ACURA PROJECTS
Division of Science and Engineering

Astronomy

Radio Astronomy

Summary of Research Project: *Students will take data with radio telescopes at the Green Bank Observatory in Green Bank WV and combine their results with archival data available from the telescope to analyze molecular clouds and neutral hydrogen clouds near the Milky Way. Students will also have the opportunity of studying pulsars and observing pulsar timings to support the Nanograv project.*

Requirements for Students: Completion of introductory math courses or a substantial math background from high school. Please interview with the professors to determine your eligibility. Students should be available for travel to the Green Bank Observatory during 3 days of the fall break.

Contact Information:
Faculty Member Name: Dr. Carl Schmiedekamp
Faculty Member Email: cws2@psu.edu
Faculty Member Office Phone: 215-881-7572
Faculty Member Office Location: 217 Woodland

Biology

Effects of High-Dose Ascorbate (Vitamin C) on gastrointestinal stromal tumor (GIST) cells

Summary of Research Project: *This project will investigate the anti-proliferative effects of high-dose vitamin C (ascorbate) on gastrointestinal stromal tumor (GIST) cells. We will also investigate possible mechanisms for the anti-proliferative effect which may include production of oxygen radicals (like hydrogen peroxide) and induction of apoptosis.*

Requirements for Students: Usually I do not take on research students until they have successfully completed BIOL 230W. (This project is not taking more students in fall 2018.)

Contact Information:
Faculty Member Name: Dr. Thomas McGuire
Faculty Member Email: tmm15@psu.edu
Faculty Member Office Phone: 215-881-7990
Faculty Member Office Location: 230 Woodland

Biology

A Comparative Analysis of Marcellus Shale and Non-Marcellus Shale Aquatic Ecosystems and Local Food Production

Summary of Research Project: *This goal of this research is to quantify the effects of hydraulic fracturing on water and soil in Pennsylvania. I travel to Southwestern Pennsylvania, collect samples from streams that flow adjacent to hydraulic fracturing operations, and deliver them to Dr. Regina Lamendella at Juniata College in Central Pennsylvania, where the samples are analyzed for microbial community structure. These results will be compared to samples from non-Marcellus Shale streams. While on the road I interview local food producers, including those with backyard garden produce stands, truck gardens, chicken coops, goats and cows, geese and turkeys, and beehives to determine changes in production between Marcellus Shale and non-Marcellus Shale operations.*

Requirements for Students: The student who participates in this research should have a keen interest in Pennsylvania small farms, forests, streams and rivers, how crucial they are to our sustainable water and food supply, and the effects that natural gas drilling may have on their future. It is cold and dirty work that could include overnight travel, or could be limited to local day trips, depending on the student's schedule. The ideal student would have willingness to attain a working knowledge of basic water chemistry, creating spreadsheets, using GPS to log altitude, latitude and longitude, field collection techniques, and reading maps, as well as organizational skills, video documentation skills, and a willingness to listen to people talk.

Contact Information:

Faculty Member Name: Michele (Shelly) Grinar
Faculty Member Email: mmg17@psu.edu
Faculty Member Office Phone: 484-744-5825
Faculty Member Office Location: 239 Woodland

Chemistry

Investigation into the synthesis of white lead pigment

Summary of Research Project: *The synthesis of white lead pigment, basic lead carbonate, has been practiced for thousands of years. An investigation into the mechanism of the synthesis of white lead pigment will be conducted through a literature review and selective syntheses based on this review.*

Contact Information:

Faculty Member Name: Dr. Kevin Cannon
Faculty Member Email: kcc10@psu.edu
Faculty Member Office Phone: 215-881-7468
Faculty Member Office Location: 314 Woodland

Chemistry

Oxidative Rearrangement Reactions

Project Description: *Our research focuses on developing new methods in organic synthesis and applying them to synthesize useful organic molecules. Current projects include: 1) investigation of new conditions for oxidative rearrangement reactions involving sulfur-containing molecules and 2) application of new and established methods to synthesize novel sulfur-containing polymers.*

Student Requirements: Students must have successfully completed organic chemistry laboratory (CHEM 213). Students currently enrolled in CHEM 210 may also be considered. Research in organic synthesis is time consuming. Students must be willing to dedicate 4-6 hours a week for laboratory work.

