National Aeronautics and Space Administration

2015 Summer Intern Experience

Neil A. Armstrong Flight Research Center

NASA's Stratospheric Observatory for Infrared Astronomy (SOFIA) takes off from home base in Palmdale, California at sunset on May 29, 2015.

Photo by Greg Perryman/USRA

NASA Armstrong Flight Research Center

A Message from the Center Director

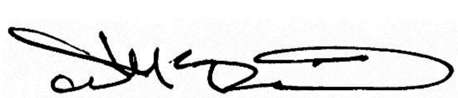
Greetings and congratulations to the NASA Armstrong Flight Research Center Summer 2015 Student Programs cohort!

Students like you—educated in the STEM disciplines of science, technology, engineering and mathematics—are the keys to America's technological leadership and economic growth in the 21st century. A gap remains between the growing need for scientists, engineers, and other technically skilled workers, and the available supply. This crisis has the potential to affect U.S. global competitiveness and the national economy. Our economy and our competitiveness hinge on continuing to fill the pipeline with talented future leaders such as you.

NASA has always been blessed with skilled workers who have made us a world leader. Our program mentors represent the best of these skilled workers. Mentoring is about unleashing the next generation to go do great things. Good mentoring is an integrated group activity and one act can propagate through an organization to create synergies. I see the skill of mentoring the development of the next generation as creating bridges between people and providing them an environment to excel. I sincerely thank the mentors this year for their efforts and support.

It's not just our skills that make us the leader, but our passion, our curiosity, our desire to reach the next horizon, our diversity and inclusiveness, and our ability to make something greater of the whole than the sum of our parts. You have continued your education for such work through your experiences here at NASA Armstrong, and we have benefited from your participation.

As Alan C. Kay of Apple said, "The best way to predict the future is to invent it." That is our mission, and that is your assignment.



David D. McBride
Center Director

NASA Armstrong Flight Research Center

Programs Description

Aeronautics Scholarship Program

The Aeronautics Scholarship Program is part of NASA's Aeronautics Research Mission Directorate (ARMD), which has a goal of advancing the science of aeronautics and fostering new generations of highly skilled scientists and engineers. As part of its commitment to mastering the core competencies of aeronautics in all flight regimes, ARMD is undertaking the Aeronautics Scholarship Program focused on aeronautical research and related degree programs at both the undergraduate and graduate levels. The program awards $15,000 for each school year to undergraduate students and $35,000 for each school year to graduate students. Students awarded the scholarship are provided an internship opportunity with a stipend at a NASA center performing aeronautical research.

Aerospace Education Research Operations (AERO) Associate

The AERO Institute is a consortium to produce the next generation of the aerospace workforce and provides 10-week summer internships to exceptional undergraduate and graduate students with STEM related career aspirations. Summer jobs are assigned based on each participant's skills and abilities and provide students with a comprehensive technical education by allowing them to participate in leading edge aerospace research in an industrial setting. Strategic partners in the AERO include NASA Dryden Flight Research Center, NASA Ames Research Center, and the City of Palmdale, California.

California Space Grant Consortium CASGC

The CaSGC mission is to serve as a crosscutting and integration agent in California to bring the aerospace-related content, technical expertise, and application environment of NASA's scientific and technical Enterprises to the educational community and the general public.

NASA Armstrong Flight Research Center

Programs Description

Curriculum Improvements Partnership Award for the Integration of Research (CIPAIR)

CIPAIR assists two- and four-year minority institutions with strengthening their science, technology, engineering and mathematics academic fields and technical programs. Funding is used to increase the quantity and quality of Science, Technology, Engineering, and Math (STEM) curricula. CIPAIR brings underrepresented and underserved college students and their teachers to NASA centers for research projects aimed at improving curriculums for future generations of students. Students gain the confidence, knowledge and skills necessary to understand conceptual frameworks, apply skills to manage projects and implement solutions to maximize efficiency.

Harriet Jenkins Pre- Doctoral Fellowship Program

The Jenkins Pre-doctoral Fellowship Project, or JPFP, seeks to increase the number of graduate degrees awarded to underrepresented persons (women, minorities and persons with disabilities) in the science, technology, engineering and mathematics, or STEM, disciplines. The ultimate goal is to increase the U.S. talent pool by developing a more inclusive, multicultural and sustainable STEM workforce.

Multidisciplinary Aeronautics Research Team Initiative (MARTI)

The NASA MARTI program offers an immersive, integrated, multi-disciplinary opportunity for students with career aspirations in the national aeronautics enterprise. The academy prepares aspiring young professionals for employment in aeronautics by providing opportunities for direct science and engineering experience with an awareness of the complex managerial, political, financial, social, and human issues faced by current and future aerospace programs. Participants in the program must be enrolled in Aeronautical, Aerospace Engineering or other related engineering discipline. Research Associates work as a team on a multi-faceted problem as guided by professional scientists and engineers..

NASA Armstrong Flight Research Center

Programs Description

NSF CREST

The Centers of Research Excellence in Science and Technology (CREST) program provides a substantial source of Federal support for research at minority-serving institutions across the United States. By facilitating research projects in science, technology, engineering and mathematics (STEM) disciplines with multi-year, multi-million dollar cooperative agreements, the main goal of CREST and its awardees is to build the research competitiveness of minority-serving institutions while increasing the recruitment and retention of individuals from diverse backgrounds in STEM study and STEM-based career

Universities Space Research Association (USRA)

NASA awarded a cooperative agreement to Universities Space Research Association to support the agency's education internship programs. USRA is a recognized leader in administering educational opportunities for students and teachers that lead to employment with NASA.

UpWard Bound Program

Upward Bound serves high school students from low-income families in which neither parent has earned a bachelor's degree. CSUSB Upward Bound provides free services that include: skills building, personal development and leadership activities, college visits, assistance with the college and financial aid application process, and a Summer University Program, which allows students to work on their academics to ensure college readiness.

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John Giammarino

NYU Polytechnic School of Engineering

Aeronautics Scholarship Program

Undergraduate Intern
Mechanical Engineering

Mentor: Matt Moholt
Code: RS
Aerostructures Branch

Developing an End-to-End Process for the Design and Manufacture of Airworthy Composite Hardware

Composite parts are very useful in aerospace applications for their high strength characteristics. Currently, the airworthiness definition does not exist for designing and manufacturing composite hardware at the National Aeronautics and Space Administration (NASA) Armstrong Flight Research Center. Engineers are limited to implementing solutions which may be less appropriate for a particular design than a composite solution. Armstrong's Aerostructures, Operations Engineering, Structural Fabrication, and Aircraft Support branches have drafted a framework by which to design and build airworthy composite parts. The goal of my summer project is to exercise the framework with a test case that starts with hardware requirements and concludes with an airworthy part. A wing-to-body fairing from a Global Hawk UAV was selected as the test piece to design my component around. Using a 3D scanning device, the shape of the fairing can be digitally reproduced and uploaded in the Pro Engineer 3D modeling program. This scanned model can then be made into a mold from which my component can be fabricated. The goal of this step is to develop a repeatable, robust manufacturing process which takes into account the mold type, mold treatment, release, ply angle tolerance, matrix application, cure cycle, et cetera. A combination of finite element analysis, witness coupons, and non-destructive evaluation standards will be used to prove the airworthiness of the finished part. This project demonstrates the feasibility of airworthy composite component fabrication at Armstrong. Running through this process from the design stage all the way to the finished component stage, will prove to be a valuable learning experience for the Armstrong team. Lessons learned during this exercise will help to minimize complications seen while working with more mission-critical or expensive components in the future.

Joaquin Martinez

California State University Long Beach

Aeronautics Scholarship Program

Undergraduate Intern
Mechanical Engineering

Mentor: Tim Cox
Code: RC
Dynamics and Controls

Developing a Research Test Bed for Small UAV's

The mass moment of inertia is a measure of how much an object will resist angular acceleration in a specified axial direction. This property can be used in flight to better understand how control surfaces of an aircraft will affect the pitch, roll, and yaw of the aircraft. My project over the summer was to create multiple technical models, such as an inertia and aerodynamic model, of an aircraft called Hugh . To calculate the inertia of the aircraft, the aircraft was hung from a test rig, and then the nose of the aircraft was perturbed to initiate a lightly damped oscillatory response. The measured frequency of the response was used to calculate the inertia in that axis. The aerodynamic model of the aircraft was estimated using flight data gathered on the aircraft during a previous flight and a program called Parameter Estimation (PEST). PEST uses aircraft dimensions and moments of inertia with the equations of motion to iterate aerodynamic derivatives until the estimated time history responses match the flight data. These aerodynamic derivatives are then used to create an aerodynamic model of the aircraft. These models will allow any future researcher working on or conducting experiments with Hugh to have a complete model of the dynamics of the aircraft and hence allow them to conduct more precise experiments.

Benjamin Martins
University of California, San Diego

Aeronautics Scholarship Program

Graduate Intern
Aerospace Engineering

Mentor: Francisco Pena
Code: RS
Fiber Optic Sensing Laboratory

Utilizing Dynamic Strain Measurements for Applications in Structural Health Monitoring

In-situ structural health monitoring has gained increasing research attention in recent years as a way to increase the utility of aging metallic and advanced composites as primary structural components in aerospace structures. Successful implementation of a structural health monitoring system would usher in the transition from time-based to condition-based maintenance in aircraft structures, with associated advantages, like advanced certification methods, improved operational efficiency, and increased safety.
The current research focuses on utilizing a network of strain based fiber-optic sensors which can provide both global behavior as well as localized impending damage of metallic and composite structures. The lightweight, easily multiplexed fiber-optic strain sensors make it possible to establish an in-situ, large scale, distributed network of thousands of sensors with negligible weight penalty. Strain data from the fiber-optic sensors is used to develop the frequency response functions (FRFs) for a structure at thousands of points. Comparing the FRFs obtained by the optical strain sensors at various points in time allows for the detection of changing structural properties which are fundamental to structural health monitoring.

Michael Arreola-Zamora

University of California, Los Angeles

Aerospace Education Research Operations (AERO) Associates

Undergraduate Intern
Mathematics
Astrophysics

Mentor: Kurt Kloesel
Code: RA
Aerodynamics and Propulsion

Thermodynamic Modeling of a Turbine Engine Using the Brayton Cycle

The purpose of this project is to construct a Brayton cycle thermodynamic model of a turbine engine. Using a fifteen pounds-force micro-turbine engine, data was obtained and used to theorize the operation of larger turbines. The engine controller is a necessity to the operation of the turbine and receives inputs: RPM, temperature, and user throttle. This information is used to control the engine fuel pump flow rate. Modern engine controllers have an automated fuel ramp sequence allowing users to avoid damaging the turbine. This ramp sequence gradually rises as each received input rises, informing the fuel pump and user if any errors occur (Ex. temperature too high). The knowledge and simulation of these ramping functions will assist in the implementation of a hybrid turbo electric airplane control system. This will help reduce both emissions and the consumption of fuel for larger aircrafts. The use of this information can make future aircrafts more efficient by allowing them to travel greater distances. With further investigation, this model can be used as a basis for turbine engines used in the future for electric powered airplanes.

Nathan Bell

University of California, Los Angeles

Aerospace Education Research Operations (AERO) Associates

Graduate Intern
Physics

Mentor: Al Bowers
Code: R
Research and Engineering Directorate

Prandtl Propeller Design

A propeller functions like a rotating wing, creating thrust as it rotates in the same way that a wing produces lift. Unlike a wing, however, the velocity of a propeller blade is not constant all the way out to the tip. The blade velocity increases with the radius, causing most of the thrust to be generated nearer to the blade tip. This velocity causes an increase in induced drag and torque. Accordingly, there is a need for modifications to propeller design to mitigate these problems and increase propeller efficiencies. The objective of this project is to design a more efficient propeller by applying techniques previously used on the Prandtl wing design. Specifically, the bell-shaped lift distribution of the Prandtl will be applied to the blades. Using XROTOR , a propeller design and analysis program, the blade geometry will be altered in iterations and analyzed until the desired thrust distribution is achieved. Primarily, the blade twist will be altered. The propeller will then be tested to determine its actual performance, and the required changes will be made to the propeller design. By the end of the design process, a propeller will have been produced displaying increased thrust with reduced induced drag and torque.



Olivia Bosma[1]
Embry Riddle Aeronautical Univeristy
Taylor Jensen[2]
Antelope Valley College
Alexander Chen[3]
Duke University

Aerospace Education Research Operations (AERO) Associates[1,3]
Universities Space Research Association (USRA) [2]

Undergraduate Interns
Aerospace Engineering[1]
Engineering & Law[2]
Biomedical Engineering[3]

Mentor: Albion Bowers
Code: R
Research and Engineering Directorate

Simulation

Birds have kept the secret of flight locked in their wings for millions of years. Understanding the flight of birds seems simple enough, but with a slightly different structure used for human flight, it is no easy task. The Prandtl wing is the first refined aircraft of its kind, complete with no vertical tail and wing twist/taper, mimicking a similar body structure as birds.

