NASEC 2017

Poster Session

Bulletin of Abstracts

1. Ian Miller, Lafayette College

A self-contained distributed sensing system for swarm robotics

Swarm robotics is a field currently experiencing great interest from the research community. The key idea is that a large number of simple robots working together can accomplish certain tasks more effectively than a traditional expensive, complex robot. Swarms are particularly useful in applications benefitting from a swarm's characteristics of parallelization and redundancy. One such application is the mapping or exploration of hostile environments. However, currently there are minimal real-world applications of swarms outside of research labs. Part of this problem has to do with robot localization being performed by external motion capture systems as well as expensive hardware. These systems require experiments to be performed in controlled lab environments, and individual robot costs can be prohibitive for swarms with many members.

In this poster, a low-cost hardware platform for swarm robotics developed at Lafayette College will be presented. The platform is capable of globally localizing the swarm based on local measurements taken by sensors on board the robots without the need for external sensors. Care has also been taken to minimize the individual robot hardware cost as much as possible. Control software and a simulation environment for testing have also been developed. Limitations and directions for future research will be briefly presented.

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2. Isaac Malsky, University of Chicago

Atmospheric escape and evolution for sub-Neptune mass exoplanets

A large number of observed exoplanets have been discovered in orbits smaller than .5 AU, and are highly irradiated by their host star. Under these conditions, the atmospheric composition of these exoplanets are thought to undergo significant evolution, as hydrodynamic escape and solar winds cause the preferential loss of either hydrogen or helium (Hu 2015). Over a time period of a billion years, the metallicity, hydrogen, and helium abundances can change by an order of magnitude. Modeling the planetary evolution will allow a better qualification of these effects and allow for a better categorization of observed exoplanets.

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3. Priyanka Ranade, University of Maryland, Baltimore County

Creating Cybersecurity Knowledge Graphs from Text

Although machines can rapidly identify attack signatures in large pools of data, syntactic variations of attacks can often times undermine cyber threat categorization. Despite this widespread issue, there are not readily available tools designed to specifically support information extraction for cybersecurity. In order to address this issue, we have utilized a semantic methodology to cognitive cybersecurity by leveraging the Unified Cyber Security Ontology (UCO) and integrating security related *information from various databases, standards, and websites, into a data repository which serves as a comprehensive spectrum of cybersecurity threats. This central repository contains annotations from various text corpuses, such as CVE (Common Vulnerabilities and Exposures) databases. Classifications such as "attacker" "exploit target" and "means/consequence" guided text extraction and annotation of corpuses. Raw annotation data will be used to support NLP pursuits, in determining relationships between words and cyber threat. These relationships, will show us vulnerabilities to later analyze and integrate into machine learning.*

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4. Alec Lawrie, University of Maryland, Baltimore County

Example-Based Clustered Shape Matching

Although physics-based techniques for computer animation have long been used in film, their high computational costs often render them unsuitable for real-time applications. The approach of strain-limited clustered shape matching provides a potential solution, allowing for large elastic deformations while still maintaining stability. In our work, we combine the clustered shape matching framework with an example-based approach for plastic deformations, enabling a high degree of artistic control over the simulation. We demonstrate that through the manipulation of an object's rest shape, we are able to control an object's deformation, and posit the integration of other example-based techniques for both plastic and elastic deformations.

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5. Hannah Gilbert, West Virginia University

EcoCAR3 Object Detection

Automated driving has become the next "big boom" within the automotive industry. Maintaining a competitive edge on current technology WVU has tackled some of the challenges of automated driving within their EcoCAR3 team. Object Detection for EcoCAR3 has developed fast and reliable traffic-sign, pedestrian, and vehicle detectors. Developing an object detector is an intricate task that requires precise construction and labeling of individual datasets. This task has been completed using MATLAB's cascade *object detector. With above satisfactory detection rates the team only continues to grow their datasets, and improve the accuracy and precision of each detector, as well as experiment with new detectors to guarantee the most desirable detector possible.*

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6. Craig Heim, Taylor Huneycutt and Skylar Dierker, Ohio State University

An Analysis and Selection of Launch and Orbital Trajectories for the JESSE OWENS Thermonuclear Propulsion Interplanetary Spaceflight Mission

Computational evaluation of potential trajectories for a sprint mission to and from Jupiter using thermonuclear propulsion rather than conventional chemical propulsion methods.

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7. Ariaki Dandawate and Nelson Pereira, New York University

Automating Vertical Farming Systems

Current developments in Vertical farming don't concentrate on its accessibility to the public. Thus, the system we are developing incorporates technology that is specifically focused on the automated monitoring of growing conditions such as pH, humidity, temperature, electrical conductivity, dissolved oxygen concentration, and carbon dioxide levels from an Arduino. Using cameras to discern specific plant characteristics not easily recognizable to the human eye and indicators of ideal plant growth, we can produce a system equipped with machine learning characteristics, capable of self-correcting irregularities that deviate from optimal conditions. With this attention towards the standardization of system parameters, the vertical farm becomes increasingly independent and self-sustaining. This shift of focus upon the user-friendliness of the system in turn increases its awareness, and expands its usage beyond large-scale production towards education and home environments.

