A Message from the Center Director

Congratulations to the NASA Armstrong Flight Research Center Summer 2017 Student Programs cohort! You all survived a hot summer in the Mojave Desert and you contributed in our mission of advancing technology and science through flight.

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, industrial base, and national economy. Our economy and our competitiveness hinge on continuing to fill the pipeline with talented future STEM 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.

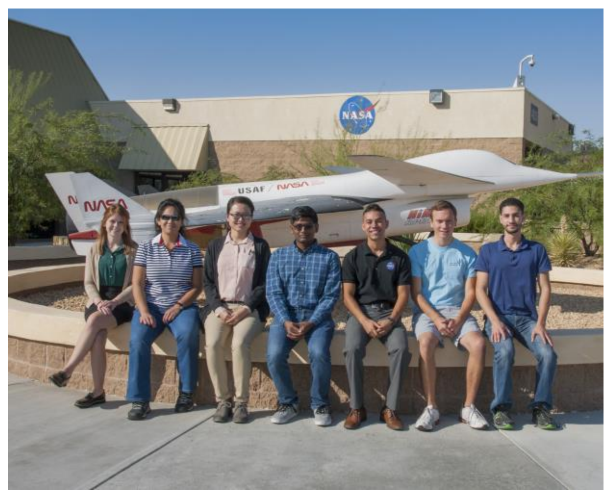
David D. McBride
Center Director

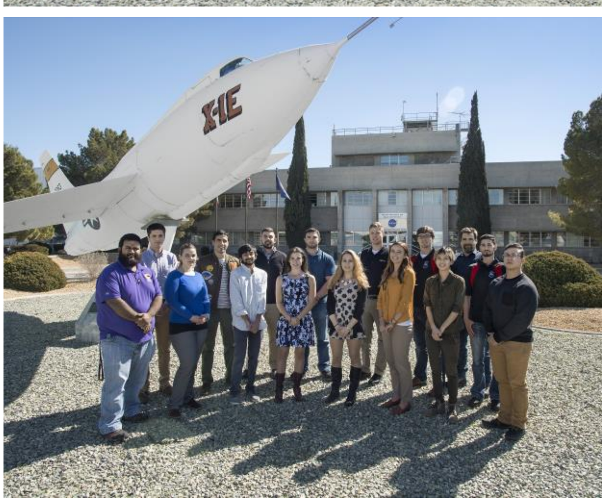
NASA Armstrong Flight Research Center Fiscal Year 2017

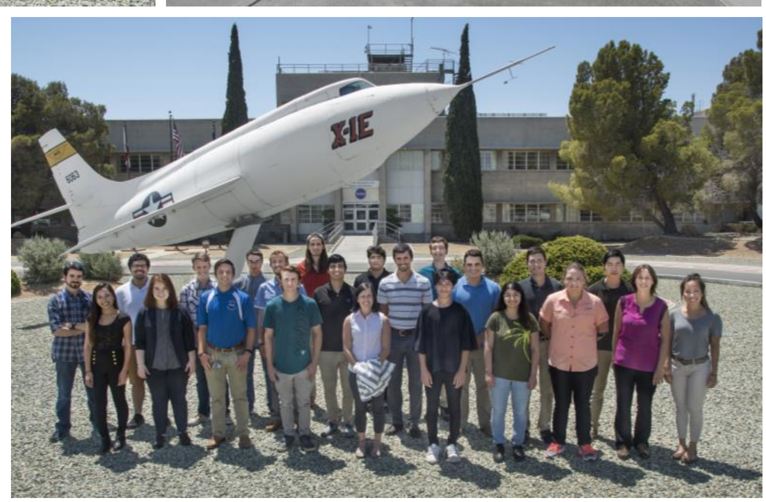
Program Description

Student internships provide the opportunity for students to work side by side with a mentor to contribute to the NASA mission. During Fiscal Year 2017, NASA Armstrong welcomed students from universities in over 27 different states ranging from Alaska to Massachusetts. Student interns were represented in 15 different organizations across NASA Armstrong and supported exciting projects such as X-57 Maxwell, UASNAS, FOSS, QueSST, TGALS, Dream Chaser, PRANDTL – M, and PRANDTL-D3c.

We would like to recognize the many funding sources that came together to make this possible for the students. These sources include NASA Armstrong mentor project funding, Universities Space Research Association (USRA), STEM Education and Accountability Projects (SEAP) and SEAP Scholars, Minority University Research and Education Projects (MUREP) and MUREP Scholars, MUREP Community College Curriculum Improvement (MC3I), Science Mission Directorate (SMD), Aeronautics Research Mission Directorate (ARMD), Space Grant Consortia in Alaska, Arkansas, California, Iowa, Minnesota, North Carolina, and Kansas, STEM Teacher and Researcher (STAR) Program, and National Science Foundation Centers of Research Excellence in Science and Technology (NSF CREST).







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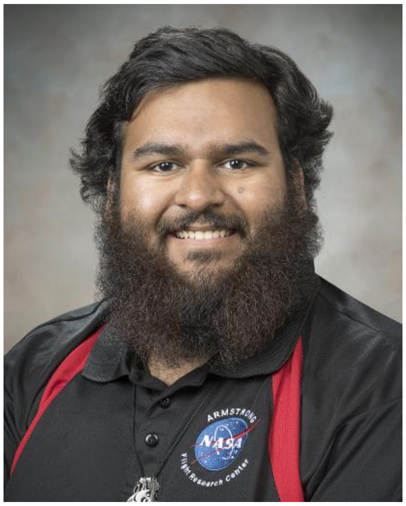


Jonathan Adams

University of California- Santa Cruz

NASA Armstrong Internship Program

Undergraduate Intern
Electrical Engineering

Mentor: Dave Berger
Code: K
Office of Education

Avionics Integration for Prandtl-M (PM)

The Preliminary Research AerodyNamic Design to Land on Mars (PM) is an application of the Preliminary Research AerodyNamic Design to Lower Drag (PRANDTL-D) research. These new designs eliminate the need for a vertical tail and could lead to a 30 percent increase in fuel economy for future aircraft. The purpose of the PM project is to prove that a rudderless flying wing design will work for a mission on Mars. The PM, however, must be compact enough to fit inside a 6U CubeSat (10x20x30 cm). Unfortunately, this means that the payload area of the PM is very limited in both available space and allowed weight. The current design for the PM has a wingspan of 31.25 inches, a root chord of 12.5 inches, and a tip chord of 3.5 inches. The PM requires multiple electronic systems for navigation, internal monitoring, inertial and optical navigation, integrated aircraft flight control, and other onboard systems. This work focuses on designing and fabricating a prototype circuit board for the PM. The circuit board must be able to support the science package, flight control system, navigation systems, and radio communication system. The circuit board must also be tested to ensure that it will perform properly in the Martian atmosphere. The circuit board is considered an intermediate step to a final flight-worthy design for the PM. This challenging work is an integral part of the ultimate success of the project.

Aala Al Hasan

University of Houston

NASA Armstrong Internship Program

Undergraduate Intern
Mathematics

Mentor: Kurt Kloesel
Code: RA
Aerodynamics and Propulsion

Digital Motor Control for Hybrid-Electric Aircrafts

Transforming aviation to improve aircraft shapes, propulsion, and efficiency has led to studies for future electric aircraft that consume only half as much fuel. This project involves thermodynamics modeling and electric power system modeling for turbo-electric generations systems and battery systems for hybrid electric aircrafts. The fundamentals of a digital motor control driver were studied through the use of a fractional horsepower development kit. The investigations were supplemented with automated motor controller software that identifies, tunes, and controls the motor, and exploits similarities and differences between all motors. A file was modified that stores all the parameters, such as inductance and resistance, and performs tests to ensure that the motor is operating smoothly and does not heat during the process. Pulse width modulation, testing flux frequency and other varied parameters resulted in consistent measurements of resistance and inductance values, making this software a robust tool for studying any motors.

Erin Askins
Tehachapi High School

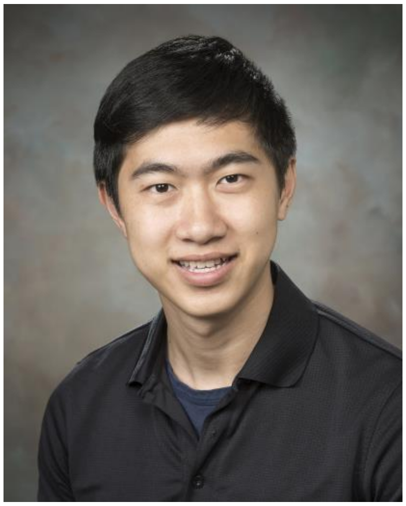
NASA Armstrong Internship Program

High School Intern
Civil Engineering

Mentor: Albion Bowers
Code: R
Research and Engineering Directorate

PRANDTL-D3c Systems Integration and Research

The Preliminary Research AerodyNamic Design To Lower Drag (PRANDTL-D) is a low-altitude, flying wing based on Ludwig Prandtl's theory of the bell spanload and rudderless flight. The PRANDTL-D3c main objective is to prove and use Prandtl's theory in order to design a tailless airplane and ultimately create a more efficient aircraft. As the development of the PRANDTL-D3c flying wing progresses, data collection becomes a more crucial part of the project. Since data collection is one of the main objectives at this stage in development, the testing of sensors and the creation of test systems in order to properly calibrate these sensors is vital. The proper calibration of the sensors is critical to the data collection process because improperly calibrated sensors provide skewed data. As the aircraft data collection relies completely on written code, a central part of the integration and research of the system is the testing and cleaning of the code. The code is run on an open source software-based microcontroller and manages all parts of the data collection process, including the procurement of pressure, orientation, air speed, and direction. As progress continues to be made on this project, the documentation of data, parts, and processes will be of great help to the next group of engineers.



Jonah Kahing Au

University of Washington - Seattle

NASA Armstrong Internship Program

Undergraduate Intern
Electrical Engineering

Mentor: Jim Adams
Code: SF
Safety & Mission Assurance

Range Safety and the Flight Termination System

Safety is paramount in any aerospace or aeronautical industry. The National Aeronautics and Space Administration (NASA) operates and uses ranges to launch, fly, land, and test space and aeronautical vehicles and their associated equipment. Range operations often involve substantial hazards that can pose significant risk to life, health, and property. The NASA implements a control factor called the Flight Termination System (FTS) to address the hazards posed by an unmanned aerial test vehicle. The FTS allows the Range Safety Officer (RSO) the option of terminating any negative flight evolution by self destructing the unmanned aerial test vehicle. The decision by the RSO to terminate is based on general safety protocol to prevent such undesirable outcomes as uncontrollable flight paths. My contribution to this program is to troubleshoot system discrepancies and develop acceptance and qualification test procedures of FTS components to ensure the equipment is in compliance with local range requirements. Implementation of these test procedures is essential to ensure proper operation of the FTS to protect people and assets. An example of a current implementation of the FTS can be seen aboard the Dream Chaser Engineering Test Article, an unmanned space cargo resupply vehicle, which is being developed by the Sierra Nevada Corporation.

Becca Baiman
Vanderbilt University

NASA Armstrong Internship Program

Graduate Intern
Masters of Education
Bachelors in Mathematics, Pomona College

Mentor: Miriam Rodón-Vachon
Code: XM
Industrial Hygiene

Streamlining Computation Methods in Industrial Hygiene

The Industrial Hygiene office is tasked with identifying health hazards and implementing programs to protect employees at the National Aeronautics and Space Administration (NASA) Armstrong Flight Research Center (AFRC) as outlined in NASA Procedural Requirements (NPR) 1800.1, "NASA Occupational Health Program Procedure." Common health hazards at AFRC include noise, oxygen depletion, ionizing radiation, and non-ionizing radiation. The office utilizes two methods for evaluating and analyzing hazards: computations and surveys. Industrial hygienists use computational methods to estimate the magnitude of stressors and to calculate an initial data point. Quantitative measurements or surveys are used to validate and adjust the results of the computation analysis. Theoretical calculations provide hazard distances for industrial hygienists to avoid harmful radiation when surveying radio frequency (RF) instruments. The complex nature of RF Near and Far field power calculations for differing types of instruments makes the process of finding hazard distances for RF instruments tedious and prone to simple computation mistakes. To increase the efficiency and accuracy of instrument analysis, I developed an RF hazard distance calculator. This calculator references the IEEE 95.3 guidelines for theoretical calculations of exposure fields from RF instruments. While calculations and unit conversions must be precise, certain equations describing RF behavior are unclear. The calculator developed selects for conservative estimates of RF hazards to ensure the safety of AFRC employees.

Brianna Becerra

Antelope Valley College

NASA Armstrong Internship Program

Undergraduate Intern
Airframe Manufacturing And Technology

Mentor: Aaron Rumsey
Code: RS
Aerostructures

Engineering Technician in the Flight Loads Lab

A variety of tests are always being performed in the NASA Armstrong Flight Research Center Flight Loads Laboratory (FLL). A few tests I experienced while working in the FLL were a ground vibration test (GVT), a wing loads test, and a moment of inertia (MOI) test. These tests are conducted to in order to learn about the different conditions an aircraft might experience under different flight conditions. The process for conducting a test in the FLL includes setting up the structure to support the test, installing data collection equipment, following the list of test procedures, and disassembling the setup upon completion of the test. I worked with other skilled technicians to create necessary aircraft test structures, and I obtained great experience using the tools and equipment relevant to the industry and the FLL test environment. Some common tasks we performed were mechanical assembly, utilizing the hydraulic loading system, general set-up and operation, electronic component assembly, instrumentation installation and wiring, data acquisition set-up, and operation of unique test hardware. Of continual importance was to ensure that each test was collecting clean and accurate data. As technology in aerospace vehicles advances, the capabilities of the FLL will continue to be critical for executing new tests and experiments that will require a wide range of different test set ups, equipment, and procedures.

Blake Berk
Massachusetts Institute of Technology

NASA Armstrong Internship Program

Undergraduate Intern
Aeronautical Engineering

Mentor: Dr. Oscar Murillo
Code: RC
Dynamics and Controls

Flight Mechanics Data Collection for PRANDTL-D3c

Determined to revolutionize aerodynamic design, the Preliminary Research AerodyNamic Design to Lower Drag (PRANDTL-D)3c attempts to demonstrate that a bell-shaped loading distribution reduces overall induced drag and experiences no adverse yaw at the wingtips. In fact, PRANDTL-D3c and its predecessors have demonstrated proverse yaw, a by-product of the attempted bell-shaped loading distribution that can eliminate the need for airplane rudders for control purposes. To prove the intended bell spanload, PRANDTL-D3c will fly with a compact Fiber Optic Sensing System (cFOSS) and an electronic pressure measurement (EPM) to measure the spanload during flight. In order to interpret the data from these new systems, it is vital to verify typical flight parameters. To collect the accelerations, rates of rotation, static pressure, dynamic pressure, angle of attack, angle of sideslip, and elevon deflections, PRANDTL-D3c will be equipped with an Arduino and the necessary sensors. Targeting a sample rate of 40 samples per second, a micro Secure Digital card will provide non-volatile memory, using binary files to increase the sample-rate potential. The flight mechanics data collection system is a necessary component of the PRANDTL-D3c research flights to validate the primary goals of the project, prove bell spanload, experience proverse yaw, and eliminate rudder necessity, all in an effort to reduce drag.

John Bodylski
Irvine Valley College

NASA Armstrong Internship Program

Undergraduate Intern
Mechanical Engineering

Mentor: Dave Berger
Code: K
Office of Education

Avionics Research for a Long Range Very High Altitude Small Unmanned Aerial Vehicle

The Preliminary Research AerodyNamic Design To Land on Mars (PRANDTL-M) (PM) is a Small Unmanned Aerial System (sUAS) platform capable of flying in the Martian atmosphere. Flight within the Martian atmosphere will be with neither global positioning system nor magnetic compass capability, and thus will require a significant workload to be performed by visual navigation as well as integration with inertial navigation systems. In order to test such a design on the Earth, it must be capable of flying up to 125,000 ft (equal to 12,000 ft above ground level on Mars). Flight at this altitude represents several special problems for both aerodynamic and electrical system designs. This corner of the flight envelope is known as the Coffin Corner because of the tightening range between aerodynamic stall and critical Mach number. The PM is a cutting edge flight combination of compact size, very low Reynolds number, high altitudes, and high subsonic speeds. The small physical size of the aircraft severely restricts the power available for onboard systems such as transceivers, servomechanisms, flight computers, imaging equipment, and science payloads. In order to both maintain communications with the aircraft and perform the necessary flight maneuvers during the extreme test conditions, a sophisticated ground communications system has been designed in conjunction with onboard power and communications systems.