When an aircraft is in the research stages, pilots perform doublets, which are certain maneuvers that agitate roll, pitch, and yaw. For Prandtl, the remote control surface still produces noise. With autopilot included, noise can be reduced and human error can be eliminated, so data analysis becomes easier. One way to make sure autopilot works is to create a simulation that will allow for accurate predictions as to how the Prandtl wing behaves with autopilot. Simulations provide valuable information, by both providing confidence in the system and revealing issues in the program that can be evaluated. With a simulation, other autopilot functions including the rumble can be analyzed for correct behaviors and proper responses.

Tyler Clinkaberry
UC Santa Cruz
Aerospace Education Research Operations (AERO) Associates

Undergraduate Intern
Computer Engineering

Mentor: Bob Guere
Code: MR
Range Operations

Radio Frequency Communications

In the Range Operations Branch, communication systems are very important in ensuring everything runs smoothly by making sure the entire team can stay in contact, and that data can be collected from aircraft. Gregory Strombo supports improvements to the International Space Station (ISS) Very High Frequency (VHF) communication system, and he is working with me to create a Simulink model of the Human Space Flight V1 Emergency Communications System. This project is intended to improve system documentation by creating a block diagram that numerically describes the radio frequency characteristics of each component, and the system as a whole. The Simulink model will enable the user to quickly evaluate alternate configurations, enhancements, or be incorporated into larger models for inter-system analyses. This allows for further improvement of the system, and increasing the speed at which improvements are made. Lastly, my project will include an evaluation of the predicted system performance in comparison to measured system performance. Model validation will consist of comparing predicted signal loss and reflected power to measured system S-parameters. This new capability will lead to better signal output and more reliable communications with the ISS.

Or Dantsker
University of Illinois

Aerospace Education Research Operations (AERO) Associates

Graduate Intern
Aerospace Engineering

Mentor: James Murray
Code: RA
Aerodynamics and Propulsion Branch

LEAPTech HEIST Wing Pressure Distribution

The Leading Edge Asynchronous Propeller Technology (LEAPTech) project will test the premise that tighter propulsion-airframe integration, made possible with electric power, will deliver improved efficiency and safety, as well as environmental and economic benefits. An experimental wing, called the Hybrid-Electric Integrated Systems Testbed (HEIST), was fabricated and mounted on a specially modified truck to experimentally measure the efficiency improvement. Instead of being installed in a wind tunnel, the HEIST wing section will remain attached to load cells on a supporting truss while the vehicle is driven at speeds up to 70 miles per hour across the lakebed at NASA Armstrong. In order to assess the efficiency of the wing, pressure taps were installed along circumference of several sections, inboard and outboard of a wing mounted motor. Given the data generated by these ports, I will calculate the pressure distribution along those sections, which will be used in the future to determine the lift, drag, and moment created by the wing. Performing this data reduction for a variety of wing and propulsion configurations will help to judge the efficiency of the wing.

Bryce Doerr
University of Minnesota-Twin Cities

Aerospace Education Research Operations (AERO) Associates

Undergraduate Intern
Aerospace Engineering

Mentor: Manny Castro
Code: ME
Simulation Engineering Branch

PRANDTL-D Aircraft Flight Simulation

The primary objective of the PRANDTL-D aircraft simulation is to validate Ludwig Prandtl's theory that a bell-shaped lift distribution, as opposed to the accepted elliptical lift distribution, across the aircraft wingspan is more efficient for flight. The bell-shaped distribution causes proverse yaw, which counteracts adverse yaw, eliminating the need for a rudder as the aircraft will cease to yaw in an undesired direction during roll maneuvers. The PRANDTL-D aircraft simulation and flight tests are the few ways to prove the efficiency of the bell-shaped lift distribution. In order to verify the bell-shaped lift distribution of the aircraft via simulation, the Coresim used in the Simulation Branch will be adapted for the aircraft. Although the simulation code has been refined with models of other aircraft, the simulation code must accommodate the aerodynamics, mass, and control surfaces of the PRANDTL-D aircraft. Aerodynamic and mass data will be taken from the aircraft to simulate the aircraft accurately in the simulation environment. An emphasis will be the testing of the aircraft simulation in a similar manner with the flight tests to verify the flight data. This method will allow further proof of the aircraft performance characteristics and support Prandtl's theory of a bell-shaped distribution as the overall most efficient lift distribution.

Louis Edelman

University of California, Davis

Aerospace Education Research Operations (AERO) Associates

Undergraduate Intern
Aerospace Science & Engineering

Mentor: Claudia Herrera
Code: RS
Aerostructures

ACTE Structural Dynamics Analysis

The Adaptive Compliant Trailing Edge (ACTE) experiment installed on the SubsoniC Research Aircraft Testbed (SCRAT) G-III aircraft seeks to demonstrate the structural effectiveness of a compliant lifting surface under the unsteady aerodynamic loads of flight. ACTE technology promises a lightweight high-lift device capable of spanwise lift distribution adjustment, while maintaining a continuous outer mold line. As a part of the NASA Environmentally Responsible Aviation initiative, ACTE promises a 3.5 percent drag reduction when retrofitted to an existing design and up to 12 percent on a clean sheet design.

The technology has flown over the past year and is preparing to extend the test campaign into the transonic regime. Before the flight envelope can be extended, it is necessary to analyze the performance of each ACTE component in order to fully understand the aeroelastic dynamics and safety of flight. The development of a flight condition cross-comparison tool allows engineers to analyze how aerodynamic, vibrational, and structural parameters influence each other and change over the flight envelope.

Lindsay Flasch
The University of Tulsa

Aerospace Education Research Operations (AERO) Associates

Undergraduate Intern
Electrical Engineering

Primary Mentor: Steve Jensen
Code: RT
Secondary Mentor: Fred Reaux
Code: RD
Research and Development

7-Output DC Power Supply

Direct current (DC) power supplies are often used on test benches to give the proper power to run the test equipment. Their use comes from their ability to supply a range of voltages and currents at great accuracy. Power supplies are a necessity for any lab environment where electronics are being tested. Many types of complex circuits, especially those that are used in aviation, require several different voltages to run. A circuit board may have a microcontroller, a sensing unit, and a microprocessor that all require a different voltage. Normally this would take two to three power supplies to run this board. Not only would this take up a lot of space, but it would also use up a lot of power supplies. The more power supplies being used on one project, the fewer that will be available for other projects. A possible solution to this problem is to create a power supply with more than one or two outputs. My project is to help design a 7-output DC power supply. This power supply will give out 3.3V, 5V, 28V, ±15V, and ±adjustable voltage from .3V to 10.5V. The constant voltages were chosen because they are some of the most commonly used voltages for electronic equipment. Designing a power supply requires knowledge of electronics and programming. The intern will need to learn to program in Spin, the language of the microcontroller that will be used. This microcontroller will control all aspects of the power supply, but the roll of the intern will be to program the touch screen interface of the supply.

Logan Francisco
Embry-Riddle Aeronautical University
Aerospace Education Research Operations (AERO) Associates

Undergraduate Intern
Software Engineering

Mentor: Allen Parker
Code: RD
Electronic Instruments Systems

Raspberry Pi Communications and Data Retrieval

Data communication is perhaps the most common yet unrecognized procedure in the modern world. What most people don't think about, though, is all the technical interaction underneath the convenient and common products and processes that go on every day. However, these processes aren't done automatically when on the forefront of research. For instance, collecting data from numerous liquid metal strain gages (LMSG) , which sense expansion and contraction, in a viable and cohesive manner requires interfacing with multiple platforms. These platforms include the sensors themselves to collect data, the microcontrollers to control the sensors, and the method of data retrieval whether that be storing the raw data or exporting the data to a computer to interpret it. My part is to use a Raspberry Pi (a small, but powerful Linux-based computer) to interface between the microcontrollers and the outside world wirelessly. The Raspberry Pi will be "stacked" with eight LMSGs to both collect data and organize data in a cohesive manner suitable for wireless communication to be interpreted by LabView on a computer. By accomplishing this, researchers will be dealing with a more convenient and standardized process to hopefully accelerate research as field testing will not only be easier, but far more efficient.

Jeremy Germita
Antelope Valley College
Aerospace Education Research Operations (AERO) Associates

Undergraduate Intern
Computer Science

Mentor: Matt Reaves
Code: RT
Vehicle Integration and Test

SOFIA Water Vapor Monitor Temperature Safety Switch

Many instruments and sensors are quite sensitive to temperature conditions. When operating these at temperatures higher than their rated temperatures, we risk damaging critical components or gathering faulty data. The Strategic Observatory for Infrared Astronomy (SOFIA) Water Vapor Monitor (WVM) is no exception.

The temperature safety switch is a component designed to switch-adjust the power to the WVM in response to the temperature. However, due to the inductive properties of many electrical components, it is extremely dangerous to rapidly switch an electrical system on and off. To mitigate this effect, the temperature safety switch is designed to switch the system off at 105 degrees Fahrenheit, and not restore power until the system ambient temperature returns to a safe lower threshold of 90 degrees Fahrenheit. This method prevents a "ping-pong" effect in which power would be restored and cut at a rapid rate due to the temperature rising and falling.

The temperature safety switch system aims to protect the electrical components within the WVM from both temperature stresses and electrical inductive stresses, to allow the WVM to safely gather consistent data between flights.

Nicole Gillian

The Art Institute of California – Orange County

Aerospace Education Research Operations (AERO) Associates

Undergraduate Intern
Photography

Mentor: Jim Ross
Code: MI
Information Systems

Photography Documentation of Aerospace Engineering

In the Photo Lab at the National Aeronautics and Space Administration (NASA) Armstrong Flight Research Center, I am learning progressive photography methods for documentation of aerospace engineering research. Our primary goal is to document data on all aircraft when needed. It is critical to get every shot for the crew of the aircraft, so the engineers can make the right corrections. My role as an intern is to help see all of the photos we need to document. The photo reflectors indoors, make sure our shutter speed, aperture, and International Organization of Standardization (ISO) are all correct for the right white balance. Our first project was photographing all of the interns for their abstract photo by working with soft boxes in the lab. One project we have shot a few times, now, is the Prandtl. Documenting the Prandtl was a challenge of panning, zooming, focusing on the plane, and keeping it in frame. Another project in the works is Viper; many engine tests have been in process solving in flight air changes. We photograph many different parts of the wings and engine on Viper. I am assisting one of my mentors on a shoot of the X-34 Advanced Technology Demonstrator , which has not moved in 15 years, to see if the spacecraft is salvageable. Our job was to document every piece that is damaged inside and outside of the spacecraft . The Photo Lab gets many random calls from different hangars who need documentation before they can move on with their project.

Darian Grisso

San José State University

Aerospace Education Research Operations (AERO) Associates

Undergraduate Intern
Health Science

Mentor: Miriam Rodon
Code: XV
Industrial Hygiene

Industrial Hygiene & Other Employee Resources

Enacted in 1970, the Occupational Health and Safety Act allows every employee a place free of recognized hazards that are causing, or are likely to cause, death or harm. Because of this, the Industrial Hygiene department works to protect Armstrong Flight Research Center (AFRC) employees from hazards such as elevated noise, chemical, or laser exposure, as well as poor ergonomic workstations that contribute to musculoskeletal diseases. This summer, I have two primary focuses: evaluating and advising employees on proper ergonomic workstations, and the consolidation and organization of data from noise surveys collected over the last fifteen years to create a map of measured areas. Industrial Hygiene, however, is just one part of the team that helps to support the facility and its mission by supporting the workers. With the guidance and influence of individuals in the Health Unit, Equal Opportunity Office, and the Employee Assistance Program, I have created a survey to evaluate what type of health problems (physical, mental, or social) AFRC employees face. With this information, a program can then be designed to address the needs of our employees to help them be most efficient in their work. For example, this information can determine if tobacco cessation workshops would be beneficial for Armstrong employees.

James Hamory
The Master's College

Aerospace Education Research Operations (AERO) Associates

High School Graduate
Communications- Electronic Media

Mentor: Lori Losey
Code: MI
Information Systems

Tastes Like Videography

During my time at the National Aeronautics and Space Administration (NASA) Armstrong Flight Research Center (AFRC), I will be able to discover many components of a video department and establish for myself a foundation upon which I can build my career. I will be exposed to the many different aspects of the department and become part of the working team for several projects. For example, I will be working behind the scenes to run the weekly Brown Bag Seminars. I will be operating cameras, working the sound board, setting up microphones, making adjustments to the lighting, producing the live stream, directing the control room, and other necessary tasks. This is one of the more exciting parts of my summer job, and I look forward to doing what needs to be done to make each seminar a success.

