and J-Series EVA, and chaired the Apollo In-Flight EVA Working Group overseeing these efforts. Assigned to Col. Borman's redesign team (Block II Redefinition) overseeing a number of Crew Compartment and EVA changes; and setup and coordinated a series of design reviews, PDRs, CCSR's, and CCFF's for ASPO in the Apollo Program, recovering from the Apollo 1 accident. Later assigned to George Low's office, reporting to his assistant, George Abbey, and for a period of time, also assigned to work for Max Faget.

Under NASA sponsored scholarship, obtained Masters Degree from University of Illinois in Human Factors, including documenting Apollo lessons learned in Human Factors, with thesis.

I was Crew Compartment and EVA Project Engineer for the Shuttle Orbiter, and chaired EVA Working Group, and Acoustic Working Group. Headed Crew Compartment and EVA Office for Orbiter Project Office. Developed the EVA Slidewire, tools, and winch concept used in Shuttle, and was responsible for EVA provisions, tools, stowage, and manual backup on Payload Bay Doors.

Worked for SP/Manned Systems Division on Crew Station, and later, was on the Division Staff. Head of the Acoustics Office, and was Acoustic Lead overseeing acoustics on all ISS hardware and Modules.

Session A-2 **Lone Star Room**

Life Sciences and Human Factors

10:30 AM

Apollo In-flight EVA Problems & Remedial Action, Post Apollo 1 Accident

Jerry R Goodman

This briefing describes the in-flight EVA provisions baseline for contingency EVA transfer from the Lunar Module (LM) to Command Module (CM) and resultant remedial designs and actions taken after the Apollo 1 accident. Initial EVA baseline provisions consisted of metal plates bonded on the CM, with their capability to accept mating with crew actuated portable EVA handholds. The crew would translate with these handholds to the CM side hatch. A portable extendable boom would be used from the LM to attach to a bail bar on the Service Module (SM), near junction between the CM and SM. The LM crew would use the boom to transfer from the LM to this bail bar location, retrieve the portable handholds and continue the transfer to the hatch using these handholds.

The above provisions were deleted and replaced by fixed EVA handholds (H/H's) on the CM that proved a transfer pathway from the CM/LM junction to the CM side hatch. The LM added an EVA handrail from the LM hatchway area to this junction. EVA H/H verification is described. CM and LM EVA provisions and transfer was evaluated on the Apollo 9 mission, in a successful demonstration of necessary EVA capabilities for lunar missions.

Use of similar EVA H/H's was successfully used for the J-Series EVA Missions on Apollo 15-17, where scientific equipment was installed in a SM SIM-Bay and EVA used to retrieve film cassettes.

Session A-3 **Lone Star Room**

SR&QA

11:00 AM

Lessons Learned on Design

Gary W. Johnson

Future spacecraft designers and managers need to be aware of past problems, corrective actions, and resulting lessons learned to avoid repeating old problems in new programs. This paper communicates valuable experience to younger engineers, so they can continue to build on the lessons of the past to create even better human spaceflight programs. The paper is organized around several themes, with personal accounts of past incidents providing examples of each theme. The themes include redundancy as a help or hindrance, documenting and sharing information, hazard analysis, and politics as the enemy of good design. Examples are drawn from the Apollo, Skylab, and Space Shuttle Programs and range in severity from minor incidents to major accidents with loss of life, such as the Apollo 1 fire.

Presenter Biography:
Gary W. Johnson is an Aerospace Safety Consultant, currently working for J & P Technologies. He worked for NASA on the major manned programs since Apollo. He started his NASA career back in 1964 in the NASA Manned Spacecraft Center, now Johnson Space Center (JSC), in the Engineering and Development Directorate Power Distribution and Sequencing Section responsible for technical direction in the design and testing of the Apollo Command and Service Module (CSM) sequencing system.

Over the years, he served as Manager for the Sequential Subsystem for the Apollo CSM, Lunar Module, and Skylab CSM; member Apollo-Soyuz Test Project (ASTP) Working Group 4; first Space Shuttle flight Orbit Flight Control Team Electrical, General Instrumentation, and Lighting (EGIL) flight controller; Mission Operations Directorate Systems Division Mechanical and Payload Systems Branch Chief and Guidance and Propulsion Systems Branch Chief; Deputy Director, Safety, Reliability, and Quality Assurance (SR&QA) Office; NASA/Mir Program Joint Safety Assurance Working Group Co-Chairman; deputy director of Russian Projects SR&QA; and NASA Co-Chairman of the International Space Station Program Joint American Russian Safety Working Group.