Connor Bray

Colorado School of Mines

NASA Armstrong Internship Program

Undergraduate Intern
Engineering Physics

Mentor: Dave Berger
Code: K
Office of Education

Using Data Driven Analysis to Evaluate and Increase PRANDTL-M Vehicle Performance

The Preliminary Research AerodyNamic Design to Land on Mars (PRANDTL-M) project aims to create a Mars glider capable of directly characterizing the Martian atmosphere. Named after Ludwig Prandtl (1875-1953), the glider will use Prandtl's bell-shaped spanload to minimize drag in the thin Martian atmosphere. This design and the Martian environment, however, create unique design challenges including size, mass, temperature, and power constraints. My role includes designing tests that will influence system design by measuring quantities critical to design implementation. For each of these tests, I write robust software and firmware for hardware operation and data collection. After the tests, I use the data collected and my background in physics and data analysis to evaluate vehicle performance and to provide design feedback. Previous tests have already influenced major design decisions, for example, environmental battery testing has revealed inaccuracies in energy capacity assumptions. For this test, I wrote desktop and embedded systems code for data collection, verification, and real-time data monitoring. My analysis of the data showed that in-flight battery heating was outside of power constraints, but that adequate power was supplied at low temperatures. This information was used to design the next test and will continue to influence vehicle design.

Brent Cano

California State University- Los Angeles

NASA Armstrong Internship Program

Undergraduate Intern
Mechanical Engineering

Mentor: Albion Bowers
Code: R
Research and Engineering Directorate

Flight Mechanics Sensor Programming for PRANDTL–D3c

One objective of the Preliminary Research AerodyNamic Design to Lower Drag (PRANDTL D)3c is to prove proverse yaw. The PRANDTL D3c aircraft does not carry an onboard flight computer, thus, the parameter identification required for flight coefficients demands a system to identify these parameters and to log the obtained data. An open source microcontroller was chosen that is capable of expanding or modifying code and catering to any compatible sensor. This system uses an accelerometer, gyroscope, pressure sensors, and potentiometers. Each sensor must be calibrated and tested rigorously to ensure accuracy. The system collects raw data in binary. The data are logged using a flash memory on the microcontroller and then transferred to a Secure Digital card to allow up to 300 samples per second. The system is lightweight and compact and can accompany other hardware, such as a compact Fiber Optic Sensing System (cFOSS) and an electronic pressure measurement (EPM) system, allowing multiple data collections per flight. The resulting raw data can be easily manipulated from calibration testing using MATLAB® (The MathWorks, Natick, Massachusetts), and by using the calibrated data, the flight coefficients can be determined.

Joseph Christian

Victor Valley Collage

NASA Armstrong Internship Program

Undergraduate Intern
Aviation Technology

Mentor: Kurt Kloesel
Code: RA
Aerodynamics & Propulsion

Development of Hybrid Turbo-Generator Aircraft

A new generation of environmentally friendly airplanes is being developed to help protect the Earth and move the aerospace industry into a clean future. The task is to replace the gas-powered engine used in general aviation twin propeller airplanes with a new, clean, electric engine. A turbo generator placed inside the structure of the airplane could charge the necessary batteries and is believed to be the best solution to the hybrid aircraft challenge. The turbo generator could allow the plane to fly for an extended amount of time compared to what would be possible with batteries alone and no real time charging system. Two types of turbo generator systems so far show great potential. The first is a turbo shaft driven engine that would be modified through its attached gear box to drive a larger generator. The attachment of this generator would be through the main drive shaft, so as to provide the most power to the generator. The second, which is commercially available already, is one component comprised of the generator attached to the turbine. Either of these two choices might provide the electrical power needed for a new type of hybrid electric airplane, and in so doing provide a foundation for future hybrid electric airplane designs.

Eliseo Cruz

Northern Arizona University

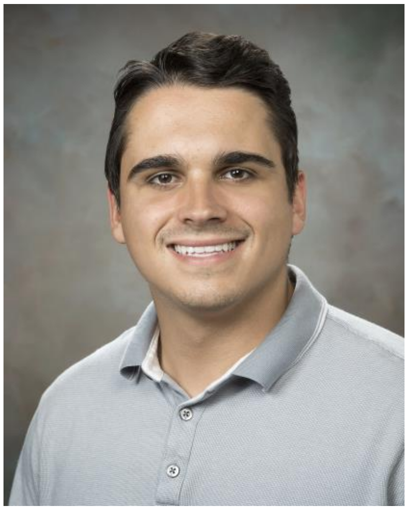
NASA Armstrong Internship Program

Undergraduate Intern
Electrical Engineering

Mentor: Annamarie Schaecher
Code: K
Office of Education

Structuring STEM Education and Robotics

The National Aeronautics and Space Administration (NASA) Armstrong Flight Research Center (AFRC) Office of Education provides many different opportunities for students. Educational robotics workshops are already very well established. This summer, the Office continues to provide LEGO® (LEGO A/S, Denmark) robotics workshops for middle school students with an established curriculum. The level of engagement of each student in a robotics workshops varies, however, because each student has different interests in the content of the workshop. In order to capture the curiosity of every student, it is important to slightly customize the format of each workshop. Using mentors for each group in a workshop, for example, allows the students to have a more interactive experience. Workshops this summer will incorporate design, coding, building, and testing the robots, which hopefully will involve every student, and enable the students to discover which discipline within STEM (science, technology, engineering and mathematics) they enjoy the most. The workshops use LEGO® EV3 Mindstorm® kits, which allow the students to be completely immersed in the engineering design process while they build a robot to complete a challenge that simulates a NASA mission. Using two different game boards of about the same difficulty allows participants to be creative in their problem solving skills. The NASA AFRC Office of Education motivates students to engage in STEM programs that shape the nation's future scientists and engineers.



Nicolas Cucinella

California State Polytechnic University-
San Luis Obispo

NASA Armstrong Internship Program

Undergraduate Intern
Electrical Engineering

Mentor: Kurt Papathakis
Code: RT
Flight Instrumentation and System Integration Branch

Acceptance Testing of the X-57 Maxwell Cruise Motors and FMEA Development

The X-57 Maxwell is the upcoming all-electric distributed propulsion airplane. The purpose of this project is to show that flights can consume 1/5th of the energy needed by internal combustion aircraft using Propulsion Airframe Integration (PAI) and other techniques. Currently, the main cruise motors for the X-57 are being tested on the AirVolt test stand to ensure they are capable and flight ready. Once clearing the acceptance tests, they will be sent off to the main contractor that is assembling the experimental plane. Another facet of pre-flight activities is completing a FMEA (Failure Modes and Effect Analysis). This document lays out the potential failures (electrical, mechanical, etc.) within the airplane and shows a causation network to other components that would be affected by a certain fault somewhere in the system. Additionally, this document analyzes the criticality of each fault and what appropriate measures must be taken for each scenario. This summer, I will be assisting with the cruise motor acceptance testing, using the AirVolt test stand. I will also be further developing the FMEA to better understand the risks and hazards associated with every potential failure.

Ethan Czuppa

California State Polytechnic University-
San Luis Obispo

NASA Armstrong Internship Program

Undergraduate Intern
Mechanical Engineering

Mentor: Al Bowers
Code: R
Research and Engineering Directorate

Instrumentation Support and Development for PRANDTL-D3c

The goal of the Primary Research AerodyNamic Design To Lower Drag (PRANDTL-D) project is to characterize and empirically validate the efficiency of Ludwig Prandtl's bell-shaped span load. Currently, the testbed will utilize both pressure ports and fiber optic strain sensing to measure the span load during flight. Valid flight research, however, requires characterizing the attitudes of the aircraft while it is in flight and collecting relevant data. No flight computer having been available, a new, open-source software based platform was developed to fulfill this role. The computer was prototyped on a breadboard, documented and optimized, and then migrated to a protoboard for installation on the aircraft. The computer records 12 relevant parameters at 100 Hz and stores the data on a 32 GB micro Secure Digital card. Attached to the computer is a separate, rigid module for the accelerometer and gyroscope 6 degrees of freedom (6 DOF) sensor. The module was calibrated using 1 g field calibration and was verified using accelerations measured with a simple pendulum. Further calibration for the gyroscope and the other sensors is ongoing, as it is critical that this flight computer gather and record data accurately. The implementation, documentation, and continued optimization of this system will aid the project flight research in the future as well as hastening the development of more efficient blended-wing airliners.

Mackenzie Duce

California State Polytechnic University-
San Luis Obispo

NASA Armstrong Internship Program

Undergraduate Intern
Mathematics, Physics

Mentor: Dave Berger
Code: K
Office of Education

Considering Environmental Challenges on Mars for PRANDTL-M Avionics

The Preliminary Research AerodyNamic Design to Land on Mars (PRANDTL-M) is a light-weight glider with a 2.5 ft. span. PRANDTL-M applies the successful research on proverse yaw and rudderless flight of the previous PRANDTL projects to potential flight on Mars. During its flight, PRANDTL-M will collect direct data of the Martian atmosphere and topography, information currently unavailable to NASA. The strict size and weight constraints of the PRANDTL-M require the avionics to be small, powerful, and able to perform at -85º F temperatures. The intent of this internship is to develop, fabricate, integrate and test a position sensor for PRANDTL-M's control surfaces. This system uses C-based programming, an embedded microcontroller, and a variable resistor to get in-flight data on degree of deflection. This will confirm the successful communication between the servos operating the control surfaces and the flight controller. It will also verify that the elevons are able to hold commanded positions against aerodynamic forces in flight. To prepare for -85º F conditions, PRANDTL-M will undergo three environmental tests to confirm the avionics can withstand low temperatures and pressures. Then, PRANDTL-M will be ready for a 125,000 ft. weather balloon drop intended to simulate the Martian atmosphere, bringing us one step closer to being the first plane on Mars.

Grant Dunbar
University of Colorado, Boulder

NASA Armstrong Internship Program

Undergraduate Intern
Aerospace Engineering

Mentors: Larry Cliatt, Sam Kantor
Code: RA
Aerodynamics and Propulsion

Sonic Booms in Atmospheric Turbulence (SonicBAT) Combined Systems Test and Checkout Flights

The overall objective of the Sonic Booms in Atmospheric Turbulence (SonicBAT) project is to build an understanding of the behavior of sonic booms as they propagate through atmospheric turbulence. In order to do this, an F-18 airplane is flown at supersonic speeds, and the resulting sonic boom is recorded at two points as it travels through the air. One of the recording points is on the ground, and the other is in the air above the turbulent boundary layer. The airborne data are collected by an instrumentation pallet called the Airborne Acoustic Measurement Platform (AAMP) that is mounted on a TG-14 motor glider. The AAMP must pass a series of airworthiness tests before it is deemed safe to fly on the motor glider. The last of these tests is the Combined Systems Test (CST), in which the aircraft and payload are operated on the ground in various configurations to determine whether they interact correctly and to ensure that codependent interference is minimal. Upon completion of the CST, checkout flights are performed to further instill confidence that the various components will operate and interact correctly when the experiment is actually performed at the National Aeronautics and Space Administration (NASA) Kennedy Space Center.

Nicholas Finks

Antelope Valley College

NASA Armstrong Internship Program

Undergraduate Intern
Mathematics

Mentor: Allen Parker
Code: RD
Sensors & Systems Development

New Center of Mass Algorithm Development for the Calculation of Improved Strain Measurements on a Fiber Optics Sensing System (FOSS)

In testing the Fiber Optic Sensor Systems (FOSS) over a long period of time, strain on a dynamic system has been observed to fluctuate in an echelon-like figure. The strain will seemingly remain constant for an extended period of time, then jump to another steady state, remain there, and repeat. We know the relation between strain and time is somewhat linear, however, the current form of data processing yields erroneous readings. Previously, a threshold center of mass calculation, $x_{com} = \sum_{i=1}^{N} \frac{m_i x_i}{M} \mid M = \text{total mass}$, has been used to calculate the Center of Mass (COM) for various strain tests, namely “drip tests.” Upon inspection of a processed grating, it has been observed that there is a strong resemblance to a sinc(x), or $\frac{\sin(x)}{x}$, function. Utilizing LABVIEW™, C, and our new sinc fitting function, we have developed a new and robust algorithm that can identify individual gratings, find their COM, and provide an accurate signal reading for all fiber gratings in real time. Using the sinc fitting function we have created, FOSS signals can now be processed and read more accurately than ever.

Annalise Giuliani

Millersville University

NASA Armstrong Internship Program

Undergraduate Intern
Early Childhood Education

Mentor: Miranda Fike
Code: K
Office of Education

STEM Outreach and Curriculum Development

The National Aeronautics and Space Administration (NASA) has a mission to “advance high quality STEM education using NASA’s unique capabilities.” The NASA Armstrong Flight Research Center (AFRC) Office of Education works to provide integrative Science, Technology, Engineering, and Mathematics (STEM) educational activities to the community at large. AFRC is dedicated to providing NASA-unique STEM opportunities in both formal and informal settings to learners of all ages, hosting various educational events to inspire and educate the public on primary NASA projects. Events include a summer lunch program throughout the city of Palmdale, where students learn about ultraviolet radiation; and teaching Tribal Temporary Assistance for Needy Families (TTANF) students about the upcoming August 21 solar eclipse. Learners are offered opportunities to exercise their problem-solving skills through hands-on STEM activities. The Office of Education also provides supplementary resources for students and educators based on current NASA missions, such as the NASA Out of School Learning Network (NOSL) curriculum. These supplemental materials offer students and educators further insight into fundamental STEM concepts. Lessons are aligned with the Next Generation Science Standards (NGSS). The Office of Education, in light of the NASA mission, continues to provide relevant, project-based, participatory and experiential learning opportunities.

Erik O. Gustafson

Cornell University

NASA Armstrong Internship Program

Undergraduate Intern
Mechanical Engineering

Mentor: Seung Yoo
Code: RC
Dynamics and Controls

Automation of Paneling for Aeroelastic Analysis with ZAERO®

Manually creating a panel model of an aircraft is tedious, consuming more than half of the time required to perform aeroelastic analysis and simulation. Manual entry can easily result in human error, and changes to geometry or mesh refinement often require repaneling the entire aircraft. This process can be sped up drastically through the use of object oriented scripts and graphical user interfaces. Taking PLOT3D input files and user input, the PANEL_GUI MATLAB script and associated graphical user interface (GUI) can generate a ZAERO® (Zona Technology, Scottsdale, Arizona) geometry file. In addition, the GUI allows users to preview, modify, and refine the mesh before running ZAERO®. This code is intended to be used for the analysis of the Quiet Supersonic Technology (QueSST) aircraft, but can be used for any aircraft with a single fuselage and a pointed nose, and can handle intersecting aerodynamic surfaces, nacelles, and inlets. Development is ongoing to allow the user to specify airfoils and control surfaces, speed up the input process, increase the number of acceptable input aircraft configurations, and increase the capability of the code to check input and detect errors. The implementation of this program into the existing analysis workflow could result in substantial time savings.

Rachel Haering

California State University- Long Beach

NASA Armstrong Internship Program

Undergraduate Intern
English

Mentor: Laura Fobel
Code: RO
Research Operations & Knowledge Management

Spotlight on Technology Transfer

The Technology Transfer Office (TTO) at the National Aeronautics and Space Administration (NASA) Armstrong Flight Research Center (AFRC) guides employees who have ideas for new technologies through the process of developing and disseminating those ideas to the commercial sector for the benefit of the economy and people of the United States. Many AFRC employees are unaware of the crucial role the TTO plays in keeping NASA at the forefront of aerospace innovation; as a TTO intern, my goal is to make our work more visible throughout the Center. My primary task has been to create a calendar featuring successful technologies that originated here at Armstrong. This project involves researching both current experimental efforts, such as the Towed Glider Air Launch System (TGALS) and the Preliminary Research AerodyNamic Design to Lower Drag (PRANDTL-D), as well as historical breakthroughs such as digital fly-by-wire and the use of fairings on freight trucks. I am also designing the layout of the calendar, curating photos of each technology, and writing brief features describing each. My secondary responsibility is writing the monthly TTO newsletter. Through news about recent partnerships and patents, interviews with NASA innovators, and articles about past inventions, I am educating AFRC personnel about different activities that fall under the umbrella of technology transfer, with the goal that more will decide to seek the expertise of our office.