One of the more menial tasks I have this summer is to digitize old footage of NASA projects and seminars, and produce DVDs equipped with closed captions. I will be aiding in the process of ingesting the film archive to a new and modern platform. This process involves borrowing tapes from the tape libraries, making digital copies of the old footage, ordering transcripts of the videos to make closed captions, saving the files on the server, and burning new DVDs. This project contributes to the NASA mission of innovation and improvement for the future, as digitizing old footage preserves the documentation of NASA accomplishments and keeps AFRC up to date with modern technology.

This internship gives me the opportunity to shadow the department videographers and witness firsthand what a career in the video field entails. I also get to be a videographer myself as we film and document the Prandtl project that some of the other interns are working on. These experiences will benefit me greatly as I begin to pursue a career in this field.

Nicholas Horn
The Ohio State University

Aerospace Education Research Operations (AERO) Associates

Undergraduate Intern
Aerospace Engineering

Mentor: Josué Cruz
Code: RS
Aerostructures Branch

Structural Loads Analysis for ACTE using Tecplot and Matlab

The Adaptive Compliant Trailing Edge (ACTE) project modified a Gulfstream III (G-III) aircraft with a new flexible flap that creates a seamless transition between the flap and the wing. As with any new modification, it is crucial to ensure that the aircraft will not become overstressed in flight. To test this, StarCCM – a computational fluid dynamics (CFD) software program – was used to calculate aerodynamic data for the aircraft at given flight conditions. The CFD model contains node and pressure coefficient (C_P) data for thousands of panels, which combine to make up the G-III aircraft's surface. My project was to take this data, formatted as a Tecplot (a post-processing tool) file, and conduct a loads analysis for the aircraft. The project provided the team with the necessary tools to prove that the aircraft can operate safely within all areas of the flight envelope. To do this, I used Tecplot's built-in functions to find the area, center, and normal vector for each panel. The data was saved, along with each panel's C_P, to a text file. Next, my Matlab script loaded the file, scaled and translated the data appropriately, and calculated the aerodynamic loads on the aircraft. Finally, the inertial loads were calculated and added to give the total load, which is compared with actual flight data taken on the aircraft.

John Jackson
University of Minnesota, Twin Cities

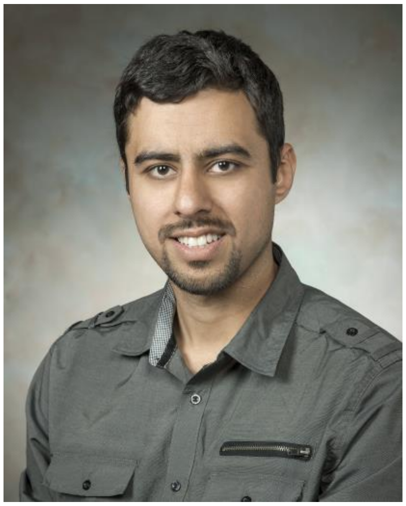
Aerospace Education Research Operations (AERO) Associates

Undergraduate Intern
Aerospace Engineering and Mechanics

Mentor: Tim Cox
Code: RC
Controls and Dynamics

sUAS Vibration Isolation

Hugh is a small unmanned aerial system (sUAS) operated by the NASA Armstrong Control and Dynamics Research Group, used for flight dynamics research. Hugh was built by the University of Minnesota, Twin Cities' UAV Laboratory and delivered to Armstrong in 2014, with 13 flights performed as of July 2015. The primary research goal of these flights is to collect data to perform a parameter identification (PID) method to characterize the aerodynamic behavior of the aircraft. In order to collect satisfactory data, the vibration of the motor needs to be minimized to prevent noise in the axial acceleration data. Previous work revealed that the aircraft's structural modes were being excited at a range of frequencies, from 48Hz to 190Hz, that correlated to the throttle command of the motor. The approaches for isolating these frequencies include installing rubber seals between the motor mount and the firewall, utilizing a triple-propeller assembly instead of a double-propeller assembly, and redesigning the motor mount. Hugh will be tested on the ground and in flight in order to determine the effectiveness of these methods.



Saba Janamian

California State University Northridge

Aerospace Education Research Operations (AERO) Associates

Undergraduate Intern
Electrical Engineering
Computer Science

Mentors:
Jeanette Le, Ting Tseng, Jeffrey Nelms, Matthew Reaves, Matthew Enga
Code: RE

Environmental Test Procedure for X-5000 Data Processor

The equipment used in any flight-vehicle system needs to be environmentally tested in order to ensure its survivability in the flight-operational environment. The purpose of this project is to develop an environmental test procedure for the X-5000 data processor. The X-5000 decommutator (decom) is a part of SOFIA instrumentation equipment and is used to process and decode data stream received from the data acquisition units (DAU). The processed data can be used for on-board, real-time data monitoring. The environmental test consists of thermal/altitude and random vibration tests. The thermal/altitude test is performed in a range of 0 Fahrenheit degrees to 160 Fahrenheit degrees, with the equivalent operational altitude condition of 17,000 ft (with the device powered on) and 50,000 ft (with the device powered off). The random vibration test is performed on all three axes according to Curve PA of document DCP-O-018 with the device powered on and connected to an in situ workstation with OMEGA NExT software for live monitoring of the performance.



Victoria Jenne[1]
Antelope Valley College
Emma Ruano[2]
Bakersfield College
Lynn Valkov[3]
Temple City High School

Aerospace Education Research Operations (AERO) Associates

Undergraduate Intern[1,2]
High School Student Intern[3]
Astrobiology[1]
Mechanical Engineering[2,3]

Mentor: Albion Bowers & Oscar Murillo
Code: R
Research and Engineering Directorate

Moments of Inertia Testing for PRANDTL-3

The primary purpose of Primary Research Aerodynamic Design to Lower Drag (PRANDTL) is to achieve and research the bell-shaped lift distribution produced in flight. Prior to flight testing, however, the glider itself must pass a number tests to produce variables which are essential for data analysis. One of the most imperative tests conducted before flight is the Moments of Inertia test, or MOI. Testing to find the glider's tendency to resist angular acceleration, a structure intended to have the dimensions 15x15x15 ft will fit the 25-ft wingspan. The MOI Testing will conduct three tests to find the variables for roll, pitch, and yaw. Primarily, the MOI testing will help determine how fast the plane will turn with the given elevon deflection. The calculations from the testing will also determine the angles necessary to be applied to the ailerons, in order to turn at a desired rate. Performing these tests and using the data will allow us to further analyze the data collected from the flight-tests themselves.

Robert Kotcher

Carnegie Mellon

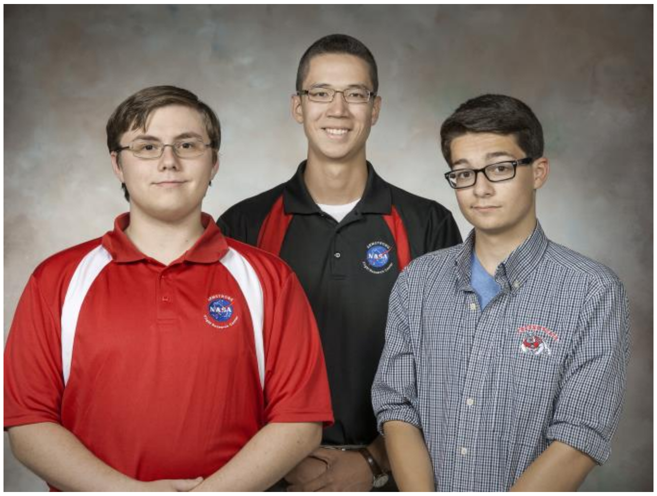
Aerospace Education Research Operations (AERO) Associates

Graduate Intern
Computer Science

Mentor: Ricardo
Code: RD
Electronic Instruments Systems Branch

Structural Loads GDL88 Installation onto the NASA GlobalHawk UAV

The National Aeronautics and Space Administration (NASA) is currently working to prepare the Global Hawk unmanned aerial vehicle (UAV) for a variety of missions with an objective of surveying hurricanes and collecting data for science experiments. The UAS in the NAS program, a joint effort between NASA and the Federal Aviation Administration (FAA), has the objective to develop technologies that will allow UAVs to safely be integrated into the U.S. airspace. One way in which Armstrong Flight Research Center has been involved with the UAS in the NAS program is through the development of sense and avoid software that can receive and manage data from automatic dependent surveillance broadcast (ADSB) systems. ADSB is an important surveillance technology that must be integrated onto all aircraft in the U.S airspace by 2020, and the Global Hawk is hoping to get a head start with the technology. My objective is to help integrate ADSB onto the Global Hawk network, ultimately allowing the data to be read by software developed at Armstrong Flight Research Center. My work involves choosing and installing network devices so that data can be transmitted safely and efficiently through the Global Hawk network. Additionally, I am updating the software to talk to the new devices.



Caleb Lloyd[1]
Georgia State University
Loren Newton[2]
The University of California
Kurt Pauer[3]
Fresno State University

Undergraduate Interns
Physics[1]
Mechanical Engineering[2,3]

Mentor: Albion Bowers
Code: R
Research and Engineering Directorate

Aerospace Education Research Operations (AERO) Associates[1,3]
California Space Grant Consortium CaSGC[2]

Data Analysis of PRANDTL-D Aircraft

The overall goal of the PRANDTL-D project is to construct and evaluate, via flight-test, scale flying wings to prove the validity of bell-shaped lift distributions, proverse yaw, and rudderless flight. This manifestation of the PRANDTL-D project seeks to analyze flight-test data so as to determine the aerodynamic coefficients of the PRANDTL-2 aircraft. Utilizing NASA Armstrong's parameter estimation (pEst) MATLAB program with flight data and calculated moment of inertia values as inputs, the aerodynamic coefficients of the aircraft can be determined. This task is of utmost importance to the overall goals of the project, as the coefficients to be calculated can model the flight characteristics of the PRANDTL wing. Specifically, a positive coefficient of yaw due to aileron deflection ($C_{n\delta a}$) will prove the existence of proverse yaw, a fundamental design objective of the PRANDTL program. By the time the PRANDTL-D project is completed, many aspects of aerodynamics and flight-testing, including data collection, aerodynamic coefficient determination, and lift distribution, will have been explored and considered. Through flight analysis, the truly revolutionary nature of the PRANDTL wing can ultimately be quantifiably communicated.

Jonathan Lokos

Cal Poly San Luis Obispo

Aerospace Education Research Operations (AERO) Associates

High School Graduate
Mechanical Engineering

Allen Parker
RD
Electronic Instruments Systems

Rapid Prototyping

Rapid prototyping is the process by which Computer Aided Design (CAD) software and 3D printing are used to facilitate the early development process of a new design or idea. By using the rapid prototyping process, many potential problems can be identified and eliminated before any real materials or funds are expended. One commonly used CAD software is Solidworks by Dassault Systems. Solidworks is a sketch-based design software in which a solid 3D model is made by drafting a 2D sketch that is then extruded to create a solid, 3D object. Solidworks models are then saved as .SLDPRT files that can be converted to .STL files for use in a 3D printer. This summer, Solidworks were used to design several enclosures that contain various control components for fiber optic instruments. One such enclosure was completely self-contained, housing such components as the power supply, I-MONS interrogator, fiber optic laser, and cooling fan. Solidworks were then used to determine the most efficient and ergonomic way for these components to be arranged inside the enclosure. Various internal brackets and spacers were then manufactured using a 3D printer. Rapid prototyping has allowed these enclosures to be created entirely in 3D before a single hole was drilled saving both time and expense.

Emily Nichols
Gonzaga University

Aerospace Educated Research Operations (AERO) Associates

Undergraduate Intern
Sociology, Business

Mentor: Charles Irving
Code: PS
Science Mission Directorate

Project Management for Armstrong Airborne Science Platforms

The major focus areas of NASA's Earth Sciences Division (ESD) include climate change, severe weather, the atmosphere, the oceans, sea ice and glaciers, and land surface. To study the planet, the Armstrong Flight Research Center (AFRC) flies approximately 2000 hours on Airborne Science Program (ASP) aircraft, including the DC-8, ER-2, C-20, and Global Hawk. It is important for NASA employees involved with the aircraft, as well as guests to the center, to stay updated on the flight status of each mission. In order to increase the availability of information regarding each mission, Code PS has decided to purchase digital signage boxes. The boxes will connect to a TV monitor through HDMI and will project updates, flight status, flight maps, and calendars onto the TV monitor. The monitors will allow anyone in the Code PS office easy access to information on each flight mission. I have been in charge of contacting the company involved, creating a project brief, and, once the brief was approved, I was responsible for getting approvals in order to purchase the box. Once the digital signage box arrives I will work on setting up the monitors and keeping them updated with current mission information over the summer.

