Example Abstracts

Science Abstracts

NOTE: There is a lot of gray area between science and engineering. STEM students will find it useful to look for a good example in both sections, instead of limiting themselves strictly to a "science" abstract or an "engineering" abstract.

Separation Control With Nanosecond Pulse Driven Dielectric Barrier Discharge Plasma Actuators

Flow separation control is widely studied because of its potential to enhance performance and efficiency across many aerodynamic platforms. Dielectric barrier discharge (DBD) plasma actuators are novel devices capable of reattaching the separated boundary layer on airfoils at post stall. This work continues the study of using DBD plasma actuators driven by high-voltage repetitive nanosecond pulses as a flow control tool. A new wind tunnel test section is designed and constructed to facilitate this investigation. Leading edge separation control on a 4-inch chord NACA 0015 airfoil is demonstrated at various post-stall angles of attack at a Reynolds numbers of 1.12×10^5. Measurements include static pressure distributions and surface flow visualization. A comparison of positive and negative polarity driving voltages is performed to investigate its influence on flow control authority. The capability of nanosecond pulse driven DBD plasma actuators for production of coherent vortex wakes is also explored.

Pan Evaporation Rates For Southeastern Arizona

Evaporation is a primary component of the hydrologic cycle. As global temperatures rise, evaporation rates may change. Evaporation pans are used throughout the world to measure open-water evaporation rates. Pan evaporation was measured using a U.S. Weather Bureau Class A Pan from 1974 to 2012 at the USDA-ARS Walnut Gulch Experimental Watershed headquarters in Tombstone, Arizona. Daily water depth measurements were reduced to compute mean monthly evaporation. Ancillary temperature, relative humidity, and wind speed measurements were related to evaporation losses using linear regression. Mean monthly evaporation ranged from 4 inches per month in January to 13 inches per month in June. Preliminary trend analyses suggested that evaporation rates did not change over the 39 year period. In general, as temperature and wind speed increased and relative humidity decreased, evaporation losses increased. These data are important for understanding how future drought conditions and temperature changes may influence semiarid water resources.

Nitrogen Removal In Anaerobic Ammonium Oxidation Bioreactors

Ammonium and nitrite nitrogen are prevalent contaminants in municipal wastewater, landfill leachates, and other effluents, and levels must be controlled for discharges into the environment, wherein the conventional approach is aerobic nitrification-denitrification. The goal of this project is to examine the feasibility of utilizing the anaerobic ammonia oxidation process to eliminate aqueous nitrogen compounds by converting them to dinitrogen gas (N2). Two continuous expanded granular sludge bed reactors were operated in a temperature controlled environment at 30°C, and key performance indicators such as specific anammox activity, conversion efficiency, and molar conversion ratio were monitored. Additionally, batch bioassays were performed to explore substrate toxicity of nitrite. It was observed that biomass pre-exposure to nitrite can cause severe inhibition. The inhibition can be reversed if biomass is first pre-exposed to nitrate (presumably due to nitrite extrusion by nitrite-nitrate antiporters). These findings help determine how to prevent substrate inhibition during bioreactor operation.

Bioremediation Of Arsenic Contaminated Water

Arsenic is an important water contaminant due to its high toxicity and widespread occurrence in groundwater and industrial wastewater. Anaerobic microorganisms can transform arsenate (As(V)) and sulfate (SO42-) to reduced species that can precipitate as insoluble minerals. The purpose of this project was to investigate the bioremediation of arsenic contaminated water by the process of anaerobic biomineralization. This process was evaluated in a continuous biological reactor inoculated with anaerobic sludge and fed with a synthetic medium containing arsenic, sulfate, and nutrients. After five days of operation, a visible yellow, arsenic-rich mineral formed inside the reactor. Additionally, the arsenic removal in the reactor was maintained at 93% over 180 days of operation. These results confirm that the bioprecipitation of arsenic sulfide minerals can be used to remove arsenic from contaminated water.

Engineering Abstracts

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Analysis Of CFD Methods In High Lift Configurations

The AIAA High Lift Prediction Workshop is a joint effort between industry and academia researchers to assess current computing capabilities of CFD software in aircraft take-off and landing configurations. In this study, CFD results obtained from the OVERFLOW2 CFD solver using different turbulence models, aircraft configurations, and different structured mesh refinement levels were compared against PIV velocity profile data. The goal was to gain a better understanding of how well CFD captures the flow phenomena and to determine best practices for simulating high lift configurations. Velocity profiles were extracted at 11 locations on the wing at three different angles of attack. As the extraction line moved further aft and outboard, CFD's prediction of the velocity profile became less accurate. The largest discrepancies were in areas with large slat wakes. The results will show the strengths and weaknesses of current CFD best practices in analyzing aircraft high lift aerodynamics.