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8. Michael Walker, USNA

A Partially Premixed Combustion Application for Diesel Power Improvement

Due to increasing weight in military platforms, engine power needs to be increased in order to maintain performance. Diesel engine power is limited by soot formation, which is an indicator of incomplete fuel combustion due to lack of oxygen and poor mixing of the fuel and air. Once the soot limit is reached in a conventional diesel engine, further fuel increases will not result in more engine power since both the time for combustion (i.e. engine RPM) and oxygen are limited. Partially Premixed Combustion (PPC) allows for better mixing of the air and fuel in the combustion chamber, leading to lower combustion temperatures and higher flame speed (shorter burn duration) as compared to conventional diesel combustion. PPC delivers additional fuel to the combustion chamber in internal combustion engines through the air intake system in addition to the in-cylinder (i.e. combustion chamber) injection event, allowing for increased power opportunities. This project sought to characterize achievable power gains in a flexible research engine that allows for the manipulation of combustion *phasing-timing, compression ratio (CR), and maximum baseline load to achieve optimal combustion phasing. Fuels to be evaluated include conventional Navy JP5 and less reactive, non-JP5 fuels. The desired outcome of this project is to show moderate power increases with PPC over conventional diesel operation.*

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9. James McLaurin, University of District of Columbia

Synchronized High-Speed Video and Infrared Thermometry Study of Bubble Dynamics during Nucleate Boiling of Nanoemulsion

Effective thermal management in various engineering systems is a critical issue, in which utilizing nucleate boiling to enhance heat transfer has attracted particular attention because its capability to remove high heat flux. However, nucleate boiling is a complex process that still requires more understanding. On one side, researchers have been relying on speculative hypotheses for decades to understand nucleate boiling heat transfer, which is a generally highly empirical and over simplified practice. On the other side, there is still disagreement on fundamental questions like: how nucleation occurs at the liquid–vapor interface for fluids with very low contact angles, and what are the physical mechanisms triggering critical heat flux etc. So there is an urgent need to collect data that enables detailed measurements of the phase, temperature, and velocity distribution during nucleation.

In this study, a combination of synchronized high-speed video (HSV) and infrared (IR) thermography was used to characterize the nucleation, growth and detachment of bubbles generated during nucleate boiling. In addition, nanoemulsion was used in current study, in which nanosized phase changeable droplets were formed inside the nanoemulsion and served as the boiling nuclei. With this unique combination, it allows controlled nucleation, time-resolved temperature distribution data for the boiling surface and direct visualization of the bubble cycle to track bubble nucleation and growth. Data gathered included measurements of bubble size and shape vs. time, bubble departure frequency, wait and growth times, as well as 2D temperature history of the heater surface and velocity distribution within the liquid surrounding the bubbles. Our findings demonstrate a significant increase in heat transfer coefficient and critical heat flux of nanoemulsion compared to conventional heat transfer fluid. It is also observed here that the bubbles occurred inside the nanoemulsion appear to be more uniform and larger in size. Using the HSV and IR data, we were able to characterize the growth rate and interfacial temperature distribution of the bubbles inside nanoemulsion: the growth rate of the bubbles inside conventional fluid agrees well with classic Rayleigh-Plesset equation with a coefficient of ½, which however, drops to be 1/4 for nanoemulsion. Future research involves more data on the effect of different phase changeable droplets, interfacial material and structures may help explain the unique nucleation process of nanoemulsion.

10. Hung Nguyen, Drexel University

A New Perspective on Hydroponics

Hydroponics is the process of growing plants without the need for soil. Such a system utilizes a nutrient solution as the food source for the plants and an inert medium as support for the roots. This system eliminates many common problems that face conventional farming like pests, diseases, and soil degradation. Unfortunately, a majority of hydroponic systems available on the market are designed for large scale operations where space is not an issue. Urban dwellers often find space and light to be commodities difficult to afford. The summer project has been spent trying to convert traditional hydroponics systems into wall based systems that can be dividers of space or part of the façade of a building. The current prototype can accommodate one plant whose growth is stable and efficient. I will continue my design process and accompanying research to develop a prototype to the product I know it can become. In the future, families plagued by food deserts and low income can afford a healthy and delicious meal grown right from their own homes.

11. Mera Shabti, George Mason University

Vegetative Reinforcement of Marshland Soils

I am conducting research on how the presence and amount of vegetation can affect rates of erosion and scour in soil in marshlands and wetlands.