Dhvani Patel
University of California, Berkeley

Aerospace Education Research Operations (AERO) Associates

Undergraduate Intern
Mechanical Engineering

Mentor: Matt Enga, Jeanette Le
Code: RE
Systems Engineering and Integration

Cooling Methodology for the SOFIA Mission Controls and Communications System (MCCS)

Within the Mission Controls Communications System (MCCS), the Platform Interface Subsystem (PIS), Data Acquisition Subsystem (DAS), and Telescope Assembly Imager Processing Subsystem (TAIPS) are crucial to the execution of science observations. The DAS gathers a combination of analog sensor data and aircraft avionics data and provides all of this data to the archive subsystem, mission workstations, and science team workstations. This data is also sent to the PIS, which provides the control and monitoring functions between the MCCS and the Telescope Assembly (TA). In addition, the TAIPS collects imager data from the TA, archives the data, and distributes the data to mission workstations. My project addresses an overheating issue on the DAS chassis, which if not solved appropriately, can bring the system down in the middle of a flight leading to a reboot, and thus loss of significant time for science observation.

The proposed solution is an incremental, 3-stage design where subsequent stages can be implemented only as needed. The first stage is to attach heat fins on the hotspot. If that is not sufficient, then the second stage is to attach a fan on top of the heat fins. If the hotspot still remains, a heat pipe system travelling from the hotspot to the front of the chassis will be imbedded into the heat fins as the last resort. If this cooling method produces ideal results, then it will also be implemented on PIS and TAIPS.

Christian Pereira
Cal Poly Pomona

Aerospace Education Research Operations (AERO) Associates

Undergraduate Intern
Major: Manufacturing Engineering

Mentor: Joseph Gonzales
Code: OE
Operations

F-15D Test Bed Development

With the retirement of tail number 836 – NASA Armstrong's modified F-15B aircraft – a newer model F-15D will serve as an aeronautics research test bed as well as a support aircraft. The updated two-seater is required for further system, program, and electrical configuration testing. A workbench is necessary to further aeronautics research, and will support flight-test fixtures including the Advanced Flight Test Fixture (AFTF), Propulsion Flight Test Fixture (PFTF), and Centerline Instrumented Pylon (CLIP). With a workbench supporting these fixtures, test engineers will be able to run new systems and programs and alter configurations while the F-15 aircraft is in flight. The workbench will be large enough to simultaneously host multiple engineers and will be equipped with a workstation for laptops. The workbench will allow engineers to download programs and run trials alongside their equipment. The ability to manipulate these fixtures before installation on the aircraft will enable high levels of efficiency. The workbench will be able to run most, if not all, of the test systems on board the F-15D aircraft.

Tommy Pestolesi
CU Boulder

Aerospace Education Research Operations (AERO) Associates

Undergraduate Intern
Aerospace Engineering

Mentor: Kurt Kloesel
Code: RA
Aerodynamics and Propulsion

An Investigation into Silicon Carbide Motor Controllers for 15 Kw PMSN Motor

Investigate controller and driver designs for a 15Kw LEAPTech (Leading Edge Asynchronous Propeller Technology) motor that are able to take up to 100 volts with current levels of up to 200 amps. One objective is to use less weight with silicon carbide control boards. Using Silicon Carbide makes it possible to use less copper for driving electric motors. Another objective is to use TI(Texas Instruments) C2000 motor control products FOC (Field Oriented Control)-instaspin algorithms that may offer reliable low cost solutions with quick turn around time. The architecture provided allows a flexible use of the controllers. It will enable team members to create PWM signals to any generic driver that is desired for the specific project.
Silicon carbide motor controllers and MOSFET(metal–oxide–semiconductor field-effect transistor) chips were tested in the lab. Their operational tolerances were tested and discovered to function within the required values for voltage and current. TI's GUI interface was used to test the limits of the motors and their control boards.

Kyle Lukacovic[1]
Oregon State University
Alex Petrik[2]
California State Polytechnic University, San Luis Obispo
Shelby Worrell[3]
California State Polytechnic University, Pomona

Multidisciplinary Aeronautics Research Team Initiative (MARTI)[1]
Aerospace Education Research Operations (AERO) Associates[2]
Universities Space Research Association (USRA) [3]

Undergraduate Interns
Mechanical Engineering[1]
Manufacturing Engineering[2]
Aerospace Engineering[3]

Mentor: Al Bowers, Oscar Murillo
Code: R
Engineering and Research Directorate

Defining Characteristics of PRANDTL-3

The purpose of PRANDTL-D is to prove that a bell-shaped lift distribution exhibits proverse yaw. An important part of this project is to find the Moment of Inertia (MOI), a measurement that describes how the vehicle will resist angular acceleration in flight. The moments of inertia are needed to understand the response of the PRANDTL-3 glider to changes in the control surface positions. An Inertial Measurement Unit (IMU) was used to collect the raw data from bifilar and compound pendulums. The methods to obtain moments of inertia included programs such as Simulink, within MATLAB. With these programs, one was able to calculate the expected MOI. In conclusion, finding the MOI and analyzing the flight data helped to explain how PRANDTL-3 executes maneuvers that exhibit proverse yaw.

Pamela Ruffner

Baylor University

Aerospace Education Research Operations (AERO) Associates

Undergraduate Intern
Mechanical Engineering

Mentor: David Tow
Code: MC
Range Engineering

Enhanced Flight Termination Systems

Range Engineering is responsible for developing and maintaining range assets that support missions at the National Aeronautics and Space Administration (NASA) Armstrong Flight Research Center. Recently, Range Engineering has been in the process of updating one such asset to meet the demands of the next generation of flight research. They have developed the Enhanced Flight Termination System (EFTS) and are currently in the testing phase to prove that this new system meets all desired specifications. The testing includes proving the EFTS performs as the manufacturer states, meets requirements determined during development, and contains no bugs or hidden features that could compromise missions. This internship consists of reviewing existing EFTS documents, developing a test plan procedure, and noting the results of testing. The existing EFTS documents include the system requirements specifications from the design process, the operation and maintenance guides for equipment from the manufacturers, and test documents from factory acceptance and from tests done at other locations. The test plan procedure is derived from the existing documents and provides a format to document the verification of or failure to meet requirements during testing. After testing is complete and documented, changes can be made to the system accordingly, or the system can be certified for use.

Savannah Shively
University of California Irvine

Aerospace Education Research Operations (AERO) Associates

Undergraduate Intern
Physics

Mentors: Manuel P. Castro, David B. Spivey
Code: ME
Simulation Software Engineering

Flight Simulator Landing Gear Comparison and Update

This investigation is to identify and address some of the main issues with the 747 airplane simulation's landing gear components. The 747 airplane model was compared to other airplane models to determine how other vehicle simulators replicated forces acting on the aircraft while in contact with the ground. Simulation engineers were approached with questions about the simulation to identify the changes that were most needed. Ground maneuver tests were performed using the 747 airplane coresim to measure stability and performance quality before and after solutions were applied. The primary issue with the 747 airplane gear model was that when the vehicle was at rest, it had a net forward velocity at all times. Secondary issues included adding more customization to the landing gear model. Other gear models, including those from the G-III and F-18 airplanes, were analyzed for options available to users. After applying fixes to the Strut object code model, the idle velocity was reduced by nearly 100 percent. There is now the option to choose the kind of landing gear for each strut. The current options are nose wheel, braking wheel, and skid; more options can be added as functions in the Strut object model. With these additions to the Armstrong coresim framework, they can, in turn, be applied to all current and future simulations.

Billy Sitz

Texas A&M University

Aerospace Education Research Operations (AERO) Associates

Undergraduate Intern
Electrical Engineering

Mentor: Matt Enga
Code: RD
Sensors & Systems Development Research Branch

Developing the SOFIA Digital Video Distribution System (DVDS) test setup in the Hardware-in-the-Loop Simulation (HILS) lab

A few of the functions of the DVDS are to create, distribute, and record video from various sources around the SOFIA aircraft. These video sources include cameras, imager data, and workstation screens. Each of these sources goes through an encoder and is streamed via network to users and systems onboard. Each stream is captured and recorded in a digital video file format and made available to users on their computers, or to the large display monitors installed on the aircraft. The test setup in the lab provides integration and testing capabilities of the DVDS off the aircraft, and in the HILS Lab. Since the aircraft is now in its operational phase, on-aircraft time is limited and highly optimized in order to turn the aircraft around quickly and conduct science missions. The process for developing the test setup includes cable design (with AutoCAD), more specifically a RS485 and power cable, fabrication, and constructing the test environment. The setup will be reviewed to ensure cable design and component installation is correct. Environmental tests will also be performed on various DVDS components to reduce the risk of failure in flight. The next step will be to begin prototyping the functional serial interface between the large displays and the DVDS server.

Patrick Sosa
Georgia Institute of Technology
Aerospace Education Research Operations (AERO) Associates

Undergraduate Intern
Aerospace Engineering

Mentor: Bruce Cogan
Code: RC
Controls and Dynamics

PTERA Flight Test Planning and Preparation

The Prototype-Technology Evaluation Research Aircraft (PTERA) was designed with the intent of providing an extremely versatile, yet inexpensive, flying laboratory to the NASA Armstrong Flight Research Center (AFRC). The PTERA project contributes to the National Aeronautics and Space Administration (NASA) AFRC's mission of "Advancing technology and science through flight," directly by supporting technology research and development, while providing a safe and cost-efficient way to evaluate these technologies outside of a laboratory. The project also helps promote partnerships with other companies and NASA centers, while bringing in funding and research opportunities to AFRC's various branches and small UAV laboratory. My task this summer is to create a flight-test plan; ensure the airworthiness and readiness of the aircraft and support systems that are going to be flight-tested in October of this year; and present this information in a technical briefing for the senior management to review and give flight clearance. As part of this task, I will also be aiding in the development of a flight simulator and the integration of a ground control station in the small UAV laboratory van. Going forward, the flight plan can be used and modified to cater to the needs of experiments and technologies flown on PTERA.

Nicholas Souza

California State University, Northridge

Aerospace Education Research Operations (AERO) Associates

Graduate Intern
Mechanical Engineering

Mentor: Francisco Peña
Code: RS
Aerostructures

Real-Time Wing Shape Control Using Segmented Trailing Edge

Wing shape plays a vital role in the performance of an aircraft, for it determines the vast majority of the aerodynamic properties. Until recently, however, it has been incredibly difficult to get a real-time, accurate estimate of the wing shape during flight. With the advancements in the Fiber Optic Sensing System (FOSS), there have been great strides in achieving precise and distributed strain measurements in real-time on an aircraft. The aircraft used for this project (APV3) is a UAV lined with approximately 2000 fiber optic strain gauges, as well as 44 segmented control surfaces along the trailing edge. Using the displacement transfer function developed at Armstrong Flight Research Center, it is relatively simple to convert the distributed strain readings into an estimate of the wing shape. Once the shape is determined, it is possible to use the segmented trailing edge to redistribute load inboard or outboard in order to reduce bending stresses or increase the efficiency of the aircraft. The redistribution of load could lead to the reduction of support structure in aircraft, which would result in reducing weight. As weight is reduced, so is fuel cost, saving money and the environment. The FOSS has widespread applications with opportunities to make huge impacts on flight and in other areas. Controlling wing shape will be essential for future aircraft and this project is one of the first steps in determining the best methods.

Kyler Stephens

George Fox University

Aerospace Education Research Operations (AERO) Associates

Undergraduate Intern
Electrical Engineering

Mentor: Allen Parker
Code: RD
Electronic Instruments Systems Branch

Liquid Metal Strain Gage Digital Signal Conditioning Development

I, along with Logan Francisco, another AERO Intern, have been tasked with building an interrogation unit that will acquire and store the data generated from experiments in the Fiber Optics Laboratory. Our unit consists of a Raspberry Pi (the "brains" of the unit), up to sixteen liquid metal strain gages (LMSGs) sensors, and a personal computer. My project is to program the LMSGs acquisition board that mounts onto the Pi, using C, to collect the data from the sensors and then to send it via I2C to the Raspberry Pi. An LMSG is a device used for measuring strain on highly elastic materials. Each LMSGs acquisition board consist of three A/Ds (analog-to-digital converters), two D/As (digital-to-analog converters), and a microcontroller. Using Serial Peripheral Interface (SPI), the microcontroller will read the data from the A/Ds and D/As and then send the data to the Raspberry Pi using I2C. The microcontroller will also write instructions to the A/Ds and D/As. Because of the wireless capabilities of the Raspberry Pi, this unit will be able to function in any location where there is a wireless Internet connection. If there is no wireless Internet connection, our unit can function in an alternate mode: the LMSGs can be directly plugged into a PC via USB and run with the PC being the "brains." The purpose of our experiment is to provide an easier and more convenient way to collect and log data from LMSGs.