Increasing Light Absorption In Concentrating Photovoltaic System Through Use Of Anti-Reflective Sol-gel Coated Ball Lens

A fused silica spherical ball lens is used at the focal point of a point-focus concentrating photovoltaic system in order to expand the tolerance of light paths penetrating the photovoltaic cells, thereby increasing energy concentration in the system. A method to evenly deposit an optimal thickness of anti-reflective Sol-gel coating on the ball lens was developed to increase light transmission through the ball. A humidity-controlled environment housing a programmable spin coater was designed to apply the coating. Challenges posed by the geometry of the ball were addressed by spinning the ball at a low speed while applying the coating before ramping up the speed to a faster rate to thin the coat. The coating was found to increase light transmission through the lens to between 97.4% and 99.3% across a range of visible wavelengths. Further efforts for automated control of the coating process will be considered in the future.

ERAU Awesome: Using Inertial Navigation Systems (INS) To Navigate Small Unmanned Aerial System (sUAS) When GPS Is Lost Or Inaccurate

The presented research provides an analysis of the implementation of an Inertial Navigation System (INS) to augment GPS navigation in small Unmanned Aircraft Systems (sUAS) when GPS is unavailable or inaccurate. The quality of the Inertial Measurement Unit (IMU) required to create a stable INS solution will be analyzed, and for how long that solution would remain valid. This is essential for an sUAS system, as the accuracy of the INS solution will degrade rapidly over time. Data has been collected using an sUAS platform to acquire readings from multiple selected IMUs, and the data is compared against the recorded flight path, GPS data, and developed models. This research will enable future research into creating robust sUAS capable of operating in GPS degraded environments, and make sUAS safer for their integration into the National Airspace.

Quadrocopter Control

A small angle approximation fifth-order control system of a quadrocopter will be presented. Quadrocopter movement between points can vary due to velocity, angle of attack, thrust, as well as method of control. The control system prioritizes fitting the input path as closely as possible. The control system has been developed using Simulink and will be adapted to a hexacopter and implemented into hardware following further code development. The control law is designed to interface with a path planning module which will send position commands to the control. The X and Y position commands are controlled by a Proportional-Integral-Derivative (PID) controller which creates theta and phi commands respectively. All angular commands are processed by proportional derivative controls. The height, or Z, is independently controlled by a PID controller as well. Progress with the controller, as well as hardware adaptation, shall be discussed.

Model-based Systems Engineering Of The OSIRIS-REx Mission's Science Processing And Operations Center.

One of the challenges facing the OSIRIS-REx mission's Science Processing and Operations Center (SPOC) systems engineering group, is to efficiently model and manage the SPOC system architecture and its interactions with other ground system segments as this model is essential for successful mission planning. The architecture is modeled by capturing mission requirements and ground element interfaces in CORE 8, a model-based systems engineering software suite that employs a layered approach to system design. Lists of specific design requirements were used to create models comprised of the following functional elements: performers, needlines, and operational items. All elements of the SPOC functional architecture and its external interfaces have now been successfully captured in CORE though minor updates are still ongoing. This ground systems engineering method has not been implemented on any previous NASA mission and therefore its success has implications on how model-based systems engineering will be used in future missions.

Journalism Abstracts

Project Pangaea

Current climate change awareness education in the media lacks focus, reality, and appeal. The purpose of the Pangaea Project is to create a visual narrative on the realities of climate change that can be utilized by all who have a stake in the health of the environment. Pangaea is an ongoing project that will culminate in a unique visual media package including infographics, comic books, and public service announcements (PSAs) among other possibilities. Characters written for the comic book will tie into the infographic and PSA series to create iconic personalities that will be widely recognized by the public. The use of various media allows for a higher accessibility in climate change awareness education for people of all ages. Pangaea will aid in providing a real-world understanding of climate change expectations and adaptations that the environment and people will likely experience in the future.

Science Journalism At The Arizona Daily Star

One continuing issue in the world of science is that important and beneficial science is always happening, but the general public does not always learn about it. When science meets journalism, the communication of science information to the general public becomes more available and easy to understand. Science journalists use research techniques to find important stories to relay to the public; interview skills to collect information; and writing to convey the story in a way that a general audience can understand easily. Important story examples include Professor Jeff Pyun's research team that discovered a way to turn waste sulfur into plastic and the University of Arizona's Undergraduate Biology Research Program. These science-related stories written throughout the last six months positively impact the general public by informing it of science work that has the potential to benefit the world.