12. Greg Hyer, USNA

A Microlensing Analysis of the Central Engine in the Lensed Quasar WFI J2033-4723

I am measuring the size of the accretion disk in the gravitationally lensed quasar WFI J2033-4723 by analyzing of 12 seasons of optical monitoring data. Using a point spread function (PSF) modeling software, I am measuring the brightness of each of this system's four images in 8 seasons of optical monitoring data taken at the the 1.3m SMARTS telescope at Cerro Tololo, Chile and the 1.5m EULER telescope in La Silla, Chile, and I will combine these new data with published measurements from Vuissoz et al. (2008) to create a 12-season set of optical light curves. Employing the Bayesian Monte Carlo microlensing analysis technique of Kochanek (2004), I will analyze these light curves to yield the first-ever measurement of the size of this quasar's accretion disk, and I will also make an independent measurement of its previously published time delays. Despite the fact that we now know of ~ 106 quasars, the size of the central engine has been measured in only 14 of these systems. This Trident scholar project *will make significant contributions to our understanding of the most luminous sources in the universe, and it will lead to a refereed article in The Astrophysical Journal.*

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13. Taehwan Kim, Bucknell University

Using an application to improve field hockey team's performance

In Bucknell, we have a women field hockey team. Using mobile application, our research team got the players' data while they were playing a game, and we analyzed the data to improve their performance.

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14. Cyree Beckett and Victor Ramos, University of the District of Columbia

NASA Human Rover Exploration Challenge

In March 2017, the University of the District of Columbia (UDC) sent myself and a team of faculty and students to a NASA workshop established to develop human rovers. The workshop--the NASA Human Exploration Rover Challenge, an annual event which hosts over 100 high schools and universities from around the world--is meant to "encourage research and development of new technology for future mission planning and crewed space missions to other worlds." The idea was to observe the Challenge so that I could prepare a team of students in a UDC-sponsored crew to participate in 2018. On my return, I established a working group of 12 students to design and build a Rover. As the leader of the team, I report to faculty advisers Drs. Sasan Haghani and Jiajun Xu, but the research project is student-led.

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15. Benjamin Smith, West Virginia University

Improving 3D Reconstruction Times via Neural Networks

In order to create 3D reconstructions of a scene, exhaustive matching must be performed between views. Unfortunately, each new view added increases matching time at an exponential rate. To alleviate this, trained neural networks will determine if two images depict the same scene. Assuming the images are of the same scene, matching is performed, otherwise the pair may be discarded before time is spent computing the pairwise geometry.

16. Abrere Kozolan, University of Maryland, Baltimore County

A study of cues to online deception

In view of the prevalence of online deception, understanding behavioral cues to online deception has significant practical implications. There have been a host of studies on cues to deception; however, the majority of these studies were conducted in face-to-face communication. In addition, the emerging studies on cues to online deception have overlooked the video modality of online communication. In this study, we investigate cues to deception via video analysis. The results reveal some interesting patterns of deception behavior.

17. Miranda Pickup, Thomas Jefferson University

The Evolution of Solid State Storage Devices: A Quantitative Study

Literature research was conducted to understand why and how NAND type solid state storage devices are the most common devices used today, and how they may develop further. Information on density, capacity, and data transfer rates was gathered for different devices that were manufactured over the last several decades. This information allowed us to map out how these features of solid state storage devices have developed over time. Research concluded that NAND type storage devices are not the fastest but they are the densest. The extremely high densities on these chips makes them the most cost effective, and therefor explains their popularity in the storage market today. Throughout the summer I learned how to become a successful member of an interdisciplinary team and how to work in a professional, scientific environment.

18. James Bruska, Clarkson University

Multi-Exploit Detection via Hardware Performance Information

Many forms of malware and security breaches exist today. One type of breach downgrades a cryptographic program by employing a man-in-the-middle attack. This work explores the utilization of hardware-level information in conjunction with machine learning algorithms to detect a selection of encryption downgrade attacks: FREAK, LOGJAM, POODLE. This research demonstrates the ability of machine learning algorithms to effectively and consistently detect unknown downgrade attacks in real time. Results indicate that this detection method is both feasible and practical. When trained with normal TLS and SSL data, the echo state network classifier was able to detect the three exploits with up to 95.852% accuracy.

19. Stephanie Jones, Villanova University

Mind Games with a Focus on Children with ADHD

Mind Games with a Focus on Children with ADHD integrates the NARBIS headset with a Raspberry PI running RetroPie. The NARBIS headset aims to increase concentration skills by monitoring brain wave activity, and providing direct feedback to the user by tinting the glasses. In our senior design project we are integrating this signal with a Mario Kart N64 simulation to modify the speed of the main player. As they are more concentrated their speed increases, but as they lose concentration their speed decreases.

20. Jacqueline Failla*,* Tulane University

Characterization of MoS2

MoS2 (Molybdenum Disulfide) is a two-dimensional semiconductor. Characterization utilizes LabVIEW code to measure IV sweeps and photocurrent of a MoS2 sample device. The MoS2 sample contains etched devices that are probed at the source, drain, and gate. The etched patterns are gold deposited designs made by photolithography or electron beam lithography. Characterization is important to the overall research of two-dimensional materials in order to make future devices such as photovoltaics and transistors.