Ethan Williams

California State University Long Beach

Aerospace Education Research Operations (AERO) Associates

Undergraduate Intern
Electrical Engineering

Mentor: Mark Skoog
Code: Z
Reimbursable Project Office

Evaluating Improved Ground Collision Avoidance Software at Oshkosh Airshow

Controlled flight into terrain (CFIT) is defined as an accident in which an airworthy aircraft, under pilot control, is unintentionally flown into the ground, a mountain, a body of water, or an obstacle. The CFIT accidents are one of the major causes of fatalities in general aviation. iGCAS is a suite of software that aims to eliminate CFIT accidents in general aviation, having origins beginning around 30 years ago with the AFTI F-16 aircraft. The ground collision avoidance algorithm that was written and developed on the AFTI F-16 has been adapted to run on a cell phone. Last summer, I, along with a team of interns, developed an improved pilot-vehicle interface to better convey the information that the algorithm is wishing to convey to the pilot. This summer, my team and I have been preparing to evaluate the effectiveness of the cell phone application. We have found that the pool of test pilots available to us is unsuitable to evaluate the effectiveness of the software. We have decided to conduct a large pilot evaluation at the Oshkosh Airshow, which has a sufficient amount of general aviation pilots. I have been preparing to ship the entire simulator evaluation set up to Wisconsin, and preparing the test environment to ensure that the trip is successful.

Madison Washburn
Brigham Young University

Aerospace Education Research Operations (AERO) Associates

Undergraduate Intern
Elementary Education

Mentor: Kirsten Fogg
Code: K
Office of Education

Educating the Community through Science, Technology, Engineering, and Mathematics (STEM) Workshops

The NASA strategic objective for Education is to “Advance the Nation’s Science, Technology, Engineering and Mathematics (STEM) education and workforce pipeline by working collaboratively with other agencies to engage students, teachers, and faculty in NASA’s missions and unique assets.” The NASA Armstrong Flight Research Center Office of Education is committed to this objective by delivering effective STEM education that provides opportunities for participatory and experiential learning activities in formal and informal settings to connect learners to NASA-unique resources. The AFRC Office of Education provides many STEM education opportunities for learners of all ages throughout the summer to inspire and educate the public, which are as various as the importance of pressure suits, the principles of flight, and the development of Unmanned Aircraft Systems’ integration into the National Airspace System. NASA Education programs, projects, and activities are designed to align with NASA missions with an emphasis on NASA’s content, people, and facilities. NASA Education is directly linked to inspiring the next generation of explorers and innovators and will continue to provide opportunities for learners to engage in STEM education engagement activities that are NASA-unique to attract and retain diverse students in STEM career fields.

Jacob Wilson

University of Nevada, Reno

Aerospace Education Research Operations (AERO) Associates

Undergraduate Intern
Mechanical Engineering

Mentor: Allen Parker
Code: RD
Electronic Instrumentation Systems

Development of a Practical Rigid Enclosure for the Flight Version of the Fiber Optic Sensing System (FOSS)

The Fiber Optic Sensing System (FOSS) team is constantly discovering new and efficient means of measuring temperature, strain, vibration, and pressure. This is achieved by integrating fiber optic cables into a wide variety of systems. The FOSS team has developed and continues to develop a variety of sensing systems which involve numerous electronic components. In the past, the FOSS team has had to purchase prebuilt enclosures that are either too big, too small, or too heavy to use for testing functions. The purpose of my internship is to design enclosures for a number of sensing systems and their subcomponents, and to bring all of the components for each system together into compact, lightweight, low-cost, practical functioning units. Mainly my work will focus on creating a flightworthy enclosure for the FOSS. The design is to be created from scratch, and will include seven major electronic components that will have the capability of sliding in and out of place. SolidWorks® will be used as the main computer-aided drafting and design program, Pro/ENGINEER® will also be used for learning purposes. A detailed technical drawing will be drafted so that the machine shop can easily machine and built the enclosure in a timely manner.

Nicole Lopez

California State University, San Bernardino

California Space Grant Consortium (CaSGC)

Undergraduate Intern
Applied Physics

Mentor: Francisco Peña
Code: RS
Aerostructures

Developing a Real Time Wing Bending and Twist Algorithm Using FOSS

My group is working on optimizing the wing shape of an Unmanned Aerial Vehicle (UAV) during flight, using the Fiber Optic Sensing System (FOSS). Applying FOSS on the wing of an airplane allows us to measure strain in the wings and calculate the lifting load. We are currently using APV-3 as the test airplane for our research; the FOSS system we have applied uses over 2000 fiber optic strain sensors on both wings. The method that is currently in use is having a flat plate with FOSS, in which we place a load on the wing. With the use of LabVIEW we are able to create a program that will show us where the bending and twist is being applied, due to the load. By having these results we will be able to move the load inward toward the root, due to it being the strongest point of the wing to reduce the strain, while also being able to determine the bending and the twist for real-time shape. We will conclude by moving the load inward, giving a better flight so the wings can stay stronger and will not be as heavy throughout the flight.

Kevin Collins
California State University, San Bernardino

Curriculum Improvements Partnership Award for the Integration of Research (CIPAIR)

Undergraduate Intern
Physics

Mentor: Kurt Kloesel
Code: Rt
Vehicle Integration & Test

An Investigation of Digitally Controlled AC to DC Converters

Electronics are powered by direct current (DC), but the power delivered by power generators is alternating current (AC), therefore an AC to DC converter must be employed. The most common type of convert is an uncontrolled rectifier circuit (URC), which make use of diodes and other passive elements to redirect current into one direction. While URCs are effective and have seen wide use in industry, they suffer from less-than desirable efficiency and are unable to dynamically vary their output voltage without additional components. A controlled rectifier circuit (CRC), on the other hand, uses a digital processor to open and close transistor switches. By opening the appropriate set of switches at the correct time the path that the current takes can be manipulated to flow in one direction. Controlled rectifier circuits have greater efficiency than URCs, are able to dynamically vary the amplitude of their output voltage, and can be used as both AC to DC and DC to AC converters. The unique ability to be used as bidirectional converter has led to an increased interest of CRCs and their application to hybrid electric vehicles. For these reasons we construct a CRC and test its bidirectional properties.

Joseph Martinez
California State University, San Bernardino

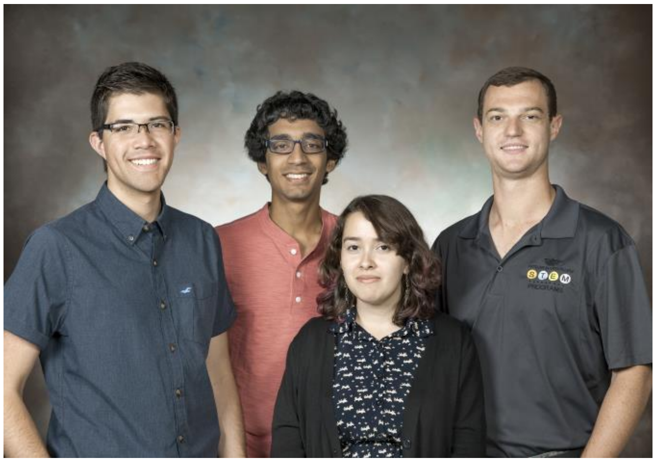
Curriculum Improvements Partnership Award for the Integration of Research (CIPAIR)

Undergraduate Intern
Physics

Mentor: Yohan Lin
Code: RT
Vehicle Integration and Test

3D Electromagnetic Modeling of a High Performance 15kW PMSM Motor

Simulation software can be a useful tool when trying to identify characteristics of a system without the need to physically manufacture anything. To do this, a 3D model of the system is created, and specific physical constraints are defined. Once the model is created, it can be run in a simulation software, and properties of the system can be calculated. Using these techniques, an electromagnetic characterization on permanent magnet synchronous motors can be done to obtain knowledge of various properties of the motor. An important area of interest is in the analysis of the electromotive force that opposes the current traveling through the coil loop (back e.m.f) of an electric motor caused by the spinning magnets in the rotor; it can be thought of as a kind of natural brake in the motor. During the cycle of an electric motor, there are moments when a coil does not have a current flowing through it from the controller, however, the back EMF still has its effect and produces a current in the coil. During this moment in time the current can be measured using that back EMF, and it can be deduced what the speed of the motor is, thus eliminating the need of a sensor and allowing for better control of a motor drive system.



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Will Morris[2]
Cal Poly Pomona
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College of the Desert
Joseph Piotrowski[4]
Cal State Long Beach

Universities Space Research Association (USRA)[1,2,4]
Curriculum Improvements Partnership Award for the Integration of Research (CIPAIR)[3]

Undergraduate Interns
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Civil Engineering[2]
Physics[3]
Mechanical Engineering[4]

Mentors: Dave Berger, Al Bowers, Kirsten Fogg
Professors: Dr. Sim, Dr. Rubayi, Dr. Bowen
Code: R
Engineering and Research Directorate

Atmospheric Characterization on the Surface of Mars

The Primary Research Aerodynamic Design to Land on Mars (PRANDTL-M) flying wing is a prototype of an unmanned glider with the possibility of being sent to gather extraterrestrial data. Potential mission goals include mapping out a proposed landing site for the human exploration of Mars, and geological mapping of Valles Marineris. Considerable terrestrial testing is required to develop the PRANDTL-M, which will be rolled up into a 3U CubeSat module. Many atmospheric sensors will be required to meet the prototyping and development demands of this project. The Arduino microprocessor suite, and its many developmental shields, allow for quick and simple sensor systems, prototyping, and data collection. Measurements taken will record vehicle air speed, orientation, magnetic field, atmospheric methane, pressure, temperature, and other relevant environmental and flight data. Several test flights, evaluating atmospheric sensors, will be executed to determine the flight capabilities for a final high-altitude (100,000 ft) balloon-based drop test. This final test represents a Mars atmosphere equivalent altitude of 12,000 ft and is the first major milestone for the PRANDTL-M mission.

Kelley Hashemi
The University of Texas at Austin

Jenkins Pre-doctoral Fellowship Project (JPFP)

Ph.D. Candidate
Aerospace Engineering

Mentor: Dr. Chan-gi Pak
Code: RS
Aerostructures Branch

Model Reference Adaptive Control for Aircraft with Nonminimum Phase Zeros

The project improves upon a risk-averse adaptive control design for flexible wing aircraft proposed last summer. The design involves partitioning the actuators of an aircraft so that some are used with an existing nonadaptive control law, and the rest are utilized by an adaptive control law to jointly control the vehicle. The partitioning ensures that operation of the nonadpative law is minimally disturbed, and that the ability to turn off the adaptive law is preserved. The partitioning also facilitates the problem being restated as a shifted version of the model reference adaptive control problem (MRAC). However, a longstanding limitation of MRAC is that it cannot be applied to nonminimum phase systems. Since aircraft models are frequently nonminimum phase, the traditional MRAC scheme must be altered to accommodate them. In the current work a new version of the MRAC scheme appropriate for nonminimum phase systems is presented. This version only requires that estimates of the unstable zeros be available for implementation and still provides reasonably bounded output tracking error. The performance of the proposed design for both flutter suppression and command tracking is demonstrated in simulation using various aircraft models.

Keenan Albee[1]
Columbia University
Jonathan Zur[2]
University of Illinois

Undergraduate Interns
Mechanical Engineering[1]
Aerospace Engineering[2]

Mentor: Albion Bowers, Oscar Murillo
Code: R

Multidisciplinary Aeronautics Research Team Initiative (MARTI)

Analysis of PRANDTL 2 Flight Data

The Prandtl-II aircraft is an experimental glider in the Prandtl-D program. During the summer of 2015, the team performed several data collection flights with this aircraft and observed the ability of the aircraft to achieve proverse yaw. Data from these flights was then analyzed in order to obtain the aerodynamic coefficients necessary to study the flight of the aircraft in depth. Specifically, finding the yaw moment due to elevon deflection allowed the team to document the presence of proverse yaw during flight. Finding most of the coefficients required the use of parameter estimation (pEst). The team used the pEst program in order to relate the controller input during a maneuver with the response of the aircraft. The pEst program analyzes the oscillating motion of the aircraft after a maneuver and then attempts to recreate the time history by approximating the aerodynamic coefficients. Through pEst, the data collected during such maneuvers was used to determine the aerodynamic parameters of the glider.