Contact Information:

Faculty Member Name: Dr. Ahmed Nuriye
Faculty Member Email: auy3@psu.edu
Faculty Member Office Phone: 215-881-7973
Faculty Member Office Location: 226 Woodland

Computer Science

Team Activity Recognition Using Kinect Depth Map and Optical Images

Summary of Research Project: *Understanding of Group Activities (GA) involving humans and objects have significant applications in civilian and military domains. The process of understanding GA is typically involved with spatiotemporal analysis of multi-modality sensor data. Video imagery is one popular sensing modality that offers rich data. However, making sense out of video imagery is a real challenge. In this research work, we would demonstrate applications of optical and Kinect imagery data for characterization of indoor group activities. Technical details of imagery techniques implemented for detection, tracking, and characterization of atomic events will also be investigated.*

Requirements for Students: 1. working knowledge in any programming language (MATLAB or python or C# or C++) or an aptitude for learning a programming language; 2. interest in learning fundamentals of data science and machine learning.

Contact Information:

Faculty Member Name: Dr. Vinayak Elangovan
Faculty Member Email: vue9@psu.edu
Faculty Member Office Phone: 215-881-7852
Faculty Member Office Location: Rydal 212

Engineering (Mechanical, Biomechanics)

Is there a link between walking variability and our risk of falling?

Summary of Research Project: *Falls are a very common complication of stroke and often result in injury and reduced quality of life. Fall risk is correlated with increased variability in stride duration, which in turn is caused by variability in leg joint movements. Since changes in temporal parameters occur due to changes in joint movements, leg joint variability may provide valuable information about fall risk. Joint variability has been parameterized for young, healthy adults walking at their self-selected speed but not for other populations. The goal of this project is to determine how stroke status and walking speed affect joint variability. Joint variability can be characterized using a type of mathematical function called Fourier series and Gaussian (normal) distributions. Using existing experimental gait data for stroke patients and speed-matched healthy individuals collected in a clinical gait lab, we will determine how the joint variability changes for people walking at different speeds who have and have not had a stroke. Students will learn about human walking biomechanics, about how stroke affects walking, and some numerical analysis techniques to quantify aspects of walking – such as stability. This project will involve analysis of gait data on the computer and may extend to running subsequent analyses as well as possibly developing some additional experimental data and analytical approaches to further understand how variability is related to falling.*

Requirements for Students: An interest in human walking biomechanics. Ability to use computers to analyze data (specific skills will be taught, but there will be considerable computer use involved). Attention to detail.

Contact Information:

Faculty Member Name: Dr. Mukul Talaty
Faculty Member Email: mxt103@psu.edu
Faculty Member Office Phone: 215-881-7916
Faculty Member Office Location: 217 Rydal

Engineering (Mechanical, Biomechanics)

Understanding contribution of prosthetic stiffness to walking stability

Summary of Research Project: *The risk of falling for persons with lower limb amputation is higher than in the general able-bodied population. There are many choices in components for leg prostheses but a clear understanding between how the choices affect performance is missing. Literature indicates there is a correlation between prosthetic stiffness and gait performance. However, there has not been a direct study on how stiffness contributes towards amputee's stability. We use a custom neuromusculoskeletal computer model of walking to explore how foot stiffness affects walking stability. The custom model contains six joints, seven segments and oriented in sagittal plane with unilateral ankle muscles removed and replaced with a rotational spring representing an amputee with a prosthesis. This model captures many important features of how real amputees walk. We can run "experiments" to test out how different componentry or other interventions affect walking by running simulations on the model. In this project, we will apply growing random perturbations to the model and quantify the model's performance in varying stiffness prosthetic feet. We will analyze these experimental data to determine if a trend exists between prosthetic stiffness and stability. Continuing to refine and run experiments on this model could help to establish a more objective basis for clinicians to select and prescribe prosthetic components and may ultimately help to reduce the risk of amputee falls during walking.*

Requirements for Students: An interest in computer modeling, prosthetics, data analysis, running and possibly writing computer codes and analyzing data. No specific skills are required; most can be learned as needed during the project. A careful attention to detail and lots of perseverance will help a LOT!

Contact Information:

Faculty Member Name: Dr. Mukul Talaty
Faculty Member Email: mxt103@psu.edu
Faculty Member Office Phone: 215-881-7916
Faculty Member Office Location: 217 Rydal

Engineering (Mechanical, Biomechanics)

Suitability and Testing of 3D Printing Prosthetic Sockets

Summary of Research Project: *Prostheses allow persons with amputations to walk again after devastating injuries. A socket is the interface between a residual limb and the functional prosthesis. Conventionally, developing a test socket for a lower extremity prostheses is a time-intensive, cumbersome, and messy process. This project will explore recent developments in the use of 3D printing to assist the development of prosthetic sockets. The goal of this project will be to use actual patient image scans to develop real test sockets (SolidWorks) and to 3D print them. We will subsequently evaluate the quality of that test socket on the bench. Some aspects we will explore will be tolerances compared to the conventional polypropylene socket, compliance, mechanical strength, etc. We have access to a fully functioning (and staffed) prosthetic fabrication facility – complete with a 3D body scanner as well as a number of 3D printers and other mechanical fabrication equipment.*

Requirements for Students: Willingness to work hard and learn without being "taught". Ability to motivate themselves to work without hard-fast deadlines. Ability to do literature review and read journal articles to learn about recent developments in the field.