Outreach/Organizational Abstracts

STEM Class And Science Club For Middle School Students

Youth are frequently not involved in Science, Technology, Engineering and Mathematics (STEM) based subjects in low income and predominately Hispanic neighborhoods. The purpose of this project is to help increase the level of interest in Science, Technology, Engineering, and Mathematics (STEM) based subjects at Lowell Elementary School in Phoenix. Mentored by college students, middle school students begin to develop an engineering approach to solving tasks. This new mindset is put to use as students prepare to compete in the Future City Competition by designing their own virtual cities. The presence of college mentors working one-on-one with middle school students was impactful. A significant difference of interest was found between the students that were placed in a class setting versus those willing to spend their own time to participate in the club. Students further exercise engineering aptitudes through the construction of rollercoasters for the MESA (Math Engineering Science Achievement) Day competition. Through exposure and mentoring, this project inspires middle school students to excel in STEM subjects and seek out STEM careers.

NAU/NASA Space Grant Survey Of Arizona STEM Best Practices Part 2

While NASA gains most of its notoriety from its work in the fields of aerospace and engineering, a lesser known side of NASA is its educational outreach. This year long project was based on NASA educational outreach and aimed to re-introduce educators to the multitude of teaching materials that NASA has to offer. In order to achieve this, a better understanding of Arizona school's proficiency in STEM education needed to be determined. This research project was undertaken in order to achieve these objectives. Arizona educators were sent a survey of questions about STEM/NASA and the answers to this survey were analyzed to make best practice recommendations for schools. Although these results yielded evidence that Arizona is lagging in STEM education integration, there are multiple ways in which Arizona's educational system can approach fixing these concerns.

The Arizona Space Grant Consortium Peer Engagement Study: Student Involvement And Retention

The NASA Arizona Space Grant Consortium undergraduate internship wants to increase the engagement of past and current interns and to increase retention of interns in program-related events. The program currently lacks a strong and expanded network for recruiting and engaging students. There is also a lack of clarity as to what exactly students are looking for that will attract them into the program. The Arizona Space Grant Consortium Peer Engagement Study will conduct research through surveys to identify key departments and organizations, focus groups and rapid experiments to seek specific information about pipeline formal and informal network connections and continued UA staff interviews. Understanding how to keep alumni engaged will result in better word-of-mouth recommendations which will grow the available network. As we move forward, we are looking to figure out best practices for identifying, engaging, and recruiting more students on campus. This will include expanding the active network that can be reached in order to better recruit and retain interns.

Project Leadership Abstracts

Daedalus Astronautics

Daedalus Astronautics at Arizona State University is comprised of a multi-dimensional team of students that undertake advanced, astronautic research projects. Over the past year, the students have worked on various projects relating to propulsion and fluid dynamics. This year, the students have completed over 20 test fires. These tests were conducted with different hybrid rocket fuels and characterize solid rocket propellant for national competitions. Additionally, the students have built and begun testing the first liquid rocket engine at Arizona State University. All of these propulsion projects moved through various design phases over the course of the school year, with some culminating in full scale test fires, and others completing complex analyses and optimizations. The results of their work have been presented at an AIAA technical conference and will be used at a national rocket competition this summer.

The Sun Devil Satellite Laboratory

The Sun Devil Satellite Laboratory (SDSL) is a student-run organization whose mission is to design, test, build, and operate a variety of spacecraft and spacecraft technologies. This year, SDSL is involved in the development of several projects at Arizona State University that provide the opportunity for diverse student engineers to gain hand-on experience in spacecraft engineering through their participation in the projects. The first of these projects is a "CanSat" being developed for the 2014 AIAA CanSat Competition. This international competition provides a design, build, and fly mission simulating an Entry, Descent, and Landing mission on an atmospheric planet. The competition will take place in June 2014 and currently has 63 participating teams from 13 countries. Another project being developed is an attitude control and determination test bed. It is currently undergoing a proof of concept prototype that will provide precision 3-axis control utilizing spherical air-bearing dynamics to produce a frictional less, space-like, environment for testing. The remaining projects include the comprehensive development of a vacuum test chamber and the design of a motor controller algorithm for a UAV quad-copter.