He retired from NASA in 2006. In 2007 served as a Safety expert to the Constellation Program, Orion Project Standing Review Board.

Session A-4 **Lone Star Room**

Space Commercialization

11:30 AM

Space Commercialization

John DiIorio

Mr. DiIorio will discuss FY 2020 NASA and U.S. Space Command budgets and proposed operations along with FY 2019 letters, cost summaries, and designs. He will discuss his "5 year Outlook" for space drones/robots including 'dual use' space vehicle designs. He will briefly touch on the anticipated U.S. Space Force core working alongside the NASA core as it applies to complex mission tasks.

Presenter Biography:
Mr. DiIorio has made three prior presentations for ATS in Space Operations and Astrodynamics. He has a Mechanical Engineering degree in power, propulsion, and energy plus a diploma in Quality and Reliability Engineering. He has made a total of six presentations for professional societies (ASQ, NOMADS, and NSS), two NASA Lunch and Learns at JCS, and five years of presentations at comic and space events (GRB convention center and NRG center). Finally, he derives base mathematical equations to support the physics and astrophysics components of complex space operations.

Session B-1 **Lone Star Room**

EVA

1:30 PM

NASA Microgravity NExT- EVA Zip Tie Cutter

Maria Gonzalez

The EVA Zip Tie Cutter is one of NASA's newest tools, "Its first slated use will be during the repair of the Alpha Magnetic Spectrometer (AMS)" -NASA JSC. Cable ties are important assets used in cable management on the International Space Station (ISS) and other space applications. They connect, tie down, and organize wires on the station and often need to be removed and replaced for a multitude of reasons. Our team's goal was to design, build and test a prototype that could easily cut, remove, and retain severed zip ties in microgravity while maintaining the integrity of cable bundles. Particularly, during Extravehicular Activities (EVA) when large gloves and suits could make the use of normal tools impractical. The tools highlighted features include a double lock mechanism, slender design and an unexposed blade that give this tool its mechanical and safety advantages. The EVA Zip Tie Cutter has been successfully tested in NASA's NBL and ARGOS facilities simulating its functionality in microgravity.

Presenter Biography:
Team CERO (Cutting Extraction Retention Operations) is an award winning student team from Lone Star College-CyFair. With guidance from advisors Dr. Yiheng Wang and Jared Cammon the team of five is led by Daniel Vasek, other team members include Maria Gonzalez, Francesca Liso, Sean Palmer, and James Philippi. The teams name is an acronym for their mission to develop a safe and reliable zip tie cutter to be used during spacewalks. Team CERO developed the first ever tool from the NASA Microgravity Neutral Buoyancy Experiment Design Teams (Micro- g NExT) to be used on the ISS. They have tested in the Neutral Buoyancy Lab, ARGOS facility and will be a featured tool in the NEEMO 23 mission. Their awards include the Spring 2018 Top Overall Design Team from Texas Space Grant Consortium (TSGC) and Focus on Innovation Award from the American Society for Engineering Education (ASEE). The team is set to watch their tool launch in July 2019.

Session B-2 **Lone Star Room**

Space Exploration

2:00 PM

Natural Language Processing Techniques and its Application in Space Exploration

Svetlana Hanson and Olga Perera

Natural language processing is a range of computational techniques for analyzing and representing naturally occurring texts at one or more levels of linguistic analysis to achieve human-like language processing for a range of specific tasks or applications. Goals of natural language processing include complete natural language understanding and real time participation in spoken dialogues with various applications ranging from information extraction, automatic summarization and text translation, question answering systems.

Natural language is simple and effortless to humans, but complex for computers, because of ambiguity produced by various meanings, sarcasm, humor and metaphors. Synchronic model is used to guide computational techniques to analyze text, which includes phonetic, morphological, lexical, syntactic, semantic, discourse and pragmatic levels of language analysis.

Application of following natural language processing techniques is required to successfully process text: (1) corpus statistics, which finds frequencies of words and word pairs, using occurrences or semantic measures; (2) machine learning (classification), which is based on produces features of the text such as classifying the text according to a set of labels, classify tweets as positive or negative, classify news according to topic.

Natural language processing offers wide range of applications in space exploration. Automated Knowledge Base systems that allow astronauts in space to extract knowledge (instructions, articles, solutions) by communicating with artificial intelligence engine that understands human natural speech and produces accurate responses in a form of requested knowledge either verbally or through a computer-generated output or communicates with the ground station to acquire that knowledge as soon as possible. Anomaly detection systems based on natural language processing (sentiment analysis) are able to process large amount of text coming through communication devices to detect abnormally negative or stressful occurrences in speech that could be detrimental in space exploration risk management.