21. Quang Tran, University of Chicago

Planet Occurrence Rates for Kepler A-Type Dwarf Sample

Most detected exoplanets orbit FGKM dwarfs, largely because detecting planets that orbit hotter stars, namely A stars, is difficult due to their rotationally-broadened spectra and large radii. This study explores the planet occurrence rates around hot A-stars in the Kepler data set, in order to investigate the role of stellar evolution on planetary formation. Kepler is the first astronomical survey to have photometric precision necessary to detect Jupiter-size planets transiting A-star hosts. We limit our stellar host samples to stars with over 6500K, matching late F-star and A-star stellar temperatures. Using both the spectroscopic and photometric data, we re-characterize the planetary system to obtain reliable, homogeneous properties. We infer the population level statistics on the planetary candidates using a hierarchical probabilistic framework. Finally, we sampling using MCMC to get the population parameters in order to constrain our planet occurrence rates.

22. Joshua Marosi, West Virginia University

Advanced Driver Assistance Systems - Object Detection

My partner and I are working on the object detection aspects of the EcoCAR project/competition for the Advanced Driver Assistance Systems team.

23. Jaime Rios, University of the District of Columbia

NASA Human Powered Rover Project

Our research into the design and fabrication of a two person rover, powered only by human power. It will be entered into the NASA Human Powered Rover Competition.

24. Peter Teague, Stevens Institute of Technology

A Smarter, More Comfortable Personal Floatation Device

Personal Flotation Devices (PFDs) are common maritime safety equipment, but current models are inadequate for the demands of the Navy SEALs. The two main reasons for this are: discomfort to the user and premature activation during mission scenarios. To combat these problems, a new PFD design is proposed. This design incorporates an inflatable bladder attached around a garment collar and moves the sensing and deployment equipment to the belt for increased comfort while reducing weight and size by removing the need for large springs to puncture CO2 canisters. The design enables a micro-controller to sense depth and time of submersion to deploy only in desired scenarios. With these improvements, PFDs will be worn more often and misfire less, increasing safety.

25. Conner Castle, West Virginia University

Robotics Research Test Platform

Physical platform that allows for testing of various types of robotics research and the applications and interactions between them. For instance the testing platform will be a space in which swarm robots and a cable robot will be able to interact and, later, the same space could be utilized to test the dynamics of a quadcopter, or the navigation and path planning of a small mobile robot could be *evaluated without having to alter the structure of the platform. The platform consists of a table, metal frame on top of the table, cameras, a computer, and the accompanying test robots.*

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26. Conrad Leonik, Tulane University

Using Phase Resetting Theory to Understand the Effect of Propofol on a Population of Cortical LTS Interneurons

Propofol is a GABAA-potentiating general anesthetic drug that increases the maximal conductance and time constant of decay of the synaptic GABAA current. Like most drugs in this category, at low doses propofol is capable of "paradoxical excitation", characterized by an increase in EEG power in the beta band (12.5-25 Hz) and a decrease in power in the lower frequency band (3.5-12.5 Hz), which includes the alpha band. Previous simulations of cortical networks (McCarthy et al., 2008) suggest that this paradoxical excitation is in part due to the emergence of antiphase firing of two clusters of low threshold spike (LTS) interneurons. At doses of propofol sufficient to induce anesthesia, power in the beta band should decrease and that in the lower frequency bands should be elevated. However, in the previous simulations, the antiphase clusters contributing to beta band power persisted at high doses. We found that if an axonal conduction delay is added to the interneuronal network, the clusters collapse into global synchrony, resulting in a population oscillation frequency in the alpha band instead.

We were able to explain our results using phase resetting theory. We conceptualized the network as consisting of two clusters; then we applied phase resetting theory to a single cluster with a self-connection that represents the other neurons in the cluster. The phase resetting curve (PRC) is measured by applying a single input, corresponding to that received from the other cluster, at different points during the oscillatory cycle. The input from the partner cluster causes the timing of the next action potential to be delayed; the amount of this delay depends on the point in the oscillatory cycle at which the input is received. The phase resetting curve can then be used to predict the existence and stability of both the two cluster antiphase mode and global synchrony. These simulations and their analysis may provide a partial explanation for the changes in relative power in the alpha and beta frequency bands for the EEG at high versus low doses of propofol and potentially further our understanding of the mechanisms of general anesthesia.

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27. Emily Sharp, Bucknell University

Electrospinning Factors Affecting the Characteristics of Poly (vinyl acetate)

Research into the characteristics and abilities of polymers is a fascinating and upcoming project, leading to practical as well as scientific innovation, modification, and progress in numerous realms, such as structural, biomedical, and aerospace fields of engineering. The experiments conducted have been a continuation of previous research in the Mather Research Group, which utilized poly(vinyl acetate) characteristics to produce water origami shapes and investigated this polymer's reaction to distinct water *application. The contemporary research aims to refine the information formerly obtained. Specifically, the combination of shrinkage properties and water sensitivity of poly(vinyl acetate) enables water origami: upon contact with water the material will fold along a line of water contact. This stimulates a desire for increased understanding on how to better control this response mechanism to moisture. Particularly, altering the electrospinning variables such as mandrel speed, flow rate, concentration, and voltage when electrospinning poly(vinyl acetate) yields distinct water- and heat-induced shrinkage and folding with each sample. Fibrous material, prepared with a range of conditions, were run through several analytical techniques such as differential scanning calorimetry (DSC), tensile testing, dynamic mechanical analysis (DMA), water-line testing, and scanning electron microscopy (SEM). These were done to examine the traits of the polymer that contribute to its mechanical response to water. Ultimately, these observations and trials will shine more light on the effects of electrospinning factors and the capabilities of poly(vinyl acetate), primarily its shrinkage properties.*

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28. Andrew Harris, Stevens Institute of Technology

Machine Learning Applied For Automated Crater Detection

Robust automated feature identification would provide planetary scientists with the ability to perform exhaustive surveys of features in orbital imagery data. An implementation of Google TensorFlow was used to detect the presence of craters within tiles from lunar digital terrain models. Results should be viewed in light of the limited training data available, which both reduces the ability to train the model and makes test results more prone to error.