Kelton Halbert

The University of Wisconsin-Madison

NASA Armstrong Internship Program

Graduate Intern
Meteorology/Atmospheric Science

Mentor: Luke Bard
Code: RA
Aerodynamics and Propulsion

Development and Integration of an Automated Wet Bulb Globe Thermometer (WBGT) Heat Stress Monitoring System

Field research and operations at the National Aeronautics and Space Administration (NASA) Armstrong Flight Research Center (AFRC) often involve long periods of heat exposure due to the arid desert climate. The safety thresholds for heat stress that have been set by the Occupational Safety and Health Administration (OSHA) must be followed by AFRC to ensure the safety of its work force. Monitoring the Wet Bulb Globe Thermometer (WBGT) index and taking appropriate precautions when the heat stress is high accomplishes this task. At this time at AFRC, the WBGT system must be manually set up, observed, and torn down on a daily basis, which means an individual is being exposed to the heat in order to report on the heat conditions. In order to prevent unnecessary heat exposure as well as provide timely and accurate measurements to the AFRC meteorologists and safety specialists, two automated WBGT measurement systems were constructed for use at AFRC, including a mobile system that can be moved to specific locations in the field during research campaigns. The mobile system is to include a radio telemetry network for data transfer and software for automated data processing and visualization that can be shared to the AFRC intranet.

James Hamory

The Master's University

NASA Armstrong Internship Program

Undergraduate Intern
Cinema & Digital Arts

Mentor: Lori Losey
Code: MI
Information Systems

Video Production and Archive Preservation

As part of the team at Armstrong TV, of the National Aeronautics and Space Administration (NASA) Armstrong Flight Research Center (AFRC), I contribute to the everyday tasks of video production, distribution, and preservation. The video department exists to provide video support for the projects, flight tests, seminars, and other activities going on at AFRC and to regulate the distribution of material to the public. My role in video production includes operating cameras for the weekly "Brown Bag" seminars. For video distribution, I prepare closed captions for previously-recorded colloquiums that are shown on NASA TV each week. The part of the process that I spearhead is the preservation of the AFRC film and tape archives. NASA film reels from half a century ago and videotapes recorded as recently as 2010 need to be preserved in a modern digital format and stored on a server. Preservation not only protects the footage from being lost but also makes it readily accessible to the videographers who compile the footage into a finished product. Additionally, I have the opportunity to take an idea from concept to completion as I direct, produce, and publish a video highlighting some of the AFRC interns and their contributions to NASA and aerospace research.

Roberto Hernandez

University of California- Riverside

NASA Armstrong Internship Program

Graduate Intern
Mechanical Engineering

Mentor: Francisco Peña
Code: RS
Aerostructures

Aerospace Structural Health Monitoring Research with Fiber Optic Sensors

The integration of a structural health monitoring system in aerospace structures can lead to savings in weight while maintaining a high confidence level in future unmanned aerial vehicle (UAV) designs. The National Aeronautics and Space Administration (NASA) Armstrong Flight Research Center Fiber Optic Sensing System (FOSS) is capable of delivering thousands of strain measurements in real time. Real-time monitoring can reduce the risk of damaging an aircraft in flight by providing crucial flight data to pilots. The data include wing deformations, wing loading, and structural stresses. The ability to measure aerodynamic loads on aircraft wings is especially useful when considering aerodynamic design. The focus of this project is the development of new methods for estimating applied operational loads and structural deformation on aircraft wings. A load test on an MQ 9 aircraft wing, similar to a wing of the NASA Ikhana aircraft, will be conducted in which the FOSS measurements will be compared to conventional sensors. These sensors will be used for shape sensing and include strain gages, string potentiometers, inclinometers, and photogrammetry. Algorithms are being developed and applied to a small scale test article to validate the load sensing techniques.

Brendan Holland

Kansas State University

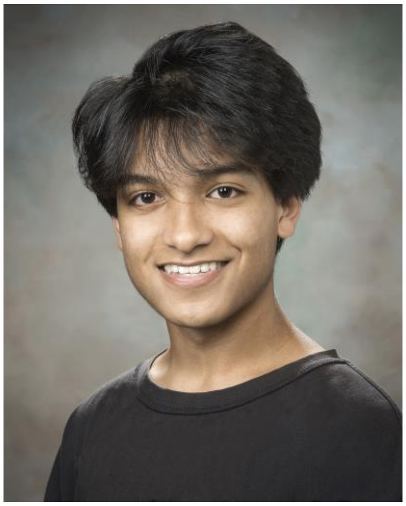
NASA Armstrong Internship Program

Undergraduate Intern
Mechanical Engineering

Mentor: Albion Bowers
Code: R
Research and Engineering Directorate

PRANDTL-D3c Systems Integration

The Preliminary Research AerodyNamic Design to Lower Drag (PRANDTL-D) project is a low-altitude, lightweight glider designed to empirically evaluate span loading during flight. PRANDTL-D3c, the fourth series in the PRANDTL family, will be used to derive and prove Ludwig Prandtl's 1933 theory on the bell span load, and thus further validate proverse yaw and rudderless flight. Being the fabrication lead, I act as a liaison between the three major systems of the PRANDTL project: compact Fiber Optic Sensing System (cFOSS), electronic pressure measurement (EPM), and an open-source flight computer, along with necessary sensors. As a primary support function, the fabrication lead's responsibilities include designing, producing, and installing support structures while mitigating various aerodynamic characteristics such as induced drag, center of gravity (CG) variations, and excessive weight. The fabrication process includes making modifications to the aircraft to ensure the fitting of larger components, analyzing potential configurations of those components, and leveraging computer-aided design (CAD) to precisely model and 3D print the support structures. Finally, it is necessary to integrate the structures into the airframe and redesign them as needed. All methods and implementation processes used will be appropriately documented for future reference.




Nikolas Pardoe[1]
University of Minnesota
NASA Armstrong Internship Program

Mahib Hosain[2]
University of California-San Diego
NASA Armstrong Internship Program

Undergraduate Interns
Aerospace Engineering[1]
Mathematics-Computer Science[2]

Mentor: Ricardo Arteaga
Code: RD
Sensors and Systems Development

ADS-B Ground Station to Support SonicBAT and CLAS-ACT

Automatic dependent surveillance -- broadcast (ADS-B) is a radio-based method of aircraft detection and tracking that provides a reliable and cost-effective alternative to radar. Its use for tracking aircraft from a ground station allows support of the Sonic Booms in Atmospheric Turbulence (SonicBAT) project, which aims to study the way sonic booms move through the atmosphere and the effects of turbulence and varying atmospheric conditions. The mission plan involves using a TG-14 motor glider equipped with audio equipment as well as ground-based microphone arrays to measure the sonic boom emitted by an F/A-18 flying various patterns. Our ground station tracking will help ensure that these patterns are accurate and provide high resolution position data and situational awareness. We will also be supporting the Conformal, Lightweight Antenna Systems for Aeronautical Communication Technologies (CLAS-ACT) project at NASA Glenn. One of the project goals is to reduce interference with ground station radios caused by UAV transmissions, so scientists at Glenn will be measuring the reduced side lobes created by their new antenna design. To do this, the aircraft must be tracked by ground-based sensors. Our ground station will enable this process by giving them position and altitude data as well as the direction and azimuth angles to the aircraft to assist in aligning their sensors.

Zachary Houghton
Victor Valley College

NASA Armstrong Internship Program

Undergraduate Intern
Mechanical Engineering

Mentor(s): Michael Butros and Kurt Kloesel
Code: RA
Aerodynamics and Propulsion

Nonlinear Aeroelastic Flutter Analysis

The accurate prediction of aeroelastic flutter and related phenomena are of major importance during the design phase of any aircraft. The use of an accurate computational model to predict flutter can save many hours of wind tunnel testing, confirm the structural integrity of the airframe, and ensure the safety of the pilot when operating within the intended flight envelope. Additionally, an accurate computational model can aid in back-checking the fidelity of wind tunnel test data. Linear aeroelasticity has been the predominant method for modeling and predicting flutter and other aeroelastic phenomena for decades; however, it can be potentially insufficient in certain cases - for example, when an aircraft has a highly flexible structure. Nonlinear methods are needed to account for the structural nonlinearities associated with the deformation that becomes possible with highly flexible wings. Similarly, aerodynamic nonlinearities can pose problems even in more rigid aircraft structures. This project aims to utilize MATLAB® (The MathWorks, Natick, Massachusetts) to evaluate nonlinear flutter prediction methods, namely bifurcations, and potentially the limit cycle oscillations, in order to analyze the aeroelastic behavior of simple wings with structural nonlinearities.

Deborah Jackson
Embry-Riddle Aeronautical University

NASA Armstrong Internship Program

Undergraduate Intern
Aerospace Engineering

Mentor: Allen Parker
Code: RD
Sensors & Systems Development

Verifying and Validating Fiber-Optic Pressure Sensor Array (FOPSA) for Fiber Optic Sensing System (FOSS)

The Fiber Optic Sensing Systems (FOSS) is a precise measurement system developed at the National Aeronautics and Space Administration (NASA) Armstrong Flight Research Center. The FOSS utilizes fiber Bragg gratings embedded within fiber optics to measure temperature, strain, vibration, and, now, pressure. The fiber-optic pressure sensor array (FOPSA), used with the current FOSS systems, can return the pressure experienced. Since the depth of fluids is directly related to the pressure experienced, the theory behind FOPSA can be demonstrated by observing its behavior in relation to the depth of water. I will integrate the FOPSA with the FOSS and develop a process to interpret fluid levels from the wavelengths returned by the fiber Bragg gratings. Utilizing the relationship between the height of water and the wavelengths returned, I will also write a graphical user interface (GUI) for future demonstrations that could yield support and funding for the continued development of the FOPSA. The GUI will display a fluid level calculated from the pressure experienced by FOPSA as the depth is changed. Currently, fluid levels are calculated using electrified wires, which method produces heat and is a risk to flammable fluids. By utilizing the FOPSA, fluid levels can be determined efficiently, precisely, and safely.

Jack Jensen
Quartz Hill High School

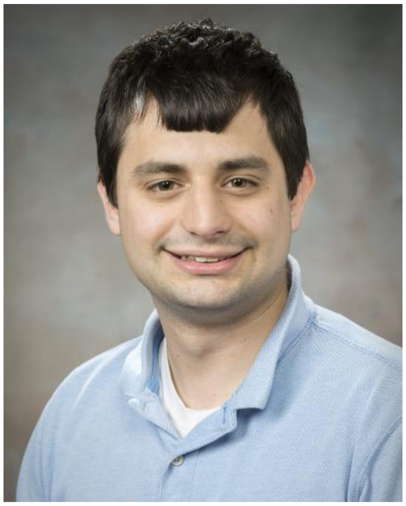
NASA Armstrong Internship Program

High school Intern

Mentor: Dave Berger
Code: K
Office Of Education

Fabrication and Flight Operations for PRANDTL-M

The Preliminary Research AerodyNamic Design To Land on Mars (PRANDTL-M) flying wing uses an airframe that mimics the wing of a bird; as such, it experiences no adverse yaw, eliminating the need for vertical stabilizers and making the aircraft extremely efficient and stable. Part of my time in this project is spent working on the fabrication of this wing, any components related to it, and its adaptation for flight in the Martian atmosphere, whether the task is laying a mold or setting up avionics. The planned mission to Mars necessitates collecting atmospheric and air data, which is where PRANDTL-M comes into play. Flight in the Martian atmosphere presents a unique set of challenges, such as extremely cold temperatures that can disrupt onboard electronics, and very low air pressure and density. My role as flight operations test conductor involves preparing for the many conditions that must be met for a successful PRANDTL-M Mars flight; the smallest detail could cause a catastrophic failure, thus no flaw may be overlooked. To date, tests that have been conducted include several flights of the PRANDTL-M airframe, and environmental tests to learn how the avionics function under Martian atmospheric conditions. Many more tests and more fabrication is planned to be performed by my team and I as we attempt to prepare for every foreseeable outcome regarding flight in the Martian atmosphere.



Landon Jernigan

California State University- Fullerton

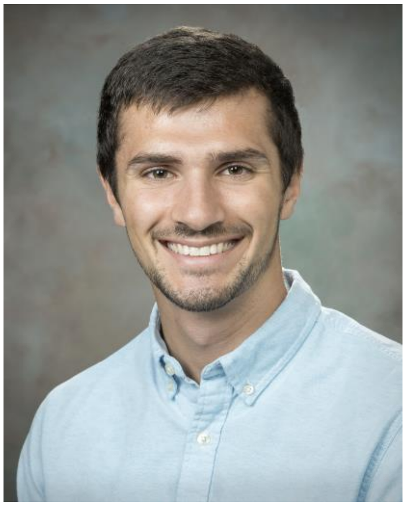
NASA Armstrong Internship Program

Undergraduate Intern
Electrical Engineering

Mentor: Dan Goodrick
Code: RT
Flight Instrumentation and System Integration

Solid State Power Controller

Solid State Power Controllers (SSPCs) offer numerous benefits over electro-mechanical power distribution units and can already be found in military ground vehicles. The practicality of the SSPC is now beginning to spread into use on manned and unmanned aircraft. An SSPC, when installed on an F-18 research vehicle, will allow power distribution to numerous sensors and equipment. The SSPC offers strong power efficiency, a small profile, resistance to wear and tear, circuit protection, and programmability. The SSPCs are controlled with a controller area network (CAN) controller using the Society of Automotive Engineers (SAE) J1939 protocol. Employing a CAN bus provides a robust control system that can withstand the unforgiving environmental conditions posed by turbojet aircraft. Installing such a system requires extensive environmental testing to vibration, heat, cold, and pressure stresses. Installation also involves integrating the SSPC and CAN controller into a usable pilot interface. An SSPC allows digital input from the pilot and also can provide live channel data in the form of response messages on the network. Further development may allow power and monitoring for up to 16 channels. Integration of an SSPC will augment NASA's ability to obtain data and avoid unnecessary maintenance downtime on F-18 aircraft. The success of this system may encourage the use of SSPCs in future aircraft as well as encourage new innovative uses of solid state devices in aviation.



Jeremy Katz
University of Kansas

NASA Armstrong Internship Program

Undergraduate Intern
Aerospace Engineering

Mentor: Alex Chin
Code: RS
Aerostructures

Viscoelastic Sandwich Study

Viscoelastic materials can increase damping in structural components at low weight costs. Successful integration of viscoelastic materials into the skin of aircraft wings or control surfaces may mitigate flutter by changing the natural frequencies of the components. Careful analysis is necessary, however, when combining metal with viscoelastic materials because viscoelastic material may reduce the desired stiffness for the application. The problem is cyclical: as the damping mitigates flutter, reducing the stiffness worsens flutter margins. Integrating viscoelastic materials into aircraft structural components may someday be the key to increased structural damping by means of clever design approaches. In the current study, finite element models (FEMs) and physical test articles are made and tested for several different variations of aluminum and viscoelastic material “sandwiches.” The resulting natural frequencies from the FEM are compared with those from the physical test articles. Changes are made to the FEM until the model results converge to those of the actual experimental data. With accurate FEMs of the experimental test articles, implications of the viscoelastic sandwich can be used in the design of future aircraft structural components in which the benefits of viscoelastic material outweigh the losses.

Douglas Keller

University of Alaska, Fairbanks

NASA Armstrong Internship Program

Undergraduate Intern
Mechanical Engineering

Mentor: Paul Bean
Code: RD
Sensors & Systems Development

QueSST Fiber Optic Sensing System Box Thermal Design

The Quiet Supersonic Technology (QueSST) project intends to modify the aerodynamic shape of a supersonic flight vehicle to control the shockwaves that occur in faster than sound flight. The desired result is a vehicle that will challenge the current supersonic regulations in the United States. The Fiber Optic Sensing System (FOSS) will be utilized to measure the response of such an aircraft during flight testing. To qualify for flight testing, the FOSS has to meet certain specific test requirements, including surviving temperatures ranging from -60 ° F to 160 ° F and pressure altitudes ranging from sea level to 75,000 ft. The primary concern is the wide temperature range. To mitigate this concern, an enclosure will contain and protect the sensitive components of the FOSS. My role was to test this enclosure to determine its thermal attributes, heat transferability, and alter the design when necessary. The current design includes using a thermoelectric cooler as the main temperature control method. Current testing has concluded the use of a two layer enclosure with interstitial insulation. Proximity of the heat source to the thermoelectric cooler heavily influences the ability of the cooler to regulate the temperature. The testing I performed also conveyed the use of heat pipes to overcome potential proximity issues. A preliminary design is currently being constructed to further enclosure testing.