Presenters Biographies:

Svetlana Hanson

Svetlana Hanson is a senior software engineer at Metecs. Svetlana currently supporting Gateway Avionics, Power and Software office with focus on level 2 requirements and ConOps as well as core flight software (cFS) project. Past projects include Internet of Things (IoT), ProX (electronic procedures application), iPASS/NextStep/BAA testing, and multiple AR projects. Svetlana Hanson has been an active member of AIAA for many years. Presently Svetlana Hanson is Houston section chair. Previously Svetlana has served as a Pre-College (k-12) Outreach, public policy and chair-elect. 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.

Olga Perera

Olga Perera is a passionate data science professional with over 10 years of experience in application development and working with organizational data. She is proficient with data mining techniques, machine learning algorithms, natural language processing, relational and noSql databases. Olga is currently completing her graduate studies in Applied Data Science at Syracuse University.

Session B-3 **Lone Star Room**

Climate Change and Engineering

2:30 PM

The Human-Induced Climate Crisis and Responses in the NASA and AIAA Communities

Douglas Yazell

I have PowerPoint-type slides to present from Climate Reality Project, but I also add my own slides with their permission when I speak as one of their volunteer Leaders, as I will do here. The always-updated slideshow presentation by Climate Reality Project's leader Al Gore is a big part of his 50% of the 2007 Nobel Peace Prize. Only Climate Reality Project volunteer Leaders may make these slideshow presentations. This non-partisan group endorses the Green New Deal (as does the non-partisan Sierra Club), so the the Green New Deal (now introduced as a resolution in the Congress of the USA) will also be discussed; Climate, Jobs and Justice. With the AIAA Diversity Working Group in mind, the 20 to 1 ratio, mentioned in the Green New Deal, will also be discussed. That is the ratio of average family wealth comparing White America to Black America. Related Gallup polling data will be discussed. NASA, including Johnson Space Center, has many connections to vital research on the climate crisis, and the NASA climate website is excellent on the subject of the human-induced climate crisis.

Presenter Biography:
Honeywell aerospace engineering 1981-2011, mostly NASA projects. Florida (1981), California (1983), and Texas NASA/JSC community (1992). BSEE, University of South Florida in Tampa, 1983. Master of Science in Engineering, University of California, Irvine. Work included space shuttle entry flight control, Space Station Freedom Guidance, Navigation and Control. International Space Station Guidance, Navigation and Control, and multi-purpose crew vehicle (capsule) Orion entry mode team flight control. Trained as a volunteer with Climate Reality Project in 2015 in Miami Florida with about 1,200 new volunteers. Not all volunteer applications are accepted. Training sessions occur about two or three times per year around the world since about 2006. Training sessions are three days long. Mentored during training in Houston in 2016. Teaching math in public high schools since 2016.

Session B-4 **Lone Star Room**

Aeronautics and Aviation

3:00 PM

A New Discovery: Nonlinear Instability Leading to Loss of Control of Aircraft

Steve Shaojie Tang

This presentation introduces one of the breakthrough findings in the book: Nonlinear Instability and Inertial Coupling Effects – The Root Causes Leading to Aircraft Crashes, Land Vehicle Rollovers, and Ship Capsizes, (2018). The presentation shows an approach to prove analytically, numerically, and experimentally that the nonlinear inertial coupling terms in the original governing equations of aircraft roll, pitch, and yaw are "elephants" in the equations, similar like Coriolis force for hurricane. These nonlinear inertial couplings have been neglected in the traditional practice under linearization. It is proved that these neglected elephants could, under certain conditions, excite roll and yaw resonances simultaneously in a pitch-only maneuver of aircraft, causing "uncommanded" roll, pitch and yaw; and eventually lead to loss of control of aircraft. A live experimental demonstration of this phenomenon using a three-gimbaled framework device will be given during the presentation. As a new discovery, this finding may shed light on the root-cause investigations for the recent crashes of two B737 Max and one B767 at Houston.