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29. John Martin, UNC-Chapel Hill

Skynet's Suite of Processing Algorithms for Single Dish Radio Telescopes

Skynet is an international network of over two dozen optical robotic telescopes operated out of the University of North Carolina at Chapel Hill. Having recently acquired privileges to the 20-meter radio telescope located at Green Bank Observatory, our team of programmers have worked to develop Radio Cartographer, a new radio data cleaning and mapping software. Here, we outline its major processing procedures and highlight the heavy influence and use of robust Chavuenet rejection (RCR) as a procedure to statistically identify and remove various forms of radio contaminants. Implementing RCR into Radio Cartographer allows us to consistently extract both accurate and precise flux values from distributions comprised of as high as 85-percent contaminated data. Combining this procedure with weighted modeling and other processing tools, we produce both cleaned and photometrically viable radio images for professional use.

30. Katie Kirkwood, USNA

Computer Simulation of Synthetic Aperture Sonar for Classroom Demonstration

Synthetic Aperture Radar (SAR) has many civilian and military applications as a high resolution imaging system. Synthetic Aperture Sonar (SAS) imitates the mechanism of SAR but replaces electromagnetic for acoustic signals. A Mathematica® (ver. 11) simulation of Synthetic Aperture Sonar (SAS) will demonstrate how two-dimensional and three-dimensional point targets on a ground plane can be imaged from a collection of acoustic echoes

31. Dylan Dutton, UNC-Chapel Hill

Single-Dish Radio Mapping Algorithm

Taking measurements has always been the most fundamental concept of science. However, these measurements can often become contaminated, sometimes significantly. Astronomical data in the radio spectrum is of no exception. Here, we present a single-dish radio mapping algorithm that removes common contaminants more effectively than currently available methods such as basket weaving. In particular, we test our algorithm's ability to remove contaminants such as (1) background noise, (2) radio-frequency interference (RFI), (3) elevation-dependent signal, and (5) large-scale astronomical signal. Testing is performed on 1-D spectra as well as 2-D radio maps.

32. Xingyuan Zhao, Drexel University

Modeling of Ripplocation Using Dimensional Analysis Approach

The objective of this work is to study the characteristics of various ripplocation parameters and provide a mathematical model to predict the character of ripples.

33. Julian Fraize, Stevens Institute of Technology

Hull Design of an Autonomous Sailing Vessel, addressing Parametric Roll

The purpose of this project is to develop a robust and stable hull for an autonomous sailing vessel. The specific project is based out of The Swedish Royal Institute of Technology (KTH), Maritime Systems department. The project is funded by the Swedish Coast Guard (Kustbevakningen), and has been underway since November 2016. The project is called Maribot VANE, and is intended to be a research *vessel capable of carrying a varying suit of sensors used in oceanographic research. Tests of the current iteration of Maribot VANE have been performed during the summer of 2017, with the goal of developing the autonomous system and rig arrangement. The current hull used for development purposes is from a class 2.4 meter sailboat. During testing the vessel showed tendencies for extreme parametric roll. During the parametric roll event the free rotating rig that the design utilizes came in contact with the water and high accelerations on the hull were recorded. Based on the results of testing, a new hull design is going to be developed in correlation with the other components of the project. The first step in the proposed work will be a literature review regarding parametric roll, and particularly the design of small unmanned sailing platforms that have been designed in the past 10 years. The key requirements for the design are that it be able to host the self-steering system developed at KTH, and have easy access to the internal electronics for testing and servicing purposes. Further the hull and rig combination should have negative buoyancy if capsized, and be arbitrarily stable to provide a good environment for testing equipment, and to minimize wear on the system components on long excursions. A focus will be put on design of integrated control surfaces for steering to minimize fragile appendages.*

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34. Mannika Kshettry, Drexel University

Multiple Antenna based Motion Detection for Infant Respiration Data using Bellyband System

The researchers at Drexel Wireless Systems Laboratory in collaboration with the Shima Technology Laboratory have designed the Bellyband, a biomedical smart textile device. The Bellyband enables wireless monitoring of biological signals such as respiration or uterine contractions using Radio Frequency Identification (RFID) technology. This device enables the patient's mobility while monitoring their biological signals and increases their comfort. A RFID antenna is knitted into the Bellyband using conductive fibers. The RFID interrogator sends signals to the knitted RFID antenna and the antenna modulates a response to convey the biological signal reading. Bellyband readings are sensitive to ambient motion of the patient, making it susceptible to false readings when patients are mobile. This is a challenge in the signal processing of the Bellyband device; therefore, motion artifact filtering of signals from the device is highly desirable. In this project, experiments were conducted to test different motion filtration methods from Bellyband readings. Multi-antenna and multi-reader configurations were explored to identify signal patterns that were a result of ambient motion. Using these configurations, data was collected by simulating various possible patient motion patterns and visualized using MATLAB. Certain configurations provided better motion detection, which will help improve Bellyband biological signal accuracy.