Gus Kendrick

Texas A&M University

NASA Armstrong Internship Program

Undergraduate Intern
Aerospace Engineering

Mentor: Timothy Risch
Code: RS
Aerostructures

Developing a Cold Plate for a Heat Flux Mapping System

During hypersonic flight, components of the wing and body of an aircraft can experience temperatures of over 2500 Kelvin. To ensure that the structure of those components will not fail during a mission, ground tests are conducted using high-powered quartz lamps to heat the components of interest to in-flight temperatures. To fully understand the heat distribution of the lamps, a heat flux mapping system is being created. The objective of the project is to create a water-cooled cold plate that will protect the heat flux mapping system for the lamps. The cold plate must protect the sensors and mounting equipment from 48 kW of heat while remaining structurally sound. To do this, a balance must be struck between minimizing cost, weight and pressure drop in the flow tubes, and maximizing the convective heat transfer in the fluid channels. Once an acceptable combination of properties is found, a simple thermal analysis under worst-case conditions is done using Patran® and MSC Nastran® (both of MSC Software Corporation, Newport Beach, California) to estimate the maximum temperature on the surface of the plate. These results are then transferred to a structural analysis, in which the deformation of the plate, due to fluid pressure and variations of the plate’s temperature, is modeled. The most effective and cost efficient results are then selected for a complete design and manufacture. With the heat flux of the lamps fully mapped, more accurate lamp arrangements can be used in future tests.

Jessica Kenny

California State University- San Bernardino
Austin Peay State University
NASA Armstrong Internship Program

Undergraduate Intern
Physics

Mentor: Kurt Kloessel
Code: RA
Aerodynamics & Propulsion

Motor Control for Hybrid-Electric and Electric Motors

Developing the technology to drive the electric motors for the National Aeronautics and Space Administration (NASA) hybrid-electric and all electric air vehicle efforts contributes to the NASA goal of reducing fuel consumption by half and reducing emissions. The inductance and resistance of several different permanent magnet synchronous motors (PMSMs) were measured using a laboratory grade inductance, capacitance and resistance (LCR) meter. The inductance and resistance values were needed to compose a robust proportional integral derivative controller for the motor. The LCR values were then used in a comparative study with motor control software with built in automatic parameter identification software in the input for validation. The inductance and the resistance were used in order to control the motor accurately. The information gathered from evaluations like these will give a better understanding toward the development of electric and hybrid-electric air vehicles.

Brandon Kloesel

Victor Valley College

NASA Armstrong Internship Program

Undergraduate Intern
Environmental Sciences

Mentor: Miriam Rodón-Vachon
Code: XM
Industrial Hygiene

Noise Safety Surveys and Analysis

"Industrial Hygiene is a science and art devoted to the anticipation, recognition, evaluation, prevention, and control of those environmental factors or stresses arising in or from the workplace which may cause sickness, impaired health and well being, or significant discomfort among workers or among citizens of the community." (American Industrial Hygiene Association). This summer, I worked within the Industrial Hygiene department at the National Aeronautics and Space Administration (NASA) Armstrong Flight Research Center (AFRC), concentrating on the evaluation, prevention, and control of noise hazards. Noise Exposure is one of the most prevalent occupational hazards at AFRC. Noise Safety Hazards are managed under the Occupational Safety and Health Administration (OSHA) regulated Hearing Conservation Program. My first assignment was a visual survey of selected AFRC facilities to verify accessible hearing protection and Noise Safety signage. I also performed various area noise dosimetry and personal noise dosimetry using noise dosimeters and logging sheets for cataloging the day to day activities of those who were tested while wearing a noise dosimeter. Interpreting the obtained data, compiling final findings, and writing the commensurate final report were also among my duties.

Stephen Lantin

University of California- Santa Barbara

NASA Armstrong Internship Program

Undergraduate Intern
Chemical Engineering

Mentor: Kurt Kloesel
Code: RA
Aerodynamics and Propulsion

Characterization of a Hybrid-Electric Integrated Systems Testbed Motor Controller

In the pursuit of safe and sustainable aviation, the National Aeronautics and Space Administration (NASA) is exploring electric propulsion technologies for the next generation of commuter aircraft. While the prospect of electric flight is not new, the technology has remained in its infancy due to low power density and efficiency losses. To overcome these limitations, the Hybrid-Electric Integrated Systems Testbed (HEIST) project is developing lighter, more efficient wings by employing three-phase motors and propellers in experimental designs. Integral to such designs is the motor controller, which must be characterized with efficiency and temperature maps to determine optimal operating conditions. These maps may also provide insight into future design improvements. In one embodiment of the testing setup, a power supply is connected in series with the controller. The controller outputs three-phase power to the flight motor, which is then attached via a dynamometer to a brake motor to simulate load. The rotational speed and load of the flight motor can then be varied incrementally using systems engineering software controller area network (CAN) inputs to the controller and the brake motor driver respectively, and probed for efficiency and temperature data using a power scope and thermistor. Further exploration into efficiency changes as a function of pulse width frequency is also studied.

James Larson

Iowa State University

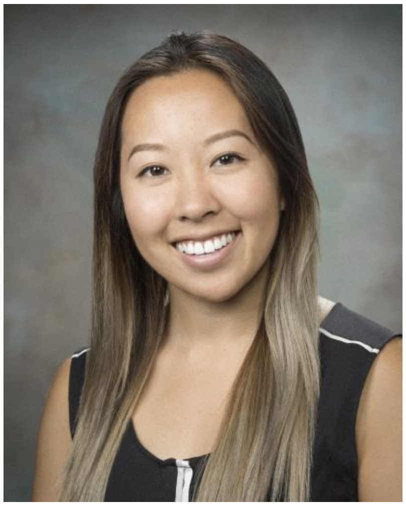
NASA Armstrong Internship Program

Undergraduate Intern
Aerospace Engineering

Mentor: Oscar Murillo
Code: RC
Dynamics and Controls

Hood Design for PRANDTL-D 3c Aircraft

The purpose of the Preliminary Research in AerodyNamic Design to Lower Drag (PRANDTL-D) is to prove the concept and viability of proverse yaw due to a bell-shaped span load and a certain amount of twist in the wing. In recent years, the existence of proverse yaw on the PRANDTL-D research aircraft has been proved. This summer, using the PRANDTL-D3c aircraft, we aim to show that proverse yaw is a direct result of the bell shaped span load and wing twist. The compact Fiber Optic Sensing System (cFOSS) will measure the strains and loads the aircraft experiences during flight. The cFOSS box, however, protrudes from the cargo bay and above the shell of the aircraft, potentially creating enough parasitic drag to skew the aerodynamic data. My main task this summer has been to design and fabricate a cover for the cFOSS box to alleviate some of this parasitic drag. To accomplish this task, I manipulated the airfoils of the aircraft and created a solid using computer-aided design software. I am currently having a mold machined in the fabrication shop, and when the mold is ready I will lay carbon fiber over the foam mold.



Joyce Le

University of California- Irvine

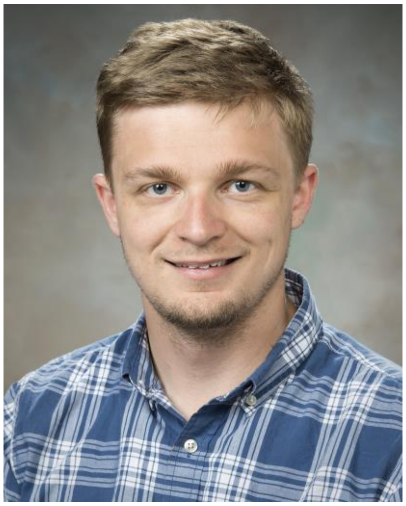
NASA Armstrong Internship Program

Undergraduate Intern
Mechanical Engineering
Aerospace Engineering

Mentor: David Berger
Code: K
Office of Education

Characterizing the Aerodynamic Performance of PRANDTL-M

The Preliminary Research AerodyNamic Design to Land on Mars (PRANDTL-M) mission is to implement geometric twist in the wing design to produce a spanwise bell-shaped lift distribution and minimize induced drag for flight in the Martian atmosphere. A bell-shaped lift distribution drives the lift to zero at the wingtips, eliminating both the negative effects of wingtip vortices (adverse yaw) and the necessity of vertical stabilizers. To prove this concept and ensure its success, it is important to numerically evaluate the performance of the aircraft in its design stages and validate the results with flight data and other computational methods. Characterizing the performance of the PRANDTL-M aircraft involves conducting a computational fluid dynamics analysis on the airfoil geometry utilizing a two-dimensional method of airfoil analysis and a three-dimensional vortex lattice method. Airfoil coordinates are used as inputs to compute the aerodynamic coefficients. The changing shape of the PRANDTL-M airfoil along the wing requires that an integration method be used in conjunction with the two dimensional method of airfoil analysis in order to yield the total coefficients of lift, drag, and pitching moment. The results from the two and three dimensional analyses will be compared with each other and then validated with the aerodynamic coefficients that are computed from parameter identification test flight data.



Zachary Lewis

Utah State University

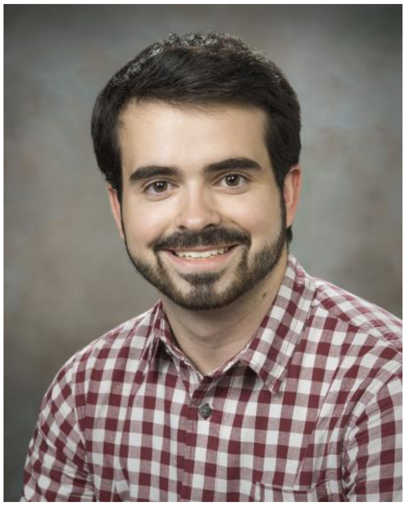
NASA Armstrong Internship Program

Graduate Intern
Mechanical and Aerospace Engineering

Mentor: Sky Yarbrough
Code: RD
Sensors and Systems Development

Towed Glider Air Launch System Sustainer Motor Controller Development

The Towed Glider Air-Launch System (TGALS) is currently under development as a lower cost method for launching small payloads to orbit. Using a towed air-launch platform retains the advantages of air-launching while providing an increased measure of safety for the crew as well as reducing cost. Part of the flight path for the TGALS platform is an attitude change to match the optimal trajectory of a ground launch, requiring that a throttle-able booster rocket be integrated into the glider airframe. For the sub-scale TGALS tests, a hybrid rocket motor developed by Utah State University was selected. My project is to develop and demonstrate a motor controller that communicates with the navigation computer of the glider and provides closed-loop control over the hybrid rocket. This controller will contain a single board computer, a high-voltage power supply, and other driving circuitry to interface with the electro-mechanical parts of the motor. Thus, two custom printed circuit boards were designed and created. After assembly of the motor controller, test software will be loaded and run to ensure the integrity of the interface. A motor control law will then be implemented, as well as a communications protocol with the navigation computer.



Jonathan Lokos

California Polytechnic State University-
San Luis Obispo

NASA Armstrong Internship Program

Undergraduate Intern
Mechanical Engineering

Mentor: Allen Parker
Code: RD
Sensors and Systems Development

Rapid Development of For-Flight Fiber Optic Sensing System Enclosures

Whenever an instrumentation system (for example, a fiber optic sensing system [FOSS]) is installed on an aircraft, its control unit must be installed as well. The control unit includes many delicate components that must be protected from the rigors of flight. That's where the enclosure comes in. Different from standard laboratory enclosures, enclosures installed on aircraft are automatically categorized as "for-flight." These enclosures must meet the G-loading requirements and environmental regulations of the aircraft they are installed on. Two such enclosures being designed this summer are for the X-56 Multi-Use Technology Testbed (MUTT) and the Quiet Supersonic Technology (QueSST) Low Boom Demonstrator. First, the enclosure is designed in a selected computer-aided design (CAD) software and a mockup is produced using a 3 D printer. The mockup is then used to fit check both its internal components and its aircraft mount. After the design is finalized, it enters the drawing phase as technical drawings are produced in the CAD software. The drawings are then sent to drawing control to be evaluated. The drawings can also be reviewed by the Aerostructures and Operations Engineering groups to determine if the design is rugged enough. Once the drawings are corrected and approved by drawing control they are sent to the fabrication shop, where the components of the enclosure are manufactured and assembled.

Jose Manriquez

California State Polytechnic University-Pomona

NASA Armstrong Internship Program

Graduate Intern
Aerospace Engineering

Mentors: Dave Berger & Alec Sim
Code: K
Office of Education

Using an Embedded Coder to Quickly Develop Non-Linear Flight Control Systems for the PRANDTL-M Glider

The Preliminary Research AerodyNamic Design To Land on Mars (PRANDTL-M) project aims to reach a new capability in tailless vehicle flight, challenging the notion that the elliptic lift distribution is the optimum for non-span limited cases of Prandtl's lifting-line theory. The PRANDTL-M attempts to mimic the wings of birds by applying a non-linear geometric twist throughout the wing span to generate proverse yaw to overcome the effects of adverse yaw during flight. This method of flight could benefit from a non-linear flight control system to incorporate the flight dynamics of a tailless flying wing. Development of the flight control system would take place in a Simulink® (The MathWorks, Natick Massachusetts) block diagram environment utilizing a specially selected embedded coder toolbox. The glider is equipped with a flight management unit (FMU), a high performance autopilot hardware that runs a real-time operating system, and a full stack open source autopilot software. The flight control system would be converted into the form of a block diagram in a C++ code application. The application could then be implemented into the source code, and then built and deployed into the FMU. This process would allow a faster development process of designing, building, and deploying the flight control system in a prototype glider for testing and debugging.

Walker Martin
John Brown University

NASA Armstrong Internship Program

Undergraduate Intern
Mechanical Engineering

Mentor: Albion Bowers
Code: R
Research and Engineering Directorate

Flight Operations Director and Flight Mechanics Implementation for PRANDTL-D 3c

The Preliminary Research AerodyNamic Design to Lower Drag (PRANDTL-D) project is a low-altitude, lightweight glider designed to enhance aircraft controllability and greatly reduce wing drag. Derived using Ludwig Prandtl's (1875-1953) 1933 theory on bell shaped spanload and proverse yaw, the PRANDTL-D3c is the third generation of this project. The PRANDTL-D3c team at the National Aeronautics and Space Administration (NASA) Armstrong Flight Research Center (AFRC) acts as the intersection for the various components of the project. The system used a parameter identifier and the AFRC compact Fiber Optic Sensing System (cFOSS) system to collect the aerodynamic data of the flight. Once development and ground testing of systems was completed, the team designed the mounting systems for the instrumentation within the carbon airfoil of the full sized PRANDTL wing. We designed the physical calibration testing beds for the gyrometer and accelerometer collection system to confirm value accuracy. The project then shifted to designing the cFOSS mounting system, in order to allow ease of access for data acquisition and proper air circulation for the system. My role as flight operations director was to maintain active communication between the project team, team management, and flight coordinators to achieve flight directives. This correspondence involved technical briefing designs and combined system test management to achieve logistical authorization for the flights. During the flights the role involved communicating to the pilot to confirm that the flight objectives for the asset mission were accurately met.

Bridget McBride
Oregon State University

NASA Armstrong Internship Program

Undergraduate Intern
History

Mentor: James C. Ross
Code: MI
Information Systems

Photography as a Historical Documentation Tool

At the National Aeronautics and Space Administration (NASA) Armstrong Flight Research Center (AFRC), the purpose of a photography intern is to support the Photography Laboratory (Photo Lab) in documenting the past and the present through various projects. In this capacity, I am assisting with two major projects in the Photo Lab. First, in a collaborative effort between two NASA Centers, the Photo Lab staff at AFRC is prepping historical negatives of the Center's past, dating back to 1949, which they will send to be scanned and archived at the NASA Johnson Space Center. This project is of utmost importance because when these negatives were originally archived, the photographers were unaware that the negatives could degrade if they were not placed in acid-free archival sleeves. The Photo Lab staff at Armstrong thus is reprocessing these images, ensuring that they can be appreciated by NASA and the public for years to come. Second, I am shadowing NASA photographers as they document current aircraft, equipment, events, and other subjects. In these ways, the AFRC Photo Lab staff is both preserving the NASA past and documenting NASA history as it unfolds. Finally, as part of the Graphics Department, I will help our summer 2017 interns prepare their posters, which will be used for their poster sessions and possibly their exit presentations.