Kira Headrick
Harvard University

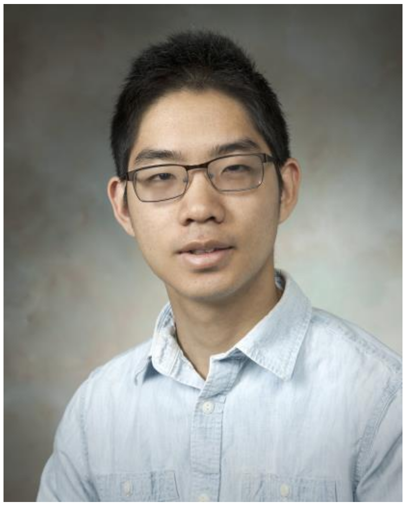
Multidisciplinary Aeronautics Research Team Initiative (MARTI)

Undergraduate Intern
Mechanical Engineering

Mentor: Francisco Pena
Code: RS
Aerostructures

Optimizing Lift in Deformable Wings Using Strain Sensing in Small Aerial Vehicles

My project group is working to interpret data from a Fiber Optic Sensing System (FOSS) measuring strain on the wings of an Unmanned Aerial Vehicle (UAV), and using this information to modify the wing's shape. The UAV being used is the APV 3 aircraft, the wings of which contain over 2000 strain sensors and 44 independently controlled flaps located along the trailing edges. The objective of this project is to deflect the flaps to redistribute the lifting load inward toward the fuselage of the aircraft during both, high-G maneuvers and steady-level flight. This would improve efficiency, gust mitigation, and the reduction of moment along the wing. With a working system, the wing could be built with less weight, thereby saving material and fuel. Code will be written for the flaps to conform to this lift distribution, the system will be tested in the air in late July, and analysis will be performed to determine whether the moment along the wing was reduced when the system was in use. If the moment along the wing was reduced, this would indicate an effective algorithm, and indicate that controllable flaps can usefully redistribute lift. With less moment necessary in the wings of an aircraft to complete a specified maneuver, an equally capable aircraft can be built with lighter, more deformable wings.



Clement Li
Princeton University

Multidisciplinary Aeronautics Research Team Initiative (MARTI)

Undergraduate Intern
Mechanical and Aerospace Engineering

Mentor: Frank Pena
Code: RS
Aero Structures Branch

Development and Evaluation of Feedback Control Systems Using Segmented Control Surfaces and Fiber Optic Sensing System

The Fiber Optic Sensing System (FOSS) consists of Fiber Bragg Gratings that allow for a large quantity of strain sensors to be embedded into a wing at a low weight cost, enabling structural health monitoring of the entire wing. The employment of many segmented control surfaces across the entire span of the wing, however, extends the capabilities of FOSS into the realm of actively shaping the lift distribution. By shifting the lift distribution inboard, it is possible to reduce the bending moment on the wingbox, while maintaining a constant total lift. The feedback control system integrating FOSS data with the actuation of the segmented control surfaces is currently being developed, with multiple control schemes being investigated. In addition to targeting a reference root strain, a control system targeting tip deflection, and eventually tailoring the entire lift distribution, will be developed and flown for evaluation on the small, unmanned APV-3. The control systems will be investigated for the capability to automatically redistribute lift and reduce structural loads during maneuvers with increased wing loadings, as well as for gust alleviation.


Kassidy McLaughlin[1]
California State University at Long Beach
Alexandra Ocasio[2]
University of Puerto Rico at Mayaguez

Undergraduate Interns Mechanical Engineering

Mentor: Oscar Murillo & Al Bowers
Code: R
Engineering and Research Directorate

Universities Space Research Association (USRA)[1]
Multidisciplinary Aeronautics Research Team Initiative (MARTI)[2]

Prandtl-D Flight Testing and Operations

Flight testing is an integral part of the National Aeronautics and Space Administration (NASA) Armstrong Flight Research Center operations and continues to grow tremendously with a variety of upcoming projects. The Primary Research AerodyNamic Design To Lower Drag (PRANDTL-D) seeks to overcome adverse yaw effects by using a non-linear aerodynamic twist. Proverse yaw, the tendency for an aircraft to roll and yaw in the same direction, is possible with the PRANDTL-D distinctive wing shape, lift distribution, and lack of a vertical tail. A PRANDTL-D type vehicle will significantly reduce drag and weight from the aircraft, therefore making worldwide green aviation goals attainable. In order to demonstrate these effects, accurate data must be recorded by performing roll and pitch doublet maneuvers on the aircraft. Instrumentation on the aircraft gathered data of interest during scheduled flights. Individuals within the flight-testing group were assigned roles to oversee flight procedures, aircraft testing, and data management. Briefings were conducted in order to maintain proper communication and ensure the airworthiness of the aircraft. With the data collected from each scheduled flight and with further research in this ground breaking discovery, we hope to be able to influence the future of aviation.

Christopher Trumbull
Utah State University

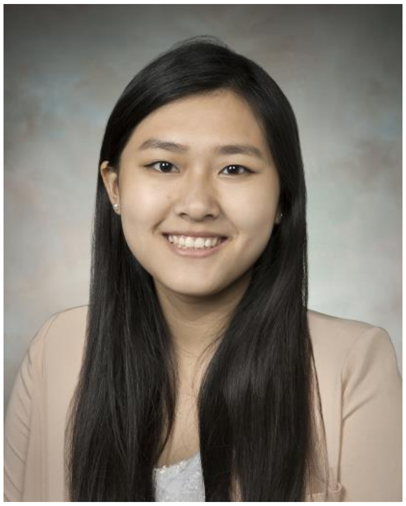
Multidisciplinary Aeronautics Research Team Initiative (MARTI)

Professional Intern
Mechanical Engineering with an emphasis in Aerospace Engineering

Mentor: Francisco Peña
Code: RS
Aerostructures

Controlling Wing Deformation In-flight Using Adaptive Control Surfaces Along Trailing Edge

Enhancing the wing shape of an aircraft provides essential flight characteristics to distribute the aerodynamic load more efficiently. Currently, however, it has been challenging to monitor the real-time shape of the wing during flight. The NASA Armstrong Flight Research Center developed a fiber-optic sensing system (FOSS) that is lightweight and capable of making a multitude of distributed strain measurements on aerospace structures in real time. The aircraft being used for this project is an Autonomous Piloted Vehicle 3 (APV3) with approximately 2000 fiber-optic strain sensors along the wingspan, and 44 segmented control surfaces along the trailing edge. The influences of the FOSS strain measurements can be used to determine the deformation of the wing during flight. Ultimately, when the shape is determined, APV3 will be able to control the trailing edge positions and thus redistribute the load to a more favorable configuration, reducing the bending stresses along the wing and increasing the performance of the aircraft. In addition, monitoring real-time shape would allow a reduction of structure support in the aircraft, minimizing weight and therefore the amount of fuel carried. The research being tested on APV3 is a step toward improving the future of the environment and of efficient flight.



Kaixi Wang

University of Texas at Austin

Multidisciplinary Aerospace Research Team Initiative (MARTI)

Undergraduate Intern
Aerospace Engineering

Mentor: Oscar Murillo
Code: R
Engineering and Research Directorate

Analysis of Steven Portugal's Ibis Formation Flight Data and Application to PRANDTL Aircraft

Many species of birds travel in distinctive "V" formations. Steven Portugal of the Royal Veterinary College has investigated flight formations of the Ibis species. His data can be correlated to the expected bell-shaped lift distribution of the PRANDTL experimental glider currently being researched at the NASA Armstrong Flight Research Center. The raw data collected by Portugal's observation of Ibis flight demonstrates an upwash/downwash curve strikingly similar to that of the PRANDTL glider. This research investigates formation flight of Ibis in order to find a correlation between the formation structure and the lift distributions across the birds themselves. The team used Portugal's GPS (global positioning system) coordinates of the flying birds to plot relationship data of the birds in stable "V" formation using MATLAB®. In this way the team was able to use the PRANDTL upwash curve to find an aerodynamic efficiency curve that can be matched to Ibis flight.

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Troy T. Kuhns

Victor Valley College

NSF Centers of Research Excellence in Science and Technology (CREST)

Undergraduate Intern
Mechanical Engineering

Mentor: Yohan Lin
Code: RT
Vehicle Test and Integration

Design of an AC/DC Convertor Utilizing Silicon Carbide Technology

The Leading Edge Asynchronous Propellers Technology (LEAPTech) program is an experimental project that looks to create hybrid and hybrid-electric aircraft propulsion. By advancing the field of alternative fuel technology like electric and hybrid-electric propulsion for flight the project can contribute to global clean-air and green technology initiatives while also achieving project goals of reduced emissions, noise reduction, and increased efficiency. The goal of this project is to investigate the advantages of using Silicon Carbide Technology over standard silicon based technology in the design of a more efficient AC/DC power convertor. With experimentation of smaller base components the project looks to discover and record the upper and lower operating limits as well as the most efficient operating ranges under a variety of testing variables to diagnose and record input/output variations. The project will apply our findings in the diagnosis of input/output variations of larger complex components which may be used in the creation of a turbo generator AC/DC power convertor. By implementing superior silicon carbide components we hope to increase efficiency and performance of the LEAPTech hybrid-electric propulsion system and project, while meeting project goals and supporting the NASA mission statement.

Timothy Nuñez

Victor Valley College

NSF Centers of Research Excellence in Science and Technology (CREST)

Undergraduate Intern
Computer Engineering

Mentor: Kurt V. Papathakis
Code: RT
Vehicle Integration and Test

LEAPTech Data Mining and Dissemination

The Leading Edge Asynchronous Propeller Technology (LEAPTech) is an experimental production that aims to power the aircraft of tomorrow through electric and hybrid electric means. Alternative power consumption technologies, like electric and hybrid electric flight, contribute to the global push in green technologies that significantly reduce fuel/energy consumption and unclean emissions. The leading objective of this project is to produce aerodynamic and power architecture data from the test runs, and develop a procedure that analyzes and processes the data in an interpretable form to be disseminated to the various stakeholders, including NASA Langley, for design considerations in developing the next electric X-plane. Data will first be collected from the LEAPTech test-runs and accessed through the Omega Data Environment (ODE). The data will then be processed through MATLAB and run through specific scripts that output the data in more manageable graphs and formats. Certain types of data will also be assembled to each user's specific needs and formats. An established process for communicating and disseminating essential data will be established and set the framework for a future position that is in charge of consolidating and disseminating data in the appropriate format to NASA Langley and other appropriate stockholders.

Christy Ailman
Azusa Pacific University
Universities Space Research Association (USRA)

Undergraduate Intern
Mathematics and Philosophy

Mentor: Christian Gelzer
Code: T
Strategic Communications

A Historical Manuscript of the Controlled Impact Demonstration

On December 1, 1984, the Armstrong Flight Research Center (AFRC) assisted the Federal Aviation Agency (FAA) in its quest to improve aircraft crash safety through the minimization of post-impact fire by conducting a full scale crash demonstration, termed as the Controlled Impact Demonstration (CID). The CID resulted in a shocking fireball. Questions still remain unanswered from this event, among them, 'Was this a success or a failure?' 'Was this a test or an experiment?' In an effort to preserve the work performed at, and the lessons learned by AFRC, my project is to produce an historical manuscript for the CID. A previously written manuscript on the CID was rendered incomplete. To provide a complete historical analysis, I seek to answer the questions begged by the CID, as well as highlight AFRC's major contributions to the CID - the Remotely Piloted Vehicle (RPV) development and the Boeing 720 systems integration. More specifically, my project consists of conducting and integrating interviews with CID engineers in to the manuscript, researching archived CID documentation, evaluating the validity of previous sources, updating the previous source information with accurate and archived documentation, and finally, editing, rewriting, and restructuring the manuscript. The manuscript will be completed the summer of 2016.

William Alfano

Rutgers, The State University of New Jersey

Universities Space Research Association (USRA)

Undergraduate Intern
Major I: Electrical & Computer Engineering
Major II: Finance

Mentor: Laura Fobel
Code: RO
Research Operations

Technology Transfer for Improved Aircraft Design (Prandtl Project)

NASA has a long history of testing, retesting, and proving its technologies before trusting them in critical mission applications. NASA is still at the cutting edge of engineering, design, research, and innovation. However, light is not always shed on these brilliant inventions and some radical innovations never make it to the public sector. In order to make these advanced technologies readily available for the public use, NASA assembled the Technology Transfer team. The mission of the Technology Transfer Office at the NASA Armstrong Flight Research Center is to bridge the gap between NASA-engineered technology and commercialization of these technologies in the open market, ultimately granting citizens of the United States access to these inventions. I and my teammate Yasmin Alkusari have been assigned the transfer and commercialization of the Prandtl project. Together we are utilizing our engineering and business backgrounds to come up with unique and creative ways of reapplying the Prandtl project. Essentially, we analyze other potential applications that include wind turbines, animal prosthetics, propellers, automotive spoiler design, new aircraft design, and retrofit solutions. Our end goal is to advance the development of the Prandtl project through various venues that include gaining exposure to multiple subject matter experts on the technology; being involved in current Prandtl-based projects to deepen our understanding of the technology; perform strength, weakness, opportunity, and threat (SWOT) analysis on the project; conduct market studies on new applications; and apply in-depth industry research that provides technical and business possibilities. As well, our objective is to provide a roadmap for commercialization and potential design prototypes through researching and analyzing key business dimensions for primary identified market applications. By using secondary research and inventor interviews and project exposure, we are building an implementable plan with relevant stakeholder contacts and potential commercial distribution channels or strategic partners.