35. Mark Tierney, UNC-Chapel Hill

Characterizing an auditory biomarker of concussive and sub-concussive trauma

The study from which the poster comes aims to characterize an electrophysiological measure in a group of college athletes before a season, at the time of clinically diagnosed concussion, at the time the concussed athletes are cleared to return to play based on subjective symptom recovery, and once more at the end of the season. This poster will consist of a correlation between preseason baseline data (68 subjects), collected August 2017, and subjects' reported history with concussions along with a comparison to normative data. These narratives offer context from which researchers and clinicians can evaluate the utility of the Frequency Following Response as a potential means by which to profile an individual's history with concussive and sub-concussive trauma to the brain.

36. Grant Rauterkas, Tulane University

Characterizing an auditory biomarker of concussive and sub-concussive trauma

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37. Julia Di, Columbia University

EDUARDO: Electrostatic Detainment Unit for Automated Removal of Debris in Orbit

The U.S. Strategic Command is currently tracking over 16, 000 objects in Earth orbit. The vast majority is considered orbital debris: pieces of older satellites, abandoned rockets, and other inoperable spacecraft. Frequently, larger debris breaks down into daughter debris, of which ~ 200, 000 to 300, 000 pieces exist. Orbital debris poses a serious threat to the active satellites functioning in Earth's vicinity. Satellites can be maneuvered to avoid debris, but this action consumes valuable fuel. The Electrostatic Detainment Unit for Automated Removal of Debris in Orbit, EDUARDO, is suggested to manage the larger debris. EDUARDO is a multi-jointed mechanism with an electrostatic gripping pad end effector, designed to capture any debris it contacts. EDUARDO's robotic arm removes large debris to prevent the creation of daughter debris, and also enables repairs of malfunctioning or inactive satellites. The prototype for this arm has been constructed with a rotating motorized shoulder mount, dual extend-able booms, and a rotating motorized joint for mounting the electrostatic gripper. It is built on a thruster-propelled air bearing mobility base designed to simulate motion in near-Earth orbit. In future developments, EDUARDO will have the capability to autonomously locate and capture problematic debris or damaged satellites. This documentation details the design process in creating the EDUARDO prototype and demonstrates the potential of electrostatic technologies to capture orbital debris.

38. Ian DesJardin, SUNY at Buffalo

The System Level Testing of the GLADOS Cubesat

The University at Buffalo Nanosatellite Laboratory is a student led undergraduate cubesat laboratory under the direction of Dr. John Crassidis. GLADOS is the first cubesat developed under UBNL. Its mission is to collect glint data on unidentified space objects for the purpose of increased space situational awareness. System level verification and validation of the engineering unit requirements is critical to ensure flight performance.

Four system level tests, the Command Execution Test, the Complete Charge Test, the Simulated Communications Test, and the Day in the Life Test have been run to validate the electrical, command and data handling, communications, software, and attitude determination and control subsystems in scenarios that simulate on-orbit conditions. Auxiliary tests have also been run to validate the satellite structure, optical payload, and image processing algorithms. These tests have all been run by students on a condensed schedule and limited budget relative to similar system level testing efforts in industry. Many tests were completed using COTS test equipment.

Results indicate that a successful system integration is underway. The power, communications, data handling systems, optics, attitude determination and control, and software have been demonstrated to work under realistic conditions. The successful results of this engineering unit testing will enable the GLADOS project to progress into flight integration and on-orbit operation states.

39. Kevin Raleigh, Steven Institute of Technology

Potential Flow-Based Boundary Element Method for Submerged 2D Rigid Bodies

This paper outlines the background and mathematics involved in the development of a basic computational fluid dynamics program to be used in resistance estimations of hydrofoils. The sections detailed in the report break down the scheme followed in outlining the program including derivation of necessary fluid mechanic equations, discretization of hydrofoil shapes and formulation of results. The basic hydrofoil resistance estimations are shown to be consistent with the findings from proven computational methods used to determine the pressure on submerged hydrofoils. This report also details, some of the various steps to be taken as future developments with this program or in similar programs of its kind.