Dario Mejia-Solis

California State Polytechnic University-Pomona

NASA Armstrong Internship Program

Undergraduate Intern
Aerospace Engineering

Mentor: Kurt Papathakis
Code: RT
Flight Instrumentation & System Integration

X-57 SCEPTOR Endurance and Propulsion Systems Acceptance Testing on the Airvolt Test Stand and Failure Modes and Effects Analysis Development

The National Aeronautics and Space Administration (NASA) is investing in a new all-electric experimental airplane, the X-57 "Maxwell." The X-57 airplane is part of the Scalable Convergent Electric Propulsion Technology and Operations Research (SCEPTOR) project as an ongoing research project that tests and validates new and more energy efficient aircraft designs for flight. The goal of the project is to demonstrate a new capability-driven approach in aircraft aviation using an all-electric propulsion system. Validating an electric motor driven aircraft leads the way to the future of general aircraft aviation. This accomplishment will help reduce carbon emissions, increase propulsion airframe integration integrity, increase aircraft energy usage, and reduce noise during flight. The following research describes the testing and analysis used to determine the feasibility of implementing (retrofitting) an experimental aircraft with an electric propulsion system with a newly-modified high aspect ratio wing. The fundamental construction of the system consists of two cruise motors, 12 high-lift motors, pitch controllers, traction bus contactors, two independent power sources (powering independent power buses), inverters, a controlled area network (CAN) bus, fiber optics bus extenders (FOBE), back-up battery, data acquisition log device, and sensors. The Airvolt test stand will enable thorough testing of the electric motor comprehensive system using a software command system that will indicate elaborative procedure commands. Systems engineering software is used for data acquisition, and MATLAB® (The MathWorks, Natick, Massachusetts) interprets the data into a supplementary visual representation of the propulsion system undertakings.

Stephen Moes

University of California- Irvine

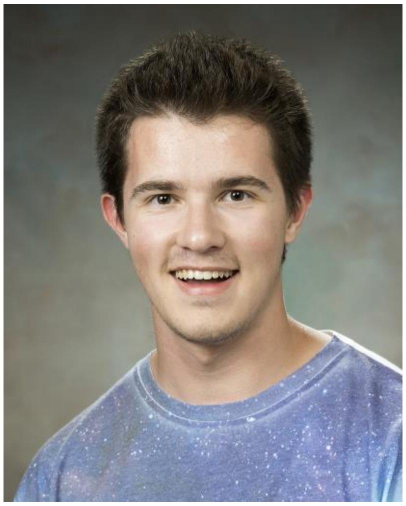
NASA Armstrong Internship Program

Undergraduate Intern
Mechanical Engineering

Mentor: Dave Berger
Code: K
Office of Education

Solid Model Design and Fabrication for PRANDTL-M

The Preliminary Research AerodyNamic Design to Land on Mars (PRANDTL-M) is a flying wing design that utilizes an airfoil inspired by Ludwig Prandtl (1875-1953). This airfoil has a twisted wing which produces upwash at the wingtips and therefore proverse yaw. This innovative and complex design increases the stability of the airplane and eliminates the need for a tail. The stable and streamlined nature of the airfoil also allows flight at very low Reynolds numbers (of approximately 20,000), which are reasonably attainable for subsonic flight in the low density atmosphere of Mars. Consistent and complete testing has been undertaken using multiple airframes which utilize foam, each with various avionics. Foam is not durable over time or rigorous flight testing, so a need exists for repeatable and robust airframes that can enable consistent avionics placement. The primary task of this work is to adapt an existing computer aided design (CAD) model to the needs of a machine in order to produce an airframe mold. The mold will be used to produce a robust-consistent airframe for flight testing and integration of control systems, avionics, and relevant hardware. The mold and the associated airframe process will be used to produce multiple airframes, enabling the optimization of control systems design. In addition to the airframe design process, a CAD model has been adapted to a three-dimensional printing process that enables sizing electronics inside a realistic model of the avionics bay and provides for a more accurate integration of the electronics. The combination of these resources aims to produce a streamlined process for design and fabrication of the PRANDTL-M flying wing.



Levin Mullaney

Montana Tech of the University of Montana

NASA Armstrong Internship Program

Undergraduate Intern
Electrical Engineering

Mentor: Lucas Moxey
Code: RT
Flight Instrumentation and System Integration

Flight Instrumentation Hardware for the NASA F-15D Supersonic Research Aircraft

Reducing flight time for commercial flights could be accomplished easily by flying at supersonic speeds; however, the commensurate sonic booms, which disturb the public, impede supersonic flight over land. The Quiet Supersonic Technology (QueSST) project is aimed at minimizing sonic boom disturbance. The project will use an F-15D airplane will be used as a support airplane to collect sonic boom data. Diagrams were drawn for integrating and implementing the necessary hardware onto the F-15D airplane. First, the integration drawing was completed for the Video and Data Recorder Interface (VADR), which is used for storing infrared video data. This integration drawing indicates the locations of inputs to the VADR and the type of wire and connectors to be used. Next, the interface block diagram for the gun bay was completed, showing how the components in the gun bay are connected and where inputs and outputs to the gun bay are wired. Last, the interconnect diagram for the entire airplane was completed. This diagram shows the wiring connections between the bays of the airplane, how the wires will be routed through the airplane, and the type of wires and connectors to be used. These drawings provide the information necessary to properly wire the data collection hardware in the F-15D airplane for supersonic research.

Hussein Nasr

California State Polytechnic University-Pomona

NASA Armstrong Internship Program

Graduate Intern
Aerospace Engineering

Mentor: Dave Berger
Code: K
Office of Education

PRANDTL-M Simulation Development

The Preliminary Research AerodyNamic Design to Land on Mars (PRANDTL-M) (PM), planned to be the first glider to fly through the Martian atmosphere, is a small vehicle with folding wings allowing it to fit inside a small 6U CubeSat. The mission of the PM is to collect ground mapping and atmospheric data on Mars. The main objective of this internship is to perform system identification (ID) on several wing geometry designs, simulate them, and compare the results with flight data. System ID, in short, is the building of mathematical models that represent the dynamics of the vehicle during flight. More specifically, the objective for this internship is to retrieve the stability and control derivatives of the vehicle. To begin, eight equations of motions are used and then linearized around trim conditions to create state space models in the longitudinal and the lateral directions. The most critical and challenging part in performing system ID for this project is retrieving the essential flight data during specified maneuvers. The PM is very small and does not produce its own thrust, so holding a steady altitude or having an alpha-beta vane is not feasible. Many work arounds must be implemented and assumptions made to get the best possible estimation of aerodynamic coefficients. Finally, coefficients will be compared with results found from using different computation fluid dynamics softwares.

Emma Neal

California State Polytechnic University-
San Luis Obispo

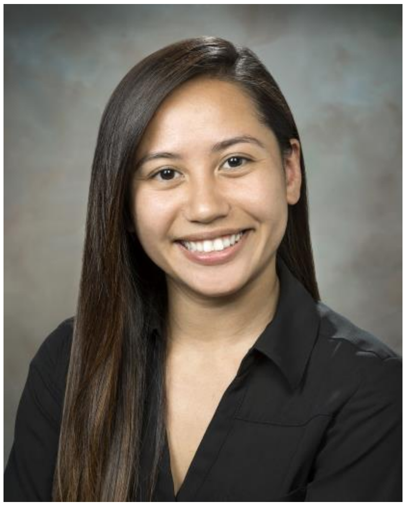
NASA Armstrong Internship Program

Undergraduate Intern
Electrical Engineering

Mentor: Dave Berger
Code: K
Office of Education

Environmental Testing of PRANDTL-M

The Preliminary Research AerodyNamic Design To Land on Mars (PRANDTL-M or PM) is an unmanned glider designed to produce Ludwig Prandtl’s (1875-1953) idea of a bell-shaped lift distribution, which induces proverse yaw and eliminates the need for a vertical tail. The PRANDTL-M mission is to fly in the Martian atmosphere in order to obtain detailed information about the atmospheric conditions of the planet. The PRANDTL-M aircraft offers the National Aeronautics and Space Administration (NASA) the opportunity to advance planetary exploration and obtain valuable data on the attributes of Mars. To ensure proper function of PM in the Martian atmosphere, environmental testing of avionics onboard the PRANDTL-M aircraft is essential. These tests consist of low temperature and high altitude tests performed in a 6 by 6 by 6 ft chamber capable of reaching temperatures of 100 °F to 500 °F and a pressure altitude of up to 200,000 ft. The objective of low temperature tests is to ensure that the components onboard the PM will receive the required amounts of power at temperatures as low as -85 °F. The abilities of the chamber and the parameters of the test exceed known Martian conditions. The results gathered from these tests will characterize the PRANDTL-M aircraft system. Characterization of the PRANDTL-M aircraft system is critical for meeting the design requirements necessary for successful flight in the Martian atmosphere.



Flor Tonie Nguyen

California State Polytechnic University-Pomona

NASA Armstrong Internship Program

Undergraduate Intern
Psychology
Small Business Management and Entrepreneurship

Mentor: Dr. Ashley Prueitt
Code: XM
Employee Assistance Program (EAP)

Stress Reduction in the Workplace

The Employee Assistance Program (EAP) is a free and confidential resource that assists civil servants, contractors, and their families at the National Aeronautics Space Association (NASA) centers with a variety of services dedicated to promoting mental health. The range of services include special topic briefings, individual counseling, management consultations, and related activities to increasing mental health well-being and awareness. My research project investigates the effectiveness of allotting a specified amount of time for video game play at work on perceived levels of stress over a six week period. The pool of participants consists of NASA employees who volunteered to take part in the study. Before they begin, participants take a pre test indicating their stress levels and then a post-test afterward to measure any detectable difference in stress levels. For the six weeks, participants spend 30 minutes per week dedicated to playing video games on a laptop with the intention that such a controlled, leisurely activity will result in decreased stress in the workplace.

Timothy Nuñez

California State Polytechnic University-Pomona

NASA Armstrong Internship Program

Undergraduate Intern
Computer Engineering

Mentor: Curtis Hanson
Co-Mentor: Stephanie Andrade
Code: RC
Dynamics and Controls

Passenger Ride Quality Tool and Vortex Model Analysis

Automated Cooperative Trajectories – Programmable Autopilot is a multi-aircraft autonomous flight research project aimed to have a trailing aircraft fly on the wingtip vortices of a lead aircraft, thus increasing the lift, reducing the drag, and reducing the fuel consumption of the trailing aircraft. My objective will be to finish the Passenger Ride Quality tool as an effort to quantify the discomfort of passengers within the trailing aircraft and compare these results to those of the leading aircraft. Attempting to quantify the vibration and noise that could affect passengers can lead to developing a model that can automatically compute discomfort levels. The tool will be completed by adding noise computations to MATLAB® (The MathWorks, Natick, Massachusetts) scripts and incorporating them within the existing vibration computations. The tool will be adapted to a user friendly graphical user interface format. Once the tool is complete it will be able to easily and accurately predict standardized discomfort levels. Another objective is to analyze the wing tip vortices of the leading aircraft and modify the vortex model within the Gulfstream III simulator in order to create a more detailed simulation of the ring like pattern seen in flight.

Keith Omogrosso
Oregon Institute of Technology

NASA Armstrong Internship Program

Undergraduate Intern
Electrical Engineering

Mentor: Matthew Waldersen
Code: RD
Sensors & Systems Development

Development of Intra-Vehicular Wireless Avionic Systems

The Sensors and Systems Development Branch at the National Aeronautics and Space Administration (NASA) Armstrong Flight Research Center is committed to hardware and software development for avionics and testing systems. The Intra-Vehicular Wireless Avionic Systems project aims to create a wireless system that can rapidly advance the Technical Readiness Level (TRL) of emerging avionic wireless technology. It is my job to help develop a wireless platform that can accommodate multiple wireless protocols and applications to streamline integration while reducing cable weight. Accommodating many different forms of communication can make integration of new avionic systems difficult. An agnostic wireless platform that acts as a data center broker overcomes many of the barriers for emerging wireless communication systems. This project also is useful for existing avionic systems, for which this wireless platform can integrate new wireless sensor technology without hardware modification. I am using commercial off the shelf components to develop a proof of concept for this system. Our goal at the end of the project is to demonstrate the successful transmission of sensor data over differing protocols to different avionics subsystems in one wireless platform.

Nazneen Peracha

University of California- Irvine

NASA Armstrong Internship Program

Undergraduate Intern
Aerospace Engineering
Minor in Information and Computer Science

Mentor: Paul Ristrim
Code: OK
Aircraft Records

NAMIS Aircraft Maintenance Tracking

The NASA Aircraft Management Information System (NAMIS) is software used to keep track of logbooks, aircraft data, and all Maintenance Directives (MDs) that affect the aircraft maintained and operated by NASA. MDs include technical directives, technical orders, service bulletins, etc. that are issued for all aircraft. These documents describe modifications that should be implemented to help ensure airworthiness and mission success. I will be loading the MDs for the aircraft maintained and operated at Armstrong Flight Research Center onto NAMIS. I will also be observing/running the Maintenance Directive Implementation Meetings (MDIMs) which are attended by a representative from Code OK along with the Operations Engineer, Operations Inspector, and Crew Chief of the specific aircraft. A MDIM is held for each aircraft at Armstrong on a monthly basis to discuss the applicability of the MDs and how and when they should be implemented. This process involves learning about inspections, types of aircraft cycles, life limits of components, tracking flight hours, and what is needed to support the diverse fleet maintained at Armstrong.

Joseph Piotrowski

California State University- Long Beach

NASA Armstrong Internship Program

Undergraduate Intern
Mechanical Engineering

Mentor: Kurt Kloesel
Code: RA
Aerodynamics & Propulsion

Research and Development on NASA's All-Electric and Hybrid Aircraft

The purpose of this project is to perform systems integration research on three different hybrid power plants for an advanced concept aircraft. The goal is to recommend a Brayton cycle power plant and an electric generator to power a manned hybrid-electric vehicle, reducing fuel consumption, carbon emissions, operating costs, and noise, and achieving high lift at low speeds. A high-winged, lightweight, 200 HP, four-seat, general aviation aircraft was chosen as the baseline model for this endeavor. The problem with this initial aircraft – prior to potentially adding a hybrid turboelectric generator and assuming it will be powered only by batteries – is that the flight time is severely limited. A preliminary trade study to increase the flight time on the high-winged light aircraft was conducted by performing system tests and analysis on whether or not adding a turboelectric generator would mitigate this problem. Three dimensional modeling programs were used to study and analyze conceptual designs of installing a hybrid turbo generator system into the newly designed aircraft. Along with inserting a new generator, the locations of the fuel tanks, power electronics, and external batteries were found. Because multiple ancillary systems are being installed into the fuselage, the payload will increase and the weight and balance of the original aircraft will drastically change - changing the entire flight dynamic of the vehicle. As such, new center of gravity (CG) and center of pressure (CP) locations were calculated for each engine configuration to ensure aircraft stability and control.

Ethan Purtee

Rochester Institute of Technology

NASA Armstrong Internship Program

Undergraduate Intern
Management Information Systems

Mentor: Lisa Illowsky
Code: K
Office of Education

Supporting Digital Learning Network Events and Optimizing use of the TriCaster® Mini

The Digital Learning Network (DLN) uses advanced technology to promote and support the science, technology, engineering and mathematics (STEM) concepts to people all over the nation. The main goal is the promotion of effective uses of interactive instructional technologies through the delivery of National Aeronautics and Space Administration (NASA) educational content for the benefit of students and educators. A branch of the DLN is located in Palmdale, California at the NASA Armstrong Flight Research Center; this branch will host the LEGO® (LEGO A/S, Denmark) and NASA Engineering Virtual Visits at the AERO Institute. The DLN as a whole is also looking for new ways to utilize the TriCaster® Mini (NewTek, Inc., San Antonio, Texas) equipment for future events. This piece of equipment is used to create camera switches and green screen special effects, and allows for the seamless integration of various other applications in order to produce events for the DLN Specialists to use to present their projects. Time spent with the DLN will consist of reviewing requests from the DLN Specialists of the most problematic issues with the TriCaster® Mini, researching techniques, integrating procedures, and creating a user manual that will assist the DLN in reaching new goals. The user manual will help the DLN Specialists learn a variety of uses for the TriCaster® Mini in order to enhance digital STEM productions.

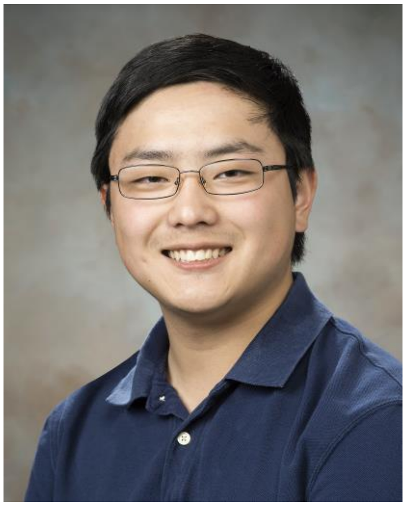
Gary Ridge
California State University- San Bernardino
NASA Armstrong Internship Program

Undergraduate Intern
Physics/English

Mentor: Kurt Kloesel
Code: RA
Aerodynamics and Propulsion

3 Dimensional Simulation of a Permanent Magnet Synchronous Motor)

A Permanent Magnet Synchronous Motor (PMSM) was modeled using 3-dimensional (3 D) dynamic motional finite element electrodynamic software. Accurate 3 D modeling of a PMSM is beneficial in studying the electromagnetic frequency (EMF), revolutions per minute (RPM), thermodynamics, torque, and stress of the PMSM. There was discovered to be a linear relationship between the induced voltage, or "back EMF," and RPM of the PMSM. By using this simulation, the relationship between back EMF and RPM can be determined. Fine motor control can thus be increased, and the need for an RPM sensor eliminated. The end goal of this project is to prove that an all-electric airplane is quieter, more efficient, better for the environment, and more economically friendly than the gas-powered airplanes that are in widespread use today.