Yasmin Alkusari
The University of Texas at San Antonio
Universities Space Research Association (USRA)

Undergraduate Intern
Biomedical Engineering
Emphasis: Biomechanics, Imaging

Mentor: Laura Fobel
Code: RO
Research Operations

Commercialization of Intellectual Property through Technology Transfer

One of the National Aeronautic and Space Administration (NASA) advancing missions is to develop innovative technologies and disperse them into industry applications for commercial use. By licensing and commercializing innovative technologies discovered, NASA is able to disseminate novel technologies to the public domain. This dissemination results in an increased quality of life, a stronger economy, and the utilization of high-tech devices on a daily basis. The Technology Transfer Office adds significant value to NASA by facilitating the patenting process for the benefit of NASA employees. Working as an engineering consultant alongside William Alfano, my business teammate, we apply our diverse backgrounds to discover unique and innovative commercial applications and opportunities for the transfer of NASA technologies to industry. Working as a team, we look for a wide range of possibilities that these technologies could be used for other than the intended purpose. Our goal is to commercialize government technologies utilizing market studies to determine where new, more efficient technologies can advance or replace existing technologies currently on the market. Engineering and business skills are combined to analyze strengths, weaknesses, opportunities, and threats on NASA innovations. Our objective is to conduct market studies, study relevant patents, and examine the current and new technology in order to develop a commercialization plan. The Technology Transfer Office uses this plan to pursue product licensing. Primary research will be conducted by interviewing inventors to fully understand the innovation and its functions. By using inventor interviews along with secondary research, we can design an equipped plan with pertinent stakeholder contacts in addition to potential commercial distribution pathways or strategic partners. The current technology our team is assessing is improved aircraft design.

Sipanah Arutyunyan[1]
Orlando Mielke[2]
Hussein Nasr[3]
Bogdan Pugach[4]

Cal Poly Pomona[1,2,3,4]

University Space Research Association (USRA)

Undergraduate Interns
Aerospace Engineering[1,2,3],
Electrical Engineering[4]

Mentors: Dave Berger, Al Bowers, Kirsten Fogg
Professors: Dr. Sim, Dr. Rubayi, Dr. Bowen
Code: R
Research and Engineering Directorate

Autopilot System for PRANDTL-M Aircraft

The Primary Research Aerodynamic Design to Land on Mars (PRANDTL-M) is a small glider that will potentially be the first airplane in Mars' atmosphere. PRANDTL-M's mission is to produce high-definition ground mapping and an atmospheric data collection system using a small, custom, lightweight microcontroller platform. The 3DR Pixhawk autopilot open source platform serves as the terrestrial control solution using GPS and standard methods. The Pixhawk will be modified in hardware and software to only include the most essential features, to avoid any unnecessary weight, and improve processor efficiency. The airspeed indicator, altimeter, gyroscope, GPS, compass, optical flow sensor, and accelerometer will gather data to assist in the navigation and control of PRANDTL-M. Pixhawk can be programmed and controlled using QGroundControl software, where the gain values will be tuned to provide for a stable flight-control solution. In addition, X-Plane, a simulation program, is used to run a Hardware-in-the-Loop (HIL) in parallel with QGroundControl to test the inputs and outputs of the system, reducing development time and allowing for first-order testing of new code. PRANDTL-M will be navigated through waypoints initially set in QGroundControl.

Christopher Bryan
Cal State University, San Bernardino
Universities Space Research Association (USRA)

Undergraduate Intern
Physics

Mentor: Joe Pahle
Code: RC
Dynamics and Controls

Display Development for Awareness of Vortex Estimation (DAVE) for Automated Cooperative Trajectories (ACT)

An aircraft in a cooperative flight formation can utilize the upwash of wake vortices generated by a lead aircraft to reduce drag and increase fuel efficiency. A wake vortex encounter while flying near the wake could be dangerous and wake vortices are generally not visible. Automated Cooperative Trajectory (ACT) control algorithms are being developed and a Display for Awareness of the Vortex Estimation (DAVE) is necessary for the pilot to monitor the automated system and display the estimated position information relative to the vortex. Display development will be accomplished on an existing head-down display (HDD) in the SubsoniC Research Aircraft Testbed (SCRAT) piloted simulation. Objects within the display will be driven by the control laws to monitor relative position to desired location and vortex proximity. In order to develop wake displays for the pilot, prototypes will be developed within the engineering team and discussed with pilots for feedback. Several candidate displays will be developed and implemented in the SCRAT simulator during which pilot evaluations will be collected. Results from this investigation will lead to recommendations for a final display.

Benjamin Cobleigh
University of Arizona
Universities Space Research Association (USRA)

Undergraduate Intern
Business Management/
Entrepreneurship

Mentor: Peggy Hayes
Code: XP
Projects

The Mars Airplane Live Event

The Mars Airplane Live event is an event to take place in October at the Aero Institute. Initially, the event needs to be accepted via proposal by the American Institute of Aeronautics and Astronautics (AIAA) for funding. The National Aeronautics and Space Administration (NASA) must also accept the proposition via tactical management board; with both organizations accepting the proposal, the event will be allowed to take place. The main idea is to create an event to attract the younger audience, as well as be a virtual way to obtain information. The event will star the Primary Research Aerodynamic Design To Land on Mars (PRANDTL-M), or The Mars Airplane, and will show the public what the concept is, what the purpose will be, and how they will obtain their expected outcome. The event will be livestreamed in order to appeal to the youth, as well as complete the task of creating a virtual medium of information. The event will start with Al Bowers describing the basics of the PRANDTL-M, followed by two interns who will go more in-depth with what they have been doing for the advancement of this project. The event will be advertised via email and social media, specifically targeting university students as well as young professionals all over the country. The event's goal is to provide a high energy, entertaining, interactive event that encourages the youth to join a prestigious organization that appeals to their love of all things aero.

Rheanna Cowee
San Diego State University

Universities Space Research Association (USRA)

Undergraduate Intern
Business Human Resources

Mentor: Rebecca Flick
Code: K
Office of Education

Coordinating the NASA Armstrong Internship Program

The Office of Education at NASA works in unity with various centers and offices to provide learners with valuable educational experiences. One goal of NASA's education program is to provide a platform for people of all ages to spark an interest in the science, technology, engineering, and mathematics fields. To provide a meaningful summer internship experience, the student coordinator is responsible for several essential duties that contribute to the functionality of the program. Some of these tasks include ensuring visit requests are completed properly, assisting in arrival orientation, and coordinating various tours of our center. Lunchtime brown bag seminars, presented by NASA employees on a variety of topics relevant to Armstrong Flight Research Center, are coordinated by the student coordinator. Briefings are hosted to provide guidance on topics including Scientific and Technical Information and Export Control. Students' preliminary plans, abstracts, professional posters, and exit presentations are coordinated, approved, and produced through the assistance of the student coordinator. Another aspect of the student coordinator's job is to evaluate the student intern program and report on student statistics. This includes producing relevant quantitative and illustrative documentation to be used in MUREP White House Reports, OEPM, Monthly MUREP Agency calls, NIFS biweekly calls, and Center Coordinator calls.

John Freudinger

California State University, Long Beach

Universities Space Research Association (USRA)

Undergraduate Intern
Computer Engineering

Mentor: Sam Kim
Code: RE
Systems Engineering and Integration

Unmanned Aircraft Systems Integration in the National Airspace System

Routine access by unmanned aircraft systems (UAS) in the National Airspace System (NAS) requires closure of a number of technology gaps. The purpose of the UAS in the NAS project is to help close these gaps by integrating multiple system components in an operationally relevant test environment. The NASA Armstrong Flight Research Center has teamed with the NASA Ames Research Center, the NASA Langley Research Center, the NASA Glenn Research Center, and several industry partners to integrate and test the viability of data communication systems, sense-and-avoid programs, and human systems integration technologies and procedures for autonomous aircraft. Once put into situations that represent real-world scenarios that UAS pilots would encounter in the NAS, these systems are designed to tell a pilot when a possible threat is approaching, and suggest a maneuver that will prevent a mid-air collision or other catastrophe that may endanger others in the air or on the ground below. NASA is also using live data to validate results, such as sensor performance and reliability, state data uncertainty, and other results, which were collected in previous tests conducted with simulations. The systems are also being tested to examine how they will react when placed in situations in which there are unpredictable factors, such as wind. Once testing is completed, the results gathered will be used to help develop the Minimum Operational Performance Standards (MOPS). These MOPS will help develop FAA technical standards and regulatory changes to allow UAS to routinely fly in the NAS.

Pablo J. Gonzalez
Florida International University
University Space and Research Association (USRA)

Undergraduate Intern
Electrical Engineering

Mentor: Ben J. Pearson
Code: ME
Simulation Engineering
Hardware

Improvement and Testing of Analog to Digital Converters

The use of an analog-to-digital (ADC) converter in systems that require the real-time response found in aircraft flight controls must be accurate and reliable to ensure safety. The ADCs found in the autopilot currently in use by the Prandtl-D aircraft are part of a critical flight control system that includes elevons, alpha vanes, and beta vanes. As these components change their angular position a corresponding change in voltage occurs. This voltage is continuous in time and must be translated into digital binary code for interpretation by the flight control computer (FCC). The performance of an ADC is predominantly dependent upon its resolution and speed. The autopilot currently uses a 16-bit Semtech SX8724C ADC that is working at half its maximum resolution, effectively rendering the precision of the ADC over a 2.5V range to 76.29μV from a theoretical 39.67μV maximum resolution. The objectives are to increase the resolution of the ADC to its maximum 16-bit capacity and improve system robustness through the design of a printed circuit board compatible with the current autopilot platform. It is important to upgrade the resolution of the ADCs with minimal disturbance to other flight systems; in order to accomplish this all final changes will be made using software. The approach is to devise a method of calibrating the ADCs while evaluating important parameters that include noise and effective resolution. Once a reliable testing and calibration method has been developed for the ADCs the corresponding changes will be made to the flight control software and tested before flight. All methods and procedures will be stored in a database to ensure sustainability.

E. Etan Halberg

University of California, Davis

Universities Space Research Association (USRA)

Graduate Student Intern
Mechanical & Aerospace Engineering

Mentors: Red Jensen, Oscar Murillo, Al Bowers
Code: R
Engineering and Research Directorate

Small, Uninhabited Aerial Systems (sUAS)

Commercial solutions for controlling and collecting flight data from research aircraft can be relatively expensive, rarely come with source code or provision for hardware or software customization, and are typically designed with vehicle control in mind and data collection as an afterthought. This typically leaves research vehicles in need of a secondary data collection system, or "data cube." One solution to the high-cost, proprietary, control-focused commercial solutions is a flight computer, nicknamed "Goldy" and built by the University of Minnesota. Goldy is an all-inclusive flight control system (FCS) with data acquisition, as well as a work in progress.

The Goldy FCS came to the NASA Armstrong Flight Research Center with software problems involving memory leaks and data throughput from peripheral sensors – specifically those on the I2C bus. The I2C data throughput problem required both hardware and software solutions in the form of a low-impedance circuit, a reprogrammed driver for the analog-to-digital converters (ADC) and modifications to the data collection functions. The embedded Configurable operating system (eCos) buffers data files stored in volatile memory, causing unlinked files to remain in memory until a hard reset occurs. The solution to this problem required un-mounting and re-mounting the file system as a part of the data logging software routine. The Goldy FCS (serial #002) with updated software has been successfully flown on the PRANDTL-2 aircraft and has collected data from almost 30 flights to date. Work still in progress includes adding support for storing data in non-volatile memory and for ADCs that provide for many more (on the order of 50) analog input channels.

Waqqas H. Khan
Stanford University
Universities Space Research Association (USRA)

Graduate Intern
Aeronautics & Astronautics Engineering

Mentor: Otto C. Schnarr
Code: RD
Sensors and Systems Development Engineer

Designing a Motor Controller for the Hybrid Rocket of the Towed-Glider

One of the unmanned aerial vehicles (UAVs) being worked on at the National Aeronautics and Space Administration (NASA) Armstrong Flight Research Center is the Towed Glider, which is carrying a rocket payload as a less expensive way to get satellites and other objects into orbit. To release the payload, there are different maneuvers being considered that benefit from additional thrust. An onboard hybrid rocket is going to be used to provide this additional thrust. However, to control the rocket, a motor controller is needed that would communicate between the rocket and the ground control station (GCS) via the Piccollo Autopilot . We were able to design the motor controller using the Code Composer Studio (CCS) for software development and Altium Designer for circuit/PCB design. The motor controller was designed using the Delfino F28335 control card microcontroller. The motor controller was lab-tested and found to interface smoothly between the GCS and the hybrid rocket.