40. **Matthew Macesker**, University of Connecticut

A Multiobjective Path-Planning Algorithm With Time Windows for Asset Routing in a Dynamic Weather-Impacted Environment

This paper presents a mixed-initiative tool for multiobjective planning and asset routing (TMPLAR) in dynamic and uncertain environments. TMPLAR is built upon multiobjective dynamic programming algorithms to route assets in a timely fashion, while considering fuel efficiency, voyage time, distance, and adherence to real world constraints (asset vehicle limits, navigator-specified deadlines, etc.). TMPLAR has the potential to be applied in a variety of contexts, including ship, helicopter, or unmanned aerial vehicle routing. The tool provides recommended schedules, consisting of waypoints, associated arrival and departure times, asset speed and bearing, that are optimized with respect to several objectives. The ship navigation is exacerbated by the need to address multiple conflicting objectives, spatial and temporal uncertainty associated with the weather, multiple constraints on asset operation, and the added capability of waiting at a waypoint with the intent to avoid bad weather, conduct opportunistic training drills, or both. The key algorithmic contribution is a multiobjective shortest path algorithm for networks with stochastic nonconvex edge costs and the following problem features: 1) time windows on nodes; 2) ability to choose vessel speed to next node subject to (minimum and/or maximum) speed constraints; 3) ability to select the power plant configuration at each node; and 4) ability to wait at a node. The algorithm is demonstrated on six real world routing scenarios by comparing its performance against an existing operational routing algorithm.

41. **Michelle Voong,** University of Connecticut

Multi-Objective, Dynamic Resource Management Algorithms for Rapid Mission Planning/Re-Planning in an Uncertain Mission Environment

This paper presents a mixed-initiative tool for multiobjective planning and asset routing (TMPLAR) in dynamic and uncertain environments. TMPLAR is built upon multiobjective dynamic programming algorithms to route assets in a timely fashion, while considering fuel efficiency, voyage time, distance, and adherence to real world constraints (asset vehicle limits, navigator-specified deadlines, etc.). TMPLAR has the potential to be applied in a variety of contexts, including ship, helicopter, or unmanned aerial vehicle routing. The tool provides recommended schedules, consisting of waypoints, associated arrival and departure times, asset speed and bearing, that are optimized with respect to several objectives. The ship navigation is exacerbated by the need to address multiple conflicting objectives, spatial and temporal uncertainty associated with the weather, multiple constraints on asset operation, and the added capability of waiting at a waypoint with the intent to avoid bad weather, conduct opportunistic training drills, or both. The key algorithmic contribution is a multiobjective shortest path algorithm for networks with stochastic nonconvex edge costs and the following problem features: 1) time windows on nodes; 2) ability to choose vessel speed to next node *subject to (minimum and/or maximum) speed constraints; 3) ability to select the power plant configuration at each node; and 4) ability to wait at a node. The algorithm is demonstrated on six real world routing scenarios by comparing its performance against an existing operational routing algorithm.*

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42. Karl Schwarzkopf, USNA

Using SVD to Efficiently Analyze Data

This project aims to develop a MATLAB code utilizing singular value decomposition of matrices to address, analyze, and quantify the changes and patterns in data of high-dimensional dynamical systems. The two systems investigated include laser propagation through water and images of arctic sea ice. By using the singular values found in decomposition, complex systems can be simplified and and estimated to a desired accuracy making computational analysis much easier.

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43. Kathryn Chapman, University of Chicago

Gigayear Timescale Instability in Multiplanet Systems

This project, like most exoplanet queries, holds its roots in our own Solar System. At first glance the Solar System appears to be relatively stable, but it is in fact chaotic. Recent work (Laskar and Gastineau 2009) has shown that there is a potential for Mercury to to become unstable through angular momentum transfer from the other planets (Mercury has a low mass and a small semi-major axis, so a relatively small change in the other planets can have a drastic effect on its orbit) and be ejected from the solar system. This then raises the question: if our own planetary system has the potential to become unstable, what about other planetary systems?

It is already common practice to test the stability of newly discovered planetary systems with short timescale (10^4 - 10^8 years) integrations. Unfortunately, integrations of this length are not long enough to catch secular instabilities, which only appear on 10^9 timescales and are theorized to be responsible for the instability in the solar system. A simple solution to this problem would be to simply run 10^9 timescale integrations, but such simulations can take months to finish even with significant computing power. The main goal of my project is then to develop less time consuming methods to assess the secular stability of multi-planet exoplanet systems, and further identify what parameters of such systems are precursors to instability which may only present itself 10^9 years in the future.

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44. Walker Gosrich, University of Buffalo

A Robotic Platform for Evaluating Autonomous Construction Methods

This work presents a robust robotic agent for performing autonomous construction in unprepared, irregular environments. The wheeled robot is made from inexpensive, off-the-shelf components, and is capable of reliable locomotion over rough terrain. It is composed of a wheeled chassis equipped with a differential drivetrain, a robotic arm with a simple gripper, a vision system, and a capable on board processor. Its modular design enables the robotic agent to be re-configured for a variety of novel autonomous construction tasks; it is equipped to be a completely self-contained unit capable of perception, planning, navigation over uneven terrain, and manipulation of irregular objects. The system has been configured to build access ramps from filled bags, but its modularity permits use in many systems, from heterogeneous multi-robot collaboration with unstructured components, to structured assembly tasks with known building blocks.