Jacob Riley

Dakota State University

NASA Armstrong Internship Program

Undergraduate Intern
Cyber Operations

Mentor: Allen Parker, Ryan Warner
Codes: RD, RT
Sensors & Systems Development, Flight Instrumentation and System Integration

Safety Critical Fiber Optic Sensing System Graphical User Interface Development

This Fiber Optic Sensing System (FOSS) graphical user interface (GUI), otherwise known as the Configuration File Interactive Editor (CeFIE), builds upon the contributions of a previous FOSS intern. The CeFIE helps achieve three goals for the FOSS group: simplify the process of configuring the FOSS unit, unburdening FOSS personnel from test support and FOSS development; make FOSS a common tool for strain measuring applications ranging from safety critical to mundane without the need for extensive training; and prevent or minimize the creation of inconsistent configuration files that result in erroneous or misleading FOSS results. The CeFIE allows both advanced and novice users to develop or modify a binary FOSS configuration file. The default user interface provides a subset of FOSS capability and is intended for users who are not as proficient configuring the FOSS unit. It steps the user through the creation or modification of a configuration file by asking them a series of questions. The advanced user interface unlocks the full capability of the FOSS unit. Users may either operate solely in the Default or Advanced User Interfaces or transfer their results from the Default User Interface to the Advanced User Interface where they can build upon the stable foundation that has been laid. The CeFIE is being developed in the C# programming language.

Bassem Said

California State University- Fullerton

NASA Armstrong Internship Program

Undergraduate Intern
Mechanical Engineer

Dave E. Berger
Code: K
Office of Education

Gondola System for the Deployment of Prandtl-M

The Preliminary Research AerodyNamic Design to Land on Mars (PRANDTL-M) is a small scale aircraft designed for deployment as a secondary payload from Mars. In order to test the capabilities of PRANDTL-M in the terrestrial environment, in a “Mars like environment,” a high altitude deployment system must be developed. This gondola system consists of a weather balloon, main gondola mount, and the Prandtl M deployment system. The balloon-gondola PRANDTL-M system will ascend to an altitude of 125,000 ft. and be released to simulate expected Mars flight conditions. The system must be tested for operational stability under all flight conditions, thus many tests will need to be conducted. For example, the PRANDTL-M will require heating and insulation in order to survive Martian atmosphere temperatures as low as -85 ° F. Environmental testing will be performed to determine the amount of active heating required by the gondola system for onboard avionics. The intrinsic characteristic of the PRANDTL wing being its nonlinear twist allowing the wing to fly using proverse yaw deploying the PRANDTL-M nose down is vital to increasing the Reynolds number in order to allow optimal control in the low density Martian atmosphere. Testing methods and subsequent gondola design must focus on optimizing the characteristics of the initial release and mitigating the environmental exposure prior to release. The data obtained from these tests can enable the design of a robust and consistent deployment platform.

Jesus Alejandro Salinas
California State University- Northridge

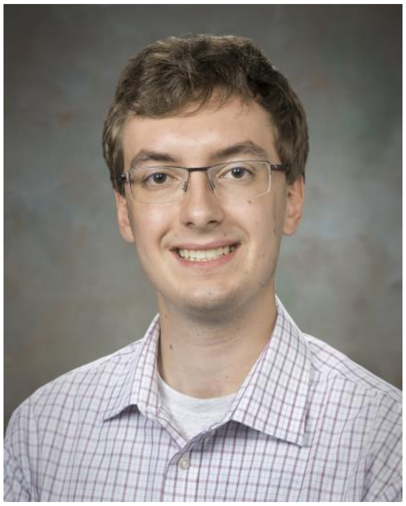
NASA Armstrong Internship Program

Undergraduate Intern
Computer Science

Mentor: Allen Parker
Code: RD
Sensors and Systems Development

Next Generation Fiber Optic Sensing System Software Development

The Fiber Optic Sensing System (FOSS) technology is a prime advancement in high speed sensing technology. The FOSS software consists of highly efficient algorithms that determine parameters such as shape, temperature, liquid level, strength, and operational loads. Next generation FOSS utilizes a system on a chip (field-programmable gate array plus central processing unit [CPU]) based board to obtain raw data from fibers. The data are then transferred to a single board computer with an octa-core heterogeneous multiprocessing advanced RISC (reduced instruction set computer) machines (ARM) CPU and Gigabit Ethernet. Data transferring is accomplished using transport control protocol (TCP) to ensure no data are lost during transmission. To optimize all cores of the single board computer, an application programming interface was used to support multiplatform shared memory multiprocessing in the C programming language. Micro FOSS (uFOSS) is the next generation of FOSS; it will use fast Fourier transform techniques to process incoming data and send that data to the user by way of the User Datagram Protocol (UDP) method, which is significantly faster and does not require a wired connection. The main purpose of this FOSS software is to receive, process, and send data simultaneously without any data overrun.



Paul Sampson
Northern Michigan University

NASA Armstrong Internship Program

Undergraduate Intern
Computer Science and Mathematics

Mentor: Philip Hamory
Code: RD
Sensors & Systems Development

Improving the Speed of Fiber Optic Sensing System Signal Processing Algorithms

The National Aeronautics and Space Administration (NASA) Armstrong Flight Research Center Fiber Optic Sensing System (FOSS) detects strain along optical fibers by measuring changes in the wavelength of light reflected by Bragg gratings along the length of the fiber. In one approach, the raw frequency data are processed by wavelet transforms, allowing the algorithm to relate changes in specific frequencies to strain at specific positions on the fiber. The C code used to implement these transforms iterates repeatedly over the frequency data, making it an excellent candidate for parallel processing. The application of certain compiler directives allows independent portions of the code to run concurrently, rather than in series. Once this process is optimized, the speed of the algorithm can be improved by several times. In addition, there exist C libraries with extremely efficient linear algebra and convolution functions. The wavelet algorithm makes extensive use of convolutions; integrating these libraries into the existing code can provide additional speed increases. Improving the speed of the algorithm in such a fashion allows the FOSS to provide a greater rate of measurements per second, which makes the system better at quickly identifying changes in stress. This capability is important to any system that requires fast reactions to such changes, including such diverse examples as hazardous materials storage tanks and experimental airframes.

Joseph Smith
Michigan State University

NASA Armstrong Internship Program

Undergraduate Intern
Computer Science

Mentor: Michael Ritchson
Code: ME
Simulation Engineering

Enterprise Architecture Implementation into the Aeronautics Research Mission Directorate Flight Data Portal

Implementing a scalable, enterprise architecture into the Aeronautics Research Mission Directorate (ARMD) Flight Data Portal is crucial for the advancement of data sharing among various National Aeronautics and Space Administration (NASA) centers. The importance of a loosely-coupled, scalable software solution cannot be underestimated when designing an enterprise data system that will rapidly grow after Phase 1.0 deployment. The ARMD Flight Data Portal Software Developers are conducting research on the most recent enterprise standards and technology prevalent throughout the software industry, and bringing that technology to the NASA Armstrong Flight Research Center (AFRC). The most effective means of loosely-coupling a central data system consisting of individual remote data systems is to leverage the XML based Universal Description, Discovery, and Integration technologies (UDDI). Implementation of UDDI into the ARMD Flight Data Portal provides an industry standard for loosely coupling project repositories into the data system. As a result, the ARMD Flight Data Portal becomes capable of quickly allowing another project at any ARMD center to integrate into the system. My role on the ARMD Flight Data Portal Software Development Team is to leverage existing enterprise architectures that are already in place at AFRC, such as the Stratospheric Observatory for Infrared Astronomy (SOFIA) Portal, and integrate the most recent enterprise standard technologies into the existing code base.

Kyler Stephens

George Fox University

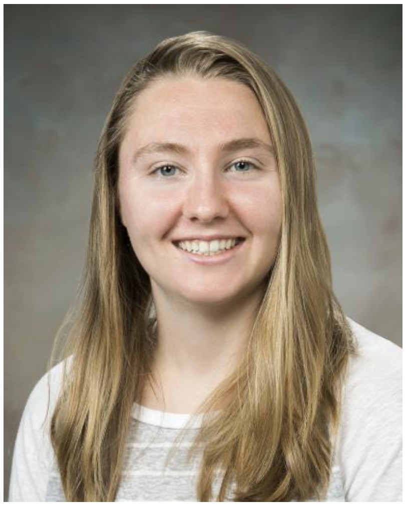
NASA Armstrong Internship Program

Undergraduate Intern
Electrical Engineering

Mentor: Allen Parker
Code: RD
Sensors and Systems Development

Electronic Pressure Measurement

The Preliminary Research AerodyNamic Design To Lower Drag (PRANDTL-D) program, in order to further develop the aircraft, is interested in measuring in flight air pressure at very specific positions across each wing. The electronic pressure measurement (EPM) system is being developed to provide an accurate, small, and fast system that can collect the necessary data. The system consists of three development boards, a small computer, and 96 digital pressure sensors. The system is consolidated into a box that can be easily mounted into the predesigned cargo bay on the PRANDTL-D aircraft. Small plastic tubes are connected to the sensors and then run down the wings to the necessary positions. The system utilizes both Serial Peripheral Interface (SPI) busses on the development boards to collect data from the sensors. The data are then converted into human comprehensible numbers before being sent to the small computer for storage using an Ethernet connection and User Datagram Protocol. The system can be set to collect data at speeds ranging from 0 to 216 samples per second (per development board), and can be easily switched on and off to conserve power and memory in the case of multiple flights. My role for the summer has been to program the development boards and ensure that the data have been collected and transmitted correctly.



Haley Stumvoll

Georgia Institute of Technology

NASA Armstrong Internship Program

Undergraduate Intern
Electrical Engineering

Mentor: Paul Dees
Code: RA
Aerodynamics & Propulsion

Airborne Location Integrating Geospatial Navigation Systems (ALIGNS)

Many projects at the National Aeronautics and Space Administration (NASA) Armstrong Flight Research Center require precision flying at supersonic speeds relative to another object, with either fixed or variable positioning. These maneuvers can be difficult to accomplish with a high level of accuracy using the current tools available. For example, the AirBOSCO (Air Background Oriented Schlieren using Celestial Objects) project requires two aircraft to line up with the sun, leaving little room for error. The Airborne Schlieren Imaging System (ASIS) project attempted to solve the same problem but experienced problems with hardware integration. The Airborne Location Integrating Geospatial Navigation Systems (ALIGNS) project aims to create a display with positional and velocity data formatted in such a way that pilots can easily adjust to get on course and hit the desired waypoint more accurately. The project uses a single-board computer for the processor, and an expansion board for the display. The graphical user interface (GUI) and all of the background calculations are coded using the Python programming language. My part of the project is to design the GUI, which displays the back end calculations. I am also responsible for designing the case to hold the hardware, finding a place to put it in the airplane, and writing the procedures for future environmental testing. The display will be integrated into an F-15 and F-18 flight simulator for extensive testing before being put on the actual airplane. The ALIGNS is currently designed for the AirBOSCO project; however, ALIGNS is the display that the pilot can look at for more accurate navigation. they can use this in the future when they're trying to collect probing data. Its also applicable to cooperative trajectories to make it easier for the pilots to stay on course

Lynn Valkov

California State Polytechnic University- Pomona

NASA Armstrong Internship Program

Undergraduate Intern
Mechanical Engineering

Mentor: Michael Marston
Code: OE
Operations Engineering

Unmanned Aircraft Systems Integration in the National Airspace System (UAS-NAS)

Integrating unmanned aircraft with piloted aircraft in the same airspace is the next step for unmanned aircraft systems (UASs). The concept, however, presents difficulties, such as the possibility of a mid-air collision. The UAS-NAS project focuses on the safe integration of UAS in the National Airspace System (NAS). This summer, the primary focus of the UAS NAS project was on Flight Test 2 of the airborne collision avoidance system (ACAS) Xu. Collaborating with the Federal Aviation Administration (FAA); Aviation Communication & Surveillance Systems (ACSS) (an L-3 Communications and Thales Avionics company); Honeywell International Inc.; and General Atomics; the National Aeronautics and Space Administration (NASA) is testing the ACAS Xu and observing its effectiveness in collision avoidance. The series of tests use the UAS “Ikhana” to perform scripted encounters with either one or two manned intruder aircraft provided by Honeywell and ACSS. These encounters have been carefully designed to provide data which will be collected and analyzed to understand the performance of ACAS Xu. Approximately 240 encounters were planned for the summer. Assigned to Test Coordinator duties, my role was to observe flights and record all pertinent information. On each flight, I worked with the Test Director and Test Conductor in the Stand Alone Facility (SAF) control room. I recorded the maneuvers, encounter parameters, and system alerts that occurred during each run; I also recorded takeoff and landing times, winds, and complications. All of this information is of utmost importance to members of the project for analyzing and improving the ACAS Xu software. As well, my notes will be used to inform the final Flight Test Report.

Kylie Vandenson

Saint Mary's College of California

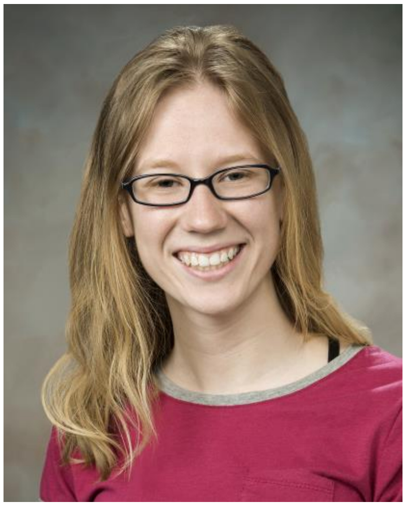
NASA Armstrong Internship Program

Undergraduate Intern
Business Administration-
Digital Media

Mentor: Rebecca Flick
Code: K
Office of Education

Coordinating the NASA Armstrong Internship Program

Engaging student learning in the subjects of Science, Technology, Engineering, and Mathematics (STEM) is a primary objective for the Office of Education at the National Aeronautics and Space Administration (NASA) Armstrong Flight Research Center (AFRC). Coordinating orientation for new students, actively engaging in the student onboarding process, tracking deliverables, and organizing student tours make the Student Coordinator Assistant intern a valuable asset to the Center. One of the principal responsibilities for this internship involved streamlining the program by managing the AFRC Student Intern website on the AFRC intranet as well as creating content for the public-facing NASA.gov AFRC Education Web site. The public site includes internship videos, One Stop Shopping Initiative (OSSI) information, and additional resources about the program. A new enhancement to the internship program involved assuming the role of Armstrong Center Chair of the Pathways Agency Cross-Center Connections (PAXC) student-led organization. The PAXC promotes professional development and a deeper understanding of NASA's overarching mission through networking activities across the Agency. This internship involved compiling and assembling the FY'17 Intern Experience Abstract Handbook by working closely with the Technical Publications Office and the Scientific and Technical Information Office. Extensive reporting was necessary by documenting student demographics and evaluating the effectiveness of the program. The results of these statistics are documented to be used in various reports for the Office of Education.



Abbigail Waddell

North Carolina A&T State University

NASA Armstrong Internship Program

Undergraduate Intern
Electrical Engineering

Mentor: Oscar Murillo
Code: RC
Dynamics and Controls

Electronic Pressure Measurement System for Prandtl-D3c

The Preliminary Research AerodyNamic Design to Lower Drag (PRANDTL-D3c) is an aircraft designed to research the concept of proverse yaw as a way of reducing drag. The electronic pressure measurement (EPM) system will be used to measure pressure in the PRANDTL-D3c aircraft in order to collect data about the how air is moving around the wings. The EPM has a total of 96 pressure transducers, each of which will be connected to tubing located in in various places across the left wing of the Prandtl-D3c. The system collects sensor data using three microcontrollers, each of which is attached to a different printed circuit board with 32 of the transducers. A small computer running a user datagram protocol program retrieves the data from the boards and stores all of the data in a singular file. The system runs quickly; it can read and store data at a maximum rate of 216 samples per second. The EPM system is significantly less expensive than other equally capable devices, making the EPM an effective solution for overall cost cutting. As part of the PRANDTL-D3c research, the EPM will contribute to a project that is advancing a new understanding of some of the basic dynamics of flight.