David Kloesel[1]
Victor Valley College
Michael Kloesel[2]
California State University, San Bernadino
Mandy Ledford[3]
Victor Valley College

Universities Space and Research Association (USRA)

Undergraduate Interns
Computer Engineering[1]
Chemistry[2]
Computer Science3[3]

Mentors: Dave Berger, Al Bowers, Kirsten Fogg
Professors: Dr. Sim, Dr. Rubayi, Dr. Bowen
Code: R
Engineering and Research Directorate

PRANDTL-M Point of Interest Mapping

The Primary Research Aerodynamic Design To Land on Mars (PRANDTL-M) is a robust glider designed for mapping terrain and detecting atmospheric properties from 20,000 feet above ground level (AGL) to the Martian surface. The development of an imaging system with resolution greater than current Mars and terrestrial satellite resolution is key to the success of the mission. In particular, image processing software is developed to create a post flight composite point of interest map from which X, Y, and Z dimensions of the terrain are extracted. This data will be used to guide mars rover exploration. The imaging system design proceeds in three main development cycles (imaging system, airframe integration, and flight testing). Arduino based camera systems are used to create a low cost first order modest resolution imaging system. Miniaturization is key because the airframe payload bay is less than two inches (span) by eight inches (chord) by half of an inch, and it must include the flight controller, battery system, avionics, and science system. The camera interface is developed on an Arduino Uno and then transitioned to an Arduino Mini . This system is then tested for environmental stability, flight stability, and on-condition operation.

Heather Laffoon

California State University, Long Beach

Universities Space Research Association (USRA)

Undergraduate Intern
Aerospace Engineering

Mentors: Dave Berger, Al Bowers, Kirsten Fogg
Code: R
Engineering and Research Directorate

Testing of PRANDTL-M

The purpose of the Primary Research Aerodynamic Design To Land on Mars (PRANDTL-M) project is to prove that the flying wing design will work for a mission to Mars, to provide better image mapping than satellites, and to collect data for atmospheric characterization. One of the most crucial is environmental testing. The equipment will be placed in environmental chambers which will simulate Martian conditions, and performance parameters, such as power draw and sampling rates, will be monitored. There will also be a series of flight tests to determine the flight characteristics and stability of the flying wing design. First, there will be indoor tests, in which several prototype flying wings will be thrown by hand or launched using a rubber band system to determine the stability of each design and calculate the lift to drag ratio. Next, the prototypes will be loaded with a simple sensing package (an accelerometer, gyroscope, and barometer) and will be launched from a building roof. This launch will yield data on the aircraft stability and flight characteristics such as roll, pitch, and yaw rates. Finally, the full flight system (autopilot, camera, sensing, and mapping) will be tested by DROID captive carry tests. The DROID aircraft will carry the glider to approximately 1,000 feet , where it will be released and allowed to glide back to the surface. This will verify the integration of the systems with the airframe and prove whether the design is a good concept for a Mars mission.

Harrison Pauer
University of California, Irvine
Universities Space Research Association (USRA)

Undergraduate Intern
Mechanical Engineering

Mentor: John Ruhf
Code: OE
Operations Engineering

Assisting and Completing Modifications on SCRAT

SubsoniC Research Aircraft Testbed (SCRAT) is a modified G-III research airplane for NASA Armstrong. SCRAT is currently modified to test Adaptive Compliant Trailing Edge (ACTE). ACTE is two modified flaps that have transition surfaces on each side of the flaps; ACTE creates a flap with a continuous surface. ACTE may allow for a 3-10 percent cruise drag reduction, 20 percent wing weight reduction, 4-6 dB noise reduction during approach and landing, structural load alleviation, and increased control surface effectiveness. This summer I mainly focused on creating or assisting modifications to SCRAT. I environmentally tested many new aircraft testing components including HD Cameras, Heat Controllers, and HDMI Recorders. I also created the environmental test plan for SCRAT. I designed a wiring pass through the pressurized AFT bulkhead for the HDMI Recorders, HD Cameras, Hydraulic Pressure Transducer, Fuel Flow Meters, and any future wiring. I learned about the operation and utility of the laser tracker measurement system. I was a part of the planning team of a joint acoustics test with Langley and Armstrong personnel on the lakebed. I assisted any member on the SCRAT or ACTE as needed for the remainder of my summer internship.

Karter Rohrer
California Polytechnic State University
Universities Space Research Association (USRA)

Undergraduate Intern
Computer Information Systems

Mentor: Ronald Ray
Code: RO
Knowledge Management

Developing a Document Naming Schema for Armstrong Flight Research Center

A document file naming schema is a standardized agreement that applies to all document types within an organization. In a database, each item is given an index, which allows users to precisely locate a piece of information. In the past, a unique naming convention was created specifically for each project at the National Aeronautics and Space Administration (NASA) Armstrong Flight Research Center and lacked unified regulation. This problem has led to data loss and wasted resources at the center. My summer project is to design and implement a unified naming standard for project data and then identify areas within test data that could use a similar process. This system will also contain metadata attributes that will assist users in identifying legacy data. The data models provided as well as past naming conventions serve as a primary baseline for my project. In order to compensate for different databases that NASA uses, this program will transfer the middleware portal from the Stratospheric Observatory For Infrared Astronomy (SOFIA) to a generic version, applying additional features that will aid in search capabilities. A primary focus is to identify all of the possible data types within project data to ensure that this process cannot be avoided by default. My project could save significant time and resources at the center and increase research efficiency. Once implemented at the entire center, my program will assure data security for present and future researchers.

Victor Gabriel Ruiz
California Polytechnic State University, Pomona

Universities Space Research Association (USRA)

Undergraduate Intern
Computer Engineering

Mentor: Robert "Red" Jensen
Code: R
Research and Engineering

Mechanical Design: PRANDTL-M and PRANDTL-3

The Prandtl airplanes and their wingtip designs have gained attention for their ability to overcome adverse yaw and turn it into proverse yaw, all without a vertical tail.

Two new projects have emerged that are building on the successes of previous Prandtl research projects. The Primary Research Aerodynamic Design To Land on Mars (Prandtl-M) is a small, 24-inch wingspan, glider that will be released from a high altitude in the Martian atmosphere and will send back to Earth high resolution images.

The Prandtl-3 is a larger scale version of the Prandtl-2. At 24 feet in wingspan, this larger size will allow for fiber optic strain sensing, as well as pressure taps in the wing to detect changes in the pressure field around the lifting surfaces.

My objective is to provide mechanical design work for both of these projects and project teams to ensure all is on track for a timely completion. Through meetings with the project teams and my mentors, the requirements for a certain 3D model are specified and allow for less remodeling as the projects move forward.

Prandtl-M will provide a better look at the surface of Mars and will allow more informed decisions to be made about future Mars missions, manned and unmanned. Prandtl-3 will allow for a more thorough, data-supported understanding of the aerodynamics of the unique wing shape.

Ivan Salazar
University of California, San Diego
University Space Research Association (USRA)

Undergraduate Intern
Electrical Engineering

Mentor: Kirsten Fogg
Code: K
Office of Education

NASA's Educational Workshops

NASA's strategic objective on education is to "Advance the Nation's Science, Technology, Engineering and Mathematics (STEM) education and workforce pipeline by working collaboratively with other agencies to engage students, teachers, and faculty in NASA's missions and unique assets." NASA Armstrong Flight Research Center's Office of Education is committed to this objective by delivering effective STEM education that provides opportunities for participatory and experiential learning activities in formal and informal settings, to connect learners to NASA-unique resources. AFRC's Office of Education provides many STEM education opportunities for learners of all ages throughout the summer, which include Thursday Nights on the Square, as well as various robotics workshops throughout the Antelope Valley. Educational content is provided to local robotics workshops through guest speakers and hands-on activities. In partnership with the AERO Institute, AFRC's Office of Education conducts multiple robotics workshops utilizing LEGO Mindstorms. The summer robotic workshops vary from teaching students and educators how to code, to teaching them how to design and build robots to play a game. NASA Education programs, projects, and activities are designed to align with NASA missions, with an emphasis on NASA's content, people, and facilities and are directly linked to inspiring the next generation of explorers and innovators.

Rachel Saltzman
California State University, Fresno
Universities Space and Research Association (USRA)

Undergraduate Intern
Mechanical Engineering

Mentor: Curtis Hanson
Code: RC
Dynamics and Controls Branch

Performance Analysis and Control Law Development for Autonomous Wake Surfing Tests and Simulations

A major goal of NASA's Aeronautics Research Mission Directorate is to save fuel and reduce harmful emissions. Migrating birds fly in a "V" formation to save each trailing bird large amounts of energy. Aircraft have also shown large fuel savings (up to 18 percent) by flying in formation. It is difficult, however, for pilots to fly in formation for long flights since a trailing plane must stay in a very narrow "sweet spot" in the lead plane's wake to derive fuel savings.

The main task involved developing model and control laws for a Gulfstream G-III airplane to act as a virtual lead plane capable of executing altitude, heading, and speed changes. It will be used in simulations and flight to test wake surfing control laws and algorithms, and will aid in testing the viability of autonomous wake surfing in commercial and military applications.

Other tasks included performing aerodynamic analysis of, and writing control laws for, a novel aircraft configuration for wake surfing using solar-powered High Altitude Long Endurance aircraft to see if it would be viable for use in long-term applications, such as in communications and atmospheric sensing. A wing-tip vortex wake estimation algorithm that was originally designed for a glider was also modified for a G-III.

Joshua Tanon[1]
University of Michigan
Eduardo Uribe-Saldana[2]
Antelope Valley College

Universities Space Research Association (USRA)

Undergraduate Interns
Aerospace Engineering[1]
Biomedical Engineering[2]

Mentors: Dave Berger, Kirsten Fogg, Al Bowers, Khalid Rubayi, Jason Bowen, Alec Sim
Code: R
Research and Engineering Directorate

Airframe Integration for the Primary Research Aerodynamic Design to Land on Mars (PRANDTL-M)

The Primary Research Aerodynamic Design To Land on Mars (PRANDTL-M) is a high-altitude, low-density glider designed for mapping terrain and detecting methane deposits at 20,000 ft above the Martian surface. Capable of autonomous navigation, the objective of the PRANDTL-M will support the National Aeronautics and Space Administration's (NASA's) overall objective of human exploration on Mars. The PRANDTL-M airframe must be durable enough to withstand the harsh environmental conditions present on Mars, but also be aerodynamic enough to maintain flight. Environmental testing will subject the airframe to temperatures and pressures beyond those present on Mars to test functional limits. The data collected will be used to analyze efficiency and durability. Several parameters must be considered, which include the center of gravity (CG) of both the fuselage and wing, weight of airframe, and aerodynamic shape. Since weight opposes lift and would negatively affect the distance the aircraft would fly, foam was chosen as the lightest material for the fuselage. Drag will be reduced by designing a fuselage with the most streamlined surfaces and configuration with an internal components bay to mitigate turbulence. Using Creo Element Pro and SolidWorks, a design will be sketched and modeled where a 3D printer will construct the final fuselage for precision. The final design will be flight-tested, both indoors and outdoors, for aerodynamic control, lift produced, and distance covered.

Benjamin Wright
California State University of Long Beach
Universities Space Research Association (USRA)

Undergraduate Intern
Film Studies

Mentor: James Ross
Code: MI
Information Systems

Working in the Photo and Video Labs at NASA

While here at NASA I am spending five weeks in the Photo Lab and five weeks in the Video Lab. While in the Photo Lab I was tasked with logging descriptions and dates of every photo taken at NASA since 1948. I only made it to about 1960 until my first five weeks were up. Along with logging photographs I also shadowed the professional photographers as they did their jobs.

After my first five weeks were up, I transferred to the Video Lab where I will conclude my internship here at NASA. My duties in the Video Lab have been to film, control, and run audio on the "Brown Bag" lecture sessions, as well as any other presentations made at NASA that require a video made of the presentation. Another notable project I am working on in the Video Lab is filming the test flights of the Prandtl-D flying wing. After all of the filming is complete, I will edit all of the footage and create one cohesive film. This film will be presented at the end of the session to the interns who worked on the Prandtl-D project.

This internship is helping me learn what being a professional photographer and videographer at NASA truly means.

Carolina Guerrero,
Diana Jerez,
Steve Pastor,
Jocelyn Ramirez,
Jose Ramirez,
Nestor Zuniga

California State University at San Bernardino Upward Bound Program

Teacher: Lance Atkinson
Coordinator: Conrad Valdez
Director: Stephen Villasenor

Mentor: Kurt Kloesel
Code: RA
Research Aerodynamics & Propulsion

Investigation of a Engine Controller for a 10kW Class Micro-Turbine

Future hybrid turbo-electric airplanes will require close coupling between the mechanical thermodynamic turbine system and the electrical generator control system. The investigation of the control system fuel start ramps of a small 10kW micro-turbine provides a stepping stone to understanding larger kW turbo-electric hybrid systems

NASA Armstrong Flight Research Center

Summer 2015 Mentors

Ricardo Arteaga
Dave Berger
Al Bowers
Manuel Castro
Bruce Cogan
Tim Cox
Josue Cruz
Matthew Enga
Rebecca Flick
Laura Fobel
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