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45. Deborah Wang, Thomas Jefferson University

The Industrial Hemp Supply Chain: An Exploration of New Materials and Products Derived from Hemp

Throughout history, hemp has been recognized as a sustainable, renewable resource with a host of industrial applications. An interdisciplinary team of Jefferson students and faculty from design, engineering, and business disciplines were challenged by The Lambert Center to explore new materials and products that can be realized from a modern US industrial hemp industry.

The challenge includes developing a basic scientific understanding of hemp and hemp-derived materials, developing new product concepts, and defining the markets and supply chains required to realize sustainable industrial hemp business models.

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46. McKenzie Burns, Bucknell University

Aqueous and oil phase products from hydrothermal liquefaction of waste biomasses

Two major problems facing society are the limited amount of fuel available for energy and the excess amount of organic waste (e.g., manure) that pollutes waterways. Hydrothermal liquefaction (HTL) can tackle both of these problems, for it takes waste and turns it into fuel. HTL of waste biomass produces both oil and aqueous products with potential valuable uses. The bio oil can be refined for use in the transportation sector with the ultimate goal of replacing fossil fuels. The aqueous phase contains unconverted organic carbon as well as nitrogen. With HTL, the goal is to valorize carbon (as energy) and nitrogen (for use in fertilizers after it is extracted from the aqueous phase) that is found in organic waste streams. The purpose of this study is threefold: (1) to establish a method for investigating the quality of bio oil produced via HTL of several waste biomass feedstocks through gas chromatography-mass spectroscopy, (2) to characterize the boiling point distributions of bio oils produced vial HTL using thermogravimetric analysis, and (3) to measure the carbon and nitrogen content of the aqueous phase produced via HTL of waste biomasses. HTL reactions were conducted in a 500 mL *reactor operated at 300 ºC and ~10 MPa of pressure. The bio-oils analyzed were produced from HTL of manure, apple waste, olive oil pomace, food waste, red wine, whey, and whiskey grain. The aqueous phase samples analyzed were produced from HTL of manure with retention times that ranged from 0 to 40 minutes. We developed a method that uses toluene as an internal standard for qualitative analysis of bio oils. The measured boiling point distributions show that the bio oils produced from the seven feedstocks are suitable for heavy oil refining techniques. For the aqueous phase, as retention time of the HTL process increased, both nitrogen and carbon concentrations decreased. Further investigation has shown that most of the feedstock carbon ends up in the oil phase. This is good for the oil prospects, as more carbon equates to more energy in the bio oil. We are continuing this work by applying the GC-MS we developed to analyze the quality of bio-oils. In addition, we are analyzing the aqueous phase for replicate reactions. This work will assist in designing HTL processes that valorize carbon and nitrogen in waste biomass.*

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47. Michael Ditzler, Ohio State University

An Analysis and Selection of Launch and Orbital Trajectories for the JESSE OWENS Thermonuclear Propulsion Interplanetary Spaceflight Mission

Using current technology and spaceflight techniques, interplanetary missions tend to last on the scale of years for a one-way trip. In particular, transits to Jupiter, such as those made by Juno and Galileo, lasted roughly five years. This project would validate some of the necessary technology, hardware and systems required for eventual human spaceflight into the outer Solar System in significantly reduced travel time. This reduction in time on transit would have numerous benefits, including reduced radiation exposure, ease of life support requirements, and avoidance of some of the other countless risks of spaceflight.

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48. Diana Godja, James Madison University

Artificial Echolocation Using Deep Neural Networks

We explore the effectiveness of bat-inspired echolocation as a practical sensory modality for extracting high-resolution depth information. Traditional ultrasonic depth sensors provide a single scalar depth estimate based on the time delay between an emitted pulse and the detection of an echo. Bats use a similar mechanism to extract depth information. However, bats and other echolocating animals are able to create a sensory percept that is much richer than a single distance measurement. We demonstrate that a deep neural network can be trained to accurately reconstruct two-dimensional depth fields by analyzing the echoes from a single 10 millisecond frequency-modulated chirp.

49. Noah Walsh, St. Mary's College

Ionogram Scaling with Neural Networks and SAMI3 Model Comparison

We improved the automation of the scaling process of converting raw ionogram soundings into usable data using machine learning techniques and neural networks, and analyzing scaled data and comparing it to our ionosphere model. We gathered data from multiple ionosonde sites across the United States, Peru and the Pacific using ionosondes. An ionosonde is a chirp-sounder that sends radio wave pulses into the ionosphere and records the reflected, refracted, and scattered radio waves. This 16 channel raw sounding data is cleaned and processed into an ionogram, and then scaled into a usable format, such as Standard Archiving Output (SAO) format. We used SAMI3, a global, three-dimensional, physics based model of the ionosphere which models the plasma and chemical evolution of multiple ion species, to understand the evolution of the peak electron density and peak height of the F2 layer. Our analysis will be used to improve the SAMI3 model. This research was performed at the U.S. Naval Research Laboratory.

50. Luke Reno, Thomas Jefferson University

Sustainable Composites as Roofing Alternative

Working with students from Durban, South Africa we want to create roofing tiles that are made from hemp fiber and waste stem as a way to create a natural, sustainable alternative to petroleum-based asphalt and tar roofing.