Heather Yoost

The Pennsylvania State University

NASA Armstrong Internship Program

Undergraduate Intern
Mechanical Engineering
Biomedical Engineering

Mentor: Jason Lechniak
Code: RA
Aerodynamics and Propulsion

Air Launch Vehicle Modeling and Simulation

Air launching, the practice of releasing a missile, rocket, or other aircraft payload from a mothership aircraft in midair, can be used in place of a traditional ground launch. Air launches provide valuable advantages, such as giving the smaller craft a range and altitude boost, while conserving the weight of the equipment and fuel needed to take off on its own. Significant funds can also be saved as crew size and major ground launch facilities are expected to be reduced. Technology demonstration is being accomplished through modeling and simulation, as well as testing of subscale unmanned aircraft. One of my projects involves creating a virtual three dimensional model of the towed glider in the National Aeronautics and Space Administration (NASA) Armstrong Flight Research Center Towed Glider Air Launch System (TGALS). The objective of TGALS is to evaluate both the operational aspects and the performance advantage of a towed, airborne launch system. The success of such a system could eventually lead to the capability of launching rockets from pilotless aircraft at high altitudes, reducing costs and improving the efficiency of sending small satellites into space. I will utilize a computer-aided design software to create several models, which will be evaluated aerodynamically. We will then be able to determine the design characteristics of each potential glider and assess performance using a flight simulator.

NASA Armstrong Flight Research Center

Spring 2017

Jonathan Adams

Napa Valley College

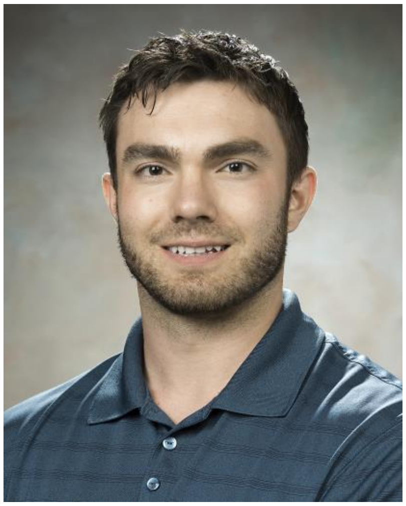
NASA Armstrong Internship Program

Undergraduate Intern
Nuclear/Electrical Engineering

Mentor: Dave Berger
Code: K
Office of Education

Avionics Integration for Prandtl-M (P-M)

The Preliminary Research Aerodynamic Design to Land on Mars (P-M) is an application of the Preliminary Research Aerodynamic Design to Lower Drag (PRANDTL-D) research. These new designs eliminate the need for a vertical tail and could lead to a 30% increase in fuel economy for future aircraft. The purpose of the P-M project is to prove that a rudderless flying wing design will work for a mission to Mars. P-M, however, must be compact enough to fit inside a 6U CubeSat (10x20x30 cm). Unfortunately, this means that the payload area of P-M is very limited in both available space and allowed weight. The current design for P-M has a wingspan of 31.25” along with a root cord of 12.5” and a tip chord of 3.5”. P-M requires multiple electronic systems for navigation, internal monitoring, inertial and optical navigation, integrated aircraft flight control, and other onboard systems. This work focuses on designing and fabricating a prototype circuit board for P-M. The circuit board must be able to support the science package, flight control system, navigation systems, and radio communication system. The circuit board must also be tested to ensure that it will perform properly in a Martian atmosphere. The circuit board is considered an intermediate step to a final flight-worthy design for P-M. This work may be challenging but it is an integral part for the project to be successful.



Jeffrey Beard

University of Texas at El Paso

NASA Armstrong Internship Program

Undergraduate Intern
Mechanical Engineering

Mentor: Tim Risch
Code:RS
Aerostructures

Multi-Wavelength Pyrometers

Pyrometers are a type of thermometer that use radiation to determine surface temperature. The amount of radiation emitted depends on the surface temperature and the emissivity, which is a property of the material being measured. The objective of this project is to assemble and calibrate two compact, multi-wavelength pyrometers capable of assessing accurate emissivity and temperature values. This is done by utilizing two miniature spectrometers; one a linear photodiode array, and the other a digital light processor. Both pyrometers are compact in size, and capable of measuring the intensities of multiple radiation wavelengths at one time. Calibration is achieved by using a black body device set to a known temperature and allowing the pyrometers to take multiple readings at their respective wavelengths. Variations of the Planck equation along with multispectral methods are used to relate the recorded wavelength intensities with corresponding temperature and emissivity. The small size of the pyrometers will eventually allow them to be mounted onto aircraft in order to take accurate readings of in-flight materials that are exposed to extremely high temperature conditions. Examples of these applications may include hypersonic jet engines, spacecraft re-entry, and thermal imaging of the earth by satellites.

John Bodylski
Irvine Valley College

NASA Armstrong Internship Program

Undergraduate Intern
Mechanical Engineering

Mentor: Dave Berger
Code: K
Office of Education

Avionics Research for Long Rang Very High Altitude sUAV

The Preliminary Research AerodyNamic Design To Land on Mars (PRANDTL-M) or (PM) is a Small Unmanned Aerial System (SUAS) platform capable of flying in the Martian atmosphere. Flight within the Martian atmosphere is without GPS and magnetic compass capability requiring significant work to be performed on visual navigation, as well as integration with Inertial Navigation Systems. In order to test this design on earth, it must be capable of flying up to 125,000 feet (12,000 ft AGL Mars). Flight at this altitude represents several special problems for both aerodynamic and electrical system designs. This range of the flight envelope is known as the Coffin Corner, due to the tightening range between aerodynamic stall and Critical Mach Number. PM is a cutting edge flight combination resulting from the very compact size, very low Reynolds number, high altitudes and high subsonic speeds. The small physical size of the aircraft severely restricts the power available for onboard systems such as transceivers, servos, flight computer(s), imaging, and science packages. In order to maintain communications with the aircraft and perform the necessary flight maneuvers--during extreme test conditions--a sophisticated ground communication system has been designed in conjunction with onboard power and communication systems.

Lily Elizabeth Buth

Florida Institute of Technology

NASA Armstrong Internship Program

Undergraduate Intern
Civil Engineering
Construction Engineering

Mentor: Peggy Hayes
Code: S
Safety & Mission Assurance

Safety and Mission Assurance

The Safety and Mission Assurance Department focuses on all aspects of safety operations here at Armstrong: Aviation Safety, Flight Assurance, Institutional Safety, and Quality Assurance. Safety is an important part of NASA culture because it must be taken into account within every function of work here at Armstrong. From conducting research, flying aircraft, aircraft maintenance, institutional operations, environmental impacts, and the daily act of creating a safe environment for employees, the Safety department is continuously involved and constantly working to minimize potential dangers and improve current conditions. Assignments include creating a dynamic mapping tool for reporting historic and current mishap events and their locations, tour construction sites for OSHA safety requirements and potential hazards, update the website with the latest information, organize Emergency Aviation Safety Packages to aid emergency personnel in the event of an accident involving NASA aircrafts, as well as use computer software programs to create a 3D virtual campus model in order to run emergency simulations, track hazardous waste material, model egress routes, and fire mitigation procedures. By integrating technology into safety operating systems, we are able to visually display areas of interest, recognize patterns of mishap events and their locations, as well as have a current tool for improving future safety procedures.

Nicholas Finks

Antelope Valley College

NASA Armstrong Internship Program

Undergraduate Intern
Mathematics

Mentor: Allen Parker
Code: RD
Sensors &Systems Development

New "Center of Mass" (COM) Algorithm Development for the Calculation of Improved Strain Measurements on a Fiber Optics Sensing System (FOSS)

In testing the Fiber Optic Senor Systems (FOSS) over a long period of time, strain on a dynamic system has been observed to fluctuate in an echelon-like figure; the strain will seemingly remain constant for an extended period of time, then jump to another steady state, remain there, and repeat. We know the relation between strain and time is somewhat linear however the current form of data processing yields erroneous readings. Previously, a threshold center of mass calculation, $x_{com} = \sum_{i=1}^{N} \frac{m_i x_i}{M} \mid M = \text{total mass},$ has been used to calculate the COM for various strain tests, namely "drip tests." Upon inspection of a processed grating, it has been observed that there is a strong resemblance to a sinc(x), or sin(x)/x, function. Utilizing LABVIEW, C and our new sinc fitting function, we have developed a new and robust algorithm that can identify individual gratings, find their "center of mass," and provide an accurate signal reading for all fiber gratings in real time. Using the sinc fitting function we have created, FOSS signals can now be processed and read more accurately than ever.

Zach Fox
University of Colorado at Boulder

NASA Armstrong Internship Program

Graduate Intern
Aerospace Engineering

Mentor: Claudia Herrera
Code: RS
Aerostructures

Dream Chaser Moment of Inertia Testing

The Moment of Inertia, or MOI, of an airborne vehicle dictates how resistant the vehicle is to rotation. When flying and otherwise moving through the air, a vehicle's MOI directly plays into how it will react to steady airflow, turbulence, and alterations to its control surfaces. Thus, accurate determination of the MOI is crucial to understanding the motion of airborne vehicles. In many cases, finite element models, or FEM, are utilized to numerically determine these values. However, accurate FEM are difficult and time-consuming to produce and even when created by experts are only approximations. This is why quantities such as the MOI are often experimentally determined. This spring, the Sierra Nevada Corporation's Dream Chaser spacecraft is undergoing such testing in preparation for upcoming glide tests. These tests involve suspending the craft from what is essentially a giant swing and applying an oscillatory force meant to swing the craft about its body axes. Once the applied force is removed, the craft is allowed to rotate freely. The period of oscillation is measured with an Inertial Measurement Unit, or IMU, and this period is input into various pendulum formulas in order to determine the MOI about each axis. For this testing, I am in charge of IMU data acquisition during the test and for MOI calculations via a MATLAB code I developed that analyzes IMU time history data and performs the aforementioned calculations.

Michael Hirsch

University of North Dakota

NASA Armstrong Internship Program

Undergraduate Intern
Mechanical Engineering

Mentor: Bruce Cogan
Code: RC
Controls & Dynamics

UAV Microgravity

The main goal of this project is to subject the cargo bay of a UAV to at least 10 seconds of microgravity. This procedure plans to provide microgravity opportunities for a cheaper costs than using a large scale jet, but also achieving microgravity for a longer amount of time than a standard drop tower. The project involves the development of scripts, using previously collected aero data to run simulations for the aircraft. This data will then help with the development of control laws and hardware to run the aircraft as an unmanned aerial vehicle (UAV). In conjunction with this, the aircraft must be fully assembled and prepped for flight. A series of test flights will be conducted to ensure the capabilities of his aircraft. This testing on the aircraft will also be done to improve the data to further benefit the control laws. Once this is complete the aircraft will be prepped for microgravity tests, most likely starting with pilot assisted maneuvers to confirm the aircrafts ability, moving on to the installation of hardware to eventually perform unmanned parabolic flight. This data can be collected and used to further refine the SIM. This data can also be used to help develop control laws for a larger craft such as PTERA to allow for the testing of cube satellite sized projects.

Samantha Ingersoll

North Dakota Sate University

NASA Armstrong Internship Program

Undergraduate Intern
Physics and Computer Science

Mentor: Dave Berger
Code: K
Office of Education

PRANDTL-M Imaging Systems

The Preliminary Research AerodyNamic Design to Land on Mars, or PRANDTL-M (PM), is a small unmanned aerial system (sUAS). The goal of the project is to be the first glider in Martian atmosphere, folding into a modified 6U CubeSat and deployed from a rocket. The ultimate mission of PRANDTL-M is to gather a higher resolution ground map of Mars then is currently capable and to also gather atmospheric data very efficiently and with low cost. The main objective of this internship is to determine what imaging capabilities are needed of the camera that will be onboard the aircraft. The imaging system must be designed to withstand environmental factors and vibrations. It also must be able to collect as many images at the highest resolution possible, resolving at an altitude of 10,000 feet, one square foot equal to one picture pixel. In order to develop to requirements for the eventual Mars camera, a miniaturized UAV camera is being characterized at varying ground, lab, and flight conditions to create scaling factors for future systems. This include taking images of known targets statically, at relevant ground speeds, and environmentally testing the camera. Data is then collected from the multiple testing procedures and the necessary information is extrapolated, resulting in determining the finest possible imaging capabilities of the PRANDTL-M.

Hussein Nasr

California Polytechnic State University-Pomona

NASA Armstrong Internship Program

Graduate Intern
Aerospace Engineering

Mentor: Dave Berger
Code: K
Office of Education

PRANDTL-M Simulation Development

The Preliminary Research AerodyNamic Design to Land on Mars (PRANDTL-M) (PM), planned to be the first glider to fly through the Martian atmosphere, is a small vehicle with wings that fold allowing it to fit inside a small 3U cubesat. PM's mission is to gather ground mapping and atmospheric data on Mars. The main objective of this internship is to preform system identification (ID) on several wing geometry designs. System ID, in short, is the building of mathematical models that represent the dynamics of the vehicle during flight. More specifically the objective for this internship is to retrieve aerodynamic and moment coefficients of the vehicle. To start, eight equations of motions are used and then linearized around trim conditions to create state space models in the longitudinal and lateral directions separately. The most critical and challenging part in doing system ID for this project is retrieving essential flight data during specified maneuvers. PM is very small and does not produce its own thrust, so holding steady altitude or having an alpha-beta vane is not feasible. Many work arounds must be done and assumptions must be made to get the best possible estimation of aerodynamic coefficients. Finally, programs like SIDPAC and pEst will take flight data and produce a best fit model with its corresponding coefficients.

Serena Pan[1]

Massachusetts Institute of Technology

NASA Armstrong Internship Program

Mihir Vedantam[2]

University of Kansas

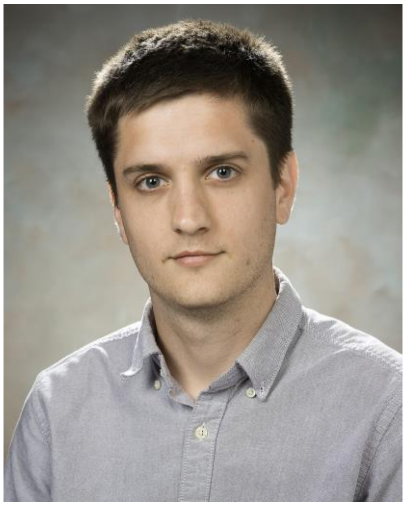
NASA Armstrong Internship Program

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

Mentor: Ricardo Arteaga
Code: RD
Sensors & Systems Development

Relative Navigation Based Pattern Swarming

Collaborative swarming models have existed since the late 1980s, however, one major unexplored area of study is using relative vectoring to create unique patterns for a swarm. This research takes the current swarm model and introduces relative vector positioning to combine the cohesion and collision avoidance components of swarm logic into one while enabling the use of unique and application specific patterns. Several different bio-inspired patterns were simulated including a small grid, a V shape, and a line. These patterns were simulated while the sUASs were tracking a final waypoint. The results indicate that the platform is capable of performing the tested patterns and track a final waypoint accurately without any collisions. Each pattern required different component weighting for good performance. The cohesiveness of each pattern could be improved by selecting a more suitable aircraft. In order to simulate a communication network between swarm mates, ADS-B architecture and sensors were simulated. Swarming is a robust and adaptive technology that enables multiple different types of missions. Some mission types that are particularly useful to NASA include: more comprehensive earth sciences missions, 360 degree observation of flight tests, lightning detection on launch days and providing a multi-hop network to a network denied environment. Other useful missions that are useful but not specifically for NASA include: collaborative swarm surveillance, patterned searches, high quality mapping of disaster zones, and emergency supply delivery in disaster zones.



Nathan Perreau

North Carolina State University

NASA Armstrong Internship Program

Graduate Intern
Aerospace Engineering
M.S.

Mentor: Francisco Peña
Code: RS
Aerostructures

Optimizing FOSS Data Analysis Through CREW Testing

The Fiber Optic Sensing System (FOSS) measures distributed strain of a structure and can estimate displacement, twist, and applied loads via integration and curve-fitting. FOSS has been instrumented and tested on several NASA aircraft, such as Ikhana, G3's, X-56, and the APV-3. In each case FOSS was able to provide and record data about wing deformation in flight, yet the precision and accuracy of the results were not definitive. To research new FOSS algorithms and verify the accuracy of the displacement/loads results, FOSS has been instrumented on a MQ9 wing, named the Calibrated Research Wing (CREW). The wing will be subjected to a ground loads analysis, and the FOSS outputs will be compared to the more tenured instrumentation of standard strain gauges, inclinometers, load cells, and photogrammetry targets. Furthermore, this will serve as the first time inclinometers will provide a calibration measurement for FOSS algorithms to accurately determine the root slope of the wing through strain measurements. The bulk of my contribution to this project consists of creating and modifying LabVIEW VI's to properly record the results of the experiment and optimize the speed of the data analysis. The grand objective of the experiment and FOSS as it pertains to NASA is to be able to provide a lightweight and sensor dense system to provide structural health monitoring in real time.