Presenter Biography:
Dr. Tang received a BS in Mechanics and a MS in Hydrodynamics from Peking university, a Ph.D in Aerodynamics from Beijing University of Aeronautics and Astronautics, and a Ph.D in Mechanical Engineering from Levich Institute of City College of New York. Dr. Tang worked at American Bureau of Shipping (ABS) for 14 years, specializing in ship and offshore platform dynamics, and was responsible for ship motion analyses for three ship accident investigations: re-investigation of MV Derbyshire missing at sea, Oil Tanker MV Castor damage in Mediterranean sea, and oil Tanker MV Prestige oil spill off the coast of Spain. It was the similarity in dynamics between ships and aircrafts that led Dr. Tang to study the instability of these vehicles for the past 20 years. Since then, Dr. Tang followed up and studied many airplane crashes. Recently, Dr. Tang published a book: Nonlinear Instability and Inertial Coupling Effects – The Root Causes Leading to Aircraft Crashes, Land Vehicle Rollovers, and Ship Capsizes in 2018 and founded a start-up company, Faiteve Inc. to promote the nonlinear instability and inertial coupling technology to save lives.

Session B-5 **Lone Star Room**

Aeronautics and Aviation

3:30 PM

Validation of a Crossflow Velocity Model Between Waverider Flowfield Planes

Jon Clegg

Waveriders are vehicles that ride on their self-induced shock wave system, and are constructed from "known flowfields." Early waverider design approaches incorporated planes made from self-similar flowfields. Examples include Caret and Conical waveriders. For these waveriders, no pressure gradients existed between adjoining planes. Beginning with the Osculating Cones Method, and later with the Osculating Axisymmetric Method and the Osculating Flowfield Method, the flowfields on neighboring osculating planes were permitted to vary. This variability greatly increased the design space available and led to improvements in waverider aerodynamic performance and volumetric efficiencies. The implied assumption is that any crossflow that would occur would be negligible, and that the overall flowfield behavior would be preserved. Beyond a single examination for Osculating Cones Waveriders, no account of the effects from the crossflow, nor the establishment of limits, has been reported for general cases of flowfield variability. Recently, the Euler equations have been examined and equations derived to quantify the crossflow velocity between the osculating planes.

The focus of the current work is to conduct three dimensional numerical simulations of the flowfield around a number of waverider geometries, and then compare the crossflow from the numerical results to the predictions made by the model. Our results indicate that the original crossflow model works well for regions of the flowfield that conform to the assumptions used in the model's derivation. However, examinations of the flowfield revealed that much of the flowfield region has significant gradients of crossflow in the streamwise and vertical directions. These gradients were assumed to be small in the original crossflow model derivation. As such, the regions of applicability of the original crossflow model are very limited. A revised model has been derived that uses the assumption of irrotational flow behind the shock wave system to recast the dropped terms in the original model. These revised terms use variables that are available from the two dimensional flowfields on the osculating planes. Comparison with this new method agree qualitatively with the three dimensional Euler results.

Presenter Biography:
Jon Clegg is a student AIAA member who is currently pursuing a M.S. in Mechanical Engineering at Rice University. There, he is researching mesh free analysis for fluid dynamics problems under Dr. Andrew Meade. Clegg commissioned as a 2nd Lieutenant at the United States Air Force Academy in May 2018, where he received his B.S. in Aeronautical Engineering.

Session B-6 **Lone Star Room**

Aeronautics and Aviation

4:00 PM

Design of a Rocket Flight Experiment to Validate Transonic Drag Minimized Waveriders

Patrick Rodi

Waveriders are vehicles that ride on their self-induced shock wave system, and are constructed from "known flowfields." Recently, an optimization process has been developed for the Osculating Flowfield Method of waverider generation that permits the design of waveriders with physical characteristics matching desired cross-sectional area distributions. To minimize transonic drag, waveriders with cross-sectional area distributions matching those optimized for minimum transonic pressure drag from linear theory (e.g. Von Karman Ogive, Sears-Haack Body) have been designed. To validate this new approach, and the waverider designs generated using this process, a sounding rocket flight test program is underway. The goal of the supersonic test flights is to obtain in-flight transonic drag measurements of waverider geometries that have been optimized to reduce the pressure drag at transonic Mach numbers. The design and development of the flight test article is the focus of this paper.

Presenter Biography:
Dr. Patrick Rodi is a Professor of the Practice in Mechanical Engineering at Rice University. Patrick earned his Ph.D. in Aerospace Engineering from The University of Texas at Austin. Prior to joining Rice University in fall of 2018, Dr. Rodi worked in industry for 23 years specializing in high speed aerodynamics, aerothermodynamics, and vehicle design, most recently as a Lockheed Martin Fellow and the AeroSciences Lead on the Orion Multi-Purpose Crew Vehicle. Patrick has authored over 50 papers on hypersonics, artificial intelligence, grid generation, and optimization. Dr. Rodi an Associate Fellow of the AIAA.