Contact Information:

Faculty Member Name: Dr. Mukul Talaty
Faculty Member Email: mxt103@psu.edu
Faculty Member Office Phone: 215-881-7916
Faculty Member Office Location: 217 Rydal

Electrical Engineering

LIDAR Assist Spatial Sensing

Summary of Research Project: *Echolocation enables people with vision impairment to comprehend the surrounding spatial information through reflected sound. However, this technique often requires substantial training, and the accuracy of echolocation is subject to various conditions. Furthermore, individuals who practice this sensing method must simultaneously generate the outward sound and process the received information. This work proposes and evaluates a conceptual framework for the LIDAR Assist Spatial Sensing (LASS) system, which intends to overcome these restrictions by obtaining the spatial information of the user's surroundings through a LIDAR sensor and translating the spatial information into stereo sound of various pitch. The stereo sound of relative pitch relays information regarding objects' angular orientation and horizontal distance, respectively, thus granting visually-impaired users an enhanced spatial perception of his or her surrounding areas and potential obstacles.*

Requirements for Students: Sufficient programming background

Contact Information:
Faculty Member Name: Dr. Yi Yang
Faculty Member Email: yzy1@psu.edu
Faculty Member Office Phone: 215-881-7565
Faculty Member Office Location: 316 Woodland

Aerospace Engineering

Prototype Demonstration of CubeSat via Weather Balloon

Summary of Research Project: *Miniaturization of satellite is considered a promising way to reduce the cost of doing science in outer space. At Penn State Abington, we will develop a prototype of CubeSat, a small satellite of the size of a grapefruit, and demonstrate its feasibility by flying to 20-km altitude -- a lower edge of space -- via weather balloon. This research project will pave a way to ultimately developing a space-rated hardware at Penn State Abington.*

Requirements for Students: This is a multi-disciplinary project involving different kinds of work: hands-on building, software coding, technical drawing, and tracking the device using GPS and radio. No one can do everything, the team should include students from variety of disciplines, skills, and interests. The team members may include students from freshmen to seniors. Relevant topics are aerospace/mechanical/electrical engineering, computer programming, and physics and space science.

Contact Information:

Faculty Member Name: Dr. Masataka Okutsu
Faculty Member Email: masataka.okutsu@psu.edu
Faculty Member Office Phone: 215-881-7562
Faculty Member Office Location: 217 Rydal

Mechanical Engineering

Muscle activation during passive leg drop

Summary of Research Project: *A StepMeter device has been developed to allow assessment of barefoot slip resistance. The device allows a seated subject's leg to be raised and dropped onto an inclined surface, allowing the heel to slip if the required coefficient of friction is greater than the available coefficient of friction. This device will allow us to quantify slip resistance of flooring surfaces for barefoot pedestrians.*

A question has arisen as to whether the subject's leg is really "passive" as it is dropped onto the test surface. If the subject's muscles are contracting, this may affect the measured slip resistance values. We wish to test whether a seated subject's muscles remain passive during a drop test.

For this project, students will become familiar with EMG (electromyography, the measurement of electrical signals from muscles), and will design and carry out an experiment to determine whether the leg muscles (specifically hamstrings, quadriceps and gastrocnemius) remain passive during a drop test, or to quantify the amount of muscle activity found.

We will test our hypothesis on a small (n=20) population of volunteers. Students will prepare the Human Subjects submission and consent form, will devise and test the protocol, collect and analyze data, and report results.

Contact Information:

Faculty Member Name: Dr. Marcus P. Besser
Faculty Member Email: mpb20@psu.edu
Faculty Member Office Phone: 215-881-7357
Faculty Member Office Location: 202 Rydal

Information Sciences & Technology, Computer Science

Virtualization for High-Performance Cloud Networking

Summary of Research Project: *Virtualization is expected to be the key attribute in future networking and cloud computing. However, the overhead introduced by virtualization brings in new challenges to high-performance networking. The objective of this project is to study how to improve virtualization performance for meeting the requirements of real-time networking and cloud computing.*

Requirements for Students: Students who have taken IST 220 (networking and telecommunications)

Contact Information:

Faculty Member Name: Dr. Qiang Duan
Faculty Member Email: qduan@psu.edu
Faculty Member Office Phone: 268-633-3317
Faculty Member Office Location: 311 Rydal Executive Plaza