Matthew Ramirez

Saint Josephs College

NASA Armstrong Internship Program

Undergraduate Intern
Mathematics

Mentor: Steve Sterk
Code: C
Chief Financial Officer

The Engineering Process of the X-Plane Cost Model and Complexity Factor Analysis in Development

Cost engineers analyze the requirements and specifications of a project and determine the cost involved to launch such a project. In a world of uncertainty and time constraints, efficiency and accuracy are vital concerns in the development process for any research project. NASA experimental planes known as X-Planes, are all unique and have different missions. This makes them considerably complex in nature and involve various integrated technological components to accomplish the objectives. Producing a constructive cost model that can input specifications and predict a cost can be rather difficult for this very reason. Unlike commercial aircraft, which can be analyzed by weight and length and account for learning curves because of their mass production, X-Planes have more complex designs and require more specific analysis. By evaluating large data sets of X-Plane specifications and conducting numerous tests for cost relationships and variances, one can determine the variables involved with an aircraft's correlation to cost. This process requires extensive mathematical regression analysis, research, and benchmarking algorithms that compares the characteristics of proposed variable candidates to leading technological trends. Variables such as weight, wingspan, characteristic designs and features, performance, and even government policies and human ratings contribute to the complexity factors of an experimental aircraft. By facilitating comparisons between these fundamentally different types of systems, a cost model can be developed to predict an accurate cost of an X-Plane project.

Joseph Smith

Michigan State University

NASA Armstrong Internship Program

Undergraduate Intern
Computer Science
Statistics

Mentor: Mike Ritchson
Code: ME
Simulation Engineering

Air Launch Vehicle Modeling and Simulation

Implementing Enterprise Architecture into the ARMD Flight Data Portal is crucial for data sharing among various NASA centers. Langley Research Center, Ames Research Center, and Glenn Research Center have displayed interest in sharing flight data with Armstrong Flight Research Center, thus causing a need for a data portal with an enterprise architecture. By designing the ARMD FDP to contain an enterprise industry standard such as service oriented architecture, we can create a scalable application which will allow for project growth throughout the agency. During my internship, I will be assisting the ARMD Flight Data Portal development team in building a dynamic solution to NASA's data sharing difficulty. My role on the team will be to design the ARMD FDP search engine. In order to extract data quickly and accurately from multiple data repositories at multiple centers, ARMD FDP needs a dynamic search strategy. With the transition from FDAS to SADF, the search engine needs to be capable of supporting a wide array of document types with various amounts of metadata. We are currently running test cases on multiple document oriented database programs, and further research will be conducted to determine the most efficient search algorithms for the ARMD FDP search engine.

Kylie Vandenson
Saint Mary's College of California

NASA Armstrong Internship Program

Undergraduate Intern
Business Administration-Digital Media

Mentor: Rebecca Flick
Code: K
Office of Education

Coordinating the NASA Armstrong Internship Program

Engaging student learning in the subjects of Science, Technology, Engineering, and Mathematics (STEM) is a primary objective for the Office of Education at NASA Armstrong. Using a hands-on approach, Spring 2017 interns are provided with valuable educational experiences and conduct meaningful research in their provided fields. One of the principal responsibilities for the Student Coordinator Assistant is to streamline the program by creating and managing the AFRC Student Intern website on Xnet. This site includes a student calendar, internship video, deliverables information, One Stop Shopping Initiative (OSSI) information, and additional resources about the program. Another task for the student coordinator is to compile and assemble the FY'17 Intern Experience Abstract Handbook by working closely with Technical Publications Office and the Scientific and Technical Information Office. Extensive reporting is also necessary, documenting student demographics and evaluating the effectiveness of the program. The results of these statistics are documented to be used in Minority University Research and Education Program (MUREP) White House Reports; Office of Education Performance Measurement (OEPM); monthly MUREP Agency calls; NASA Internships, Fellowships and Scholarships biweekly calls; Center Coordinator calls; Weekly Activity Reports; and Armstrong Monday Management Meeting Notes. In addition to these responsibilities, the Student Coordinator Assistant worked with the AFRC Photo Lab to archive hundreds of negatives dating back to 1958 to preserve the history of the Center.

Heather Yoost

The Pennsylvania State University

NASA Armstrong Internship Program

Undergraduate Intern
Mechanical Engineering
Biomedical Engineering

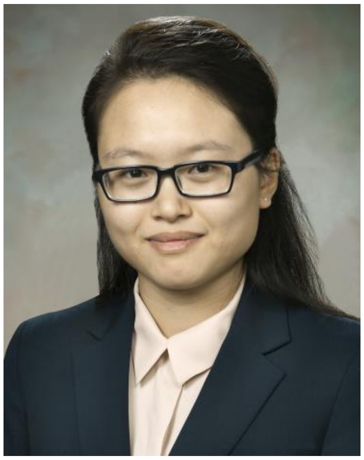
Mentor: Jason Lechniak
Code: RA
Aerodynamics and Propulsion

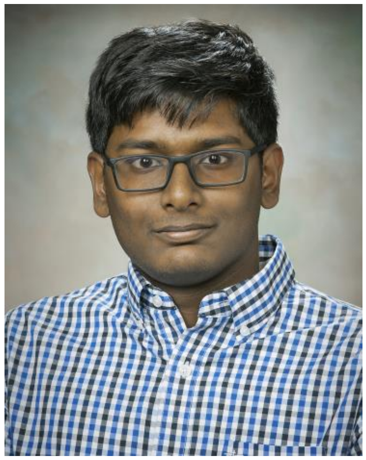
Air Launch Vehicle Modeling and Simulation

Air launching, the practice of releasing a missile, rocket, or other aircraft payload from a mothership aircraft in midair, can be used in place of a traditional ground operation. Air launches provide valuable advantages, such as giving the smaller craft a range and altitude boost, while conserving the weight of the equipment and fuel needed to take off on its own. Significant funds can also be saved as crew size and major ground launch facilities are expected to be reduced. Technology demonstration is being accomplished through modeling and simulation, as well as testing of subscale unmanned aircraft. Modeling and simulation techniques are used to optimize such a vehicle's design parameters, like the number of propeller blades or the propeller's tip radius. These techniques involve constructing vehicle configurations, generating aerodynamic models, and completing an initial evaluation of the model and its appropriateness for a flight simulator. These models must be incorporated into the flight simulator, where each configuration can then be virtually flight-tested for the intended purpose of the vehicle. It is hoped that the overall end state of my project will be a generalized flight simulation capability to optimize air vehicle designs. The air launch capability will aid NASA in efficiently placing small satellites into orbit.

NASA Armstrong Flight Research Center

Fall 2016





Hong Truong[1]
University of California, Davis
Aruljothi, Arunvenkatesh[2]
Stevens Institute of Technology
NASA Armstrong Internship Program
Undergraduate Intern[1,2]
Mechanical Engineering[1,2]
Aerospace Engineering[1]
Mentor: Ricardo Arteaga
Code: RD
Sensors & Systems Development

Small Unmanned Aerial Systems in the National Airspace System

By 2020 the Federal Aviation Administration (FAA) mandates that all aircraft flying in Class A airspace must be equipped with an Automatic Dependent Surveillance Broadcast (ADS-B) system. The ADS-B system provides the location of an aircraft to other aircraft and ground stations using an inexpensive satellite global positioning system (GPS) receiver (currently, costly radar systems identify the location s of aircraft). Various NASA centers are utilizing ADS-B technology to advance Unmanned Aerial Systems in the National Airspace System (UAS in NAS) project. The Detect and Avoid (DAA) program was developed previously at the NASA Armstrong Flight Research Center to provide the pilot with possible collision warnings and ideal resolutions using the Stratway conflict resolution algorithm. Research in this internship focuses on modifying and expanding the program to assist small UAS (sUAS) pilots as well as provide autonomous control of sUAS. To complete this task, an Android application (Google Inc., Mountain View, California) and the DAA personal computer program are being developed to autonomously control a DJI Phantom 4 drone (DJI, Shenzhen, China). Autonomous control involves Java programming as well as comprehensive flight-testing. The Android application will interface with both the DAA program and the DJI Phantom 4. Additionally, safe separation parameters for sUAS are being researched and tested. The ADS-B equipment is housed in a 3D-printed mount, which clamps onto the DJI Phantom 4. The mount, modeled in PTC Creo (PTC, Needham, Massachusetts), is designed to protect the equipment from adverse conditions and to avoid radio frequency interference between devices. Other design considerations include structural integrity, weight, balance, and user-friendliness. The main goal of this project is to show that ADS-B coupled with the DAA program can be used to fly sUAS beyond line of site.

John Bodylski
Irvine Valley College

NASA Armstrong Internship Program

Undergraduate Intern
Mechanical Engineering

Mentor: Dave Berger
Code: K
Office of Education

Avionics Research for Long Rang Very High Altitude sUAV

The Preliminary Research AerodyNamic Design To Land on Mars (PRANDTL-M) or (PM) is a small unmanned aerial system (sUAS) platform capable of flying in the Martian atmosphere. Flight within the Martian atmosphere has neither global positioning system (GPS) nor magnetic compass capability, requiring significant work to be performed by visual navigation as well as integration with inertial navigation systems. In order to test this design on the Earth, the design must be capable of flying up to an altitude of 125,000 ft above ground level (AGL) on Earth (12,000 ft AGL on Mars). Flight at this altitude represents several special problems for both aerodynamic and electrical system designs. This range of the flight envelope is known as the coffin corner (Q corner), due to the tightening range between aerodynamic stall and critical Mach number. The PM is a virtually untested flight combination because of the very compact size, very low Reynolds number, and potential high altitudes and high subsonic speeds. The small physical size of the aircraft severely restricts the power available for onboard systems such as transceivers, servomechanism(motor)s, flight computers, imaging, and science packages. In order to maintain communications with the aircraft and perform the necessary flight maneuvers during extreme test conditions a sophisticated ground communication system has been designed in conjunction with onboard power and communication systems.

Donna Cendana[1]
City College of New York
Felipe Valdez[2]
Sacramento State University
NASA Armstrong Internship Program

Graduate Interns[1,2]
Mechanical Engineering[1,2]

Mentors: Oscar Murillo, Albion Bowers
Codes: K, R
Office of Education, Research and Engineering

PRANDTL-D3c Data Acquisition System

Flight mechanics data are essential for the Preliminary Research Aerodynamic Design to Lower Drag, or PRANDTL-D, in order to demonstrate the bell-shaped lift distribution curve and prove that this new wing design, with an aerodynamic twist, provides an overall increase in aircraft efficiency. The objective of the PRANDTL-D3c data acquisition (DAQ) system is to record critical sensor data from flight tests in order to obtain the derivation of the model structure and parameters, such as aerodynamic stability and control derivatives. A suitable flight computer, therefore, is a vital element of this selection. A flight computer requirements list was generated, and research was then conducted for the selection of a DAQ system. Several companies and technical departments were also contacted in order to gather information. Based on project requirements, a Piccolo II autopilot (Cloud Cap Technology, Hood River, Oregon) was selected as the flight management system and will be used for PRANDTL-D3c as a real-time flight data recorder. This autopilot offers a basic inertial measurement unit functionality (pitch, roll, and yaw rates, and longitudinal, normal and lateral accelerations), in addition to in-ports to receive data from external sensors. External sensors include a pitot static system, alpha- beta probes, and control position transducers to acquire wind speed, angle of attack, sideslip angle, and right and left deflections. Earlier PRANDTL-D DAQ system data show inconsistency when comparing the 25 and 100 Hz recorded data. The new system will be tested and verified to ensure that problems with previous flight data do not recur with the new flight computer.

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NASA Armstrong Internship Program

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Aerospace Engineering

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Aerodynamics & Propulsion

Stability of a Towed Glider Air Launch System

The Towed Glider Air Launch System (TGALS) offers a unique approach to delivering economical rocket launches. The purpose of TGALS, as its name implies, is to create a system in which rockets or other aerial payloads can be launched from a reusable system. For this system, a continuation of the stability analysis of TGALS was beneficial in determining the viability of the current model. The advantages of launching payloads from a reusable system include decreased launch costs, increased payload capacity, and launch site flexibility. Performing an analysis of the stability characteristics of the system can highlight areas where improvements need to be made. These improvements can be made in the analysis of the model, in the tools used to assess the model, and even in the model itself. Modeling of the aerodynamic properties was performed using program tools such as Open Vehicle Sketch Pad (OpenVSP)(an open source parametric aircraft geometry tool) and Athena Vortex Lattice (AVL) (Massachusetts Institute of Technology). Both of these programs work with low-fidelity models to produce relatively quick solutions for aerodynamic and stability coefficients. The fidelity of the model impacted the results, and so did the fidelity of the analysis. As with most models, it is good practice to check the results against a secondary solution. In order to verify the solutions given by AVL and OpenVSP, the program solutions were checked against each other; however, empirical calculations were also used as a tertiary method to clear up disputes between the program solutions. In order to ensure the results were on par with other aircraft characteristics, the solutions were also compared against data trends from other aircraft. Finally, the results were integrated into a simulator to determine the combined effect of each of the stability parameters.

Lydia Hantsche

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Electronic Pressure Measurement (EPM) System for PRANDTL-D

This project is to continue designing the Electronic Pressure Measurement (EPM) system for the current Preliminary Research AerodyNamic Design to Lower Drag, or PRANDTL-D, glider to collect pressure information from various points along the wing of the aircraft. The information gathered will be used to determine the lift load on the wing and prove that Ludwig Prandtl's bell-shaped load distribution is present. Proving this concept could lead to the creation of aircraft that more closely imitate the flight of birds, resulting in reduced drag and the revolution of human flight. This goal will be accomplished by installing multiple individual pressure transducers and collecting digital data by way of a microprocessor. The data collected will be analyzed and a visual representation of the data will be produced. This approach will entail design and fabrication of a pressure-sensing circuit board as well as software development for the system. The system will cycle through groups of pressure transducers gathering data from one at a time, organizing the data according to location of the measurement and the time the measurement was taken. Data will be recorded on a removable memory device or transferred over a network cable onto a computer so that the data can be analyzed post-flight.

Hussein Nasr

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PRANDTL-M Simulation Development

The Preliminary Research AerodyNamic Design to Land on Mars, or PRANDTL-M, planned to be the first aeronautical vehicle in Martian atmosphere, is a small glider with wings that fold allowing it to fit inside a small 3U CubeSat. The PRANDTL-M mission is to gather ground mapping and atmospheric data on Mars. The main objective of this internship is to create a full working simulation of the PRANDTL-M. This simulation will be used to test various inertial and control derivatives, minimizing the cost and time needed to build test models. The simulation is created on Simulink® (The MathWorks, Inc., Natick, Massachusetts) using a series of algebraic loops modeled by the flight dynamics found within *NASA Reference Publication 1207, "Derivation and Definition of a Linear Aircraft Model," by Eugene L. Duke, Robert F. Antoniewicz, and Keith D. Krambeer.* The simulation will be able to predict the acceleration, velocity, and position in six degrees of freedom with any combination of input parameters at various altitudes and atmospheric conditions. Once a few favorable configuration parameters are found, drop tests will be performed on prototypes that will be constructed from foam using a computer numerical control (CNC) foam-cutting machine. The model will be built using carbon fiber and will be subjected to a 120,000-ft drop test mimicking the Martian atmosphere.

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Computer Systems Engineering

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Sensors & Systems Development

Next Generation Fiber Optic Sensing System Development

Fiber optic sensing systems (FOSS) can collect real-time data from a variety of engineering parameters that have applications in the aerospace field. Within the aerospace field, it is especially important to preserve size while maintaining accuracy and performance. To further FOSS development, the FOSS lab will integrate new laser technology that has more tuning capabilities and is more cost-effective. Integrating this laser technology will require two different software applications that will communicate with each other to send laser control commands to the serial port. The main laser control application will take in commands over a network, send the commands to the serial port, and return the feedback from the laser. This application will send and receive strings from the other application or from any computer over the network. The second application will contain functions for laser control to allow the laser to be configured and run alongside the main FOSS software. In addition to adding the new laser, circuit boards will be designed, prototyped, and tested in the laboratory to improve the signal-to-noise ratio for the next generation system. Combining these development projects will lead to a more compact and efficient fiber optic sensing system.

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