Poster Listing, 2018

U: Undergraduate
G: Graduate
FA: Faculty Advisor
F/P: Faculty or Practicing Professional

Poster #	Level	Engineering Projects: Title	Authors	Organization
1	U *FA*	Combustion Characteristics of Heptane/iso-butanol Mixture Droplets	A. Dalili, J.D. Brunson, *C.T. Avedisian*	Cornell University
2	U *FA*	Physical, Chemical, and Compositional Properties of Calcium Phosphates Change During the In-vitro Conversion of ACP to HA	Cassidy Mileti, Erik A Taylor, *Eve L Donnelly*	Cornell University
3	U	Synthetic Tongue: Measuring Complex Solution Composition via Multi-Material Hydrogel Electrodes	Alice Huang	Cornell University
4	U G *FA*	The Role of Tetraspanin Proteins in Muscle Stem Cell Function	Paula M Fraczek, Sharon Soueid-Baumgarten, Kun Ho Kim, *Benjamin D Cosgrove*	Cornell University
5	U	Flexible self-Organizing Robotic Modules (FORMbots)	Daniel S Kim, Claire L Chen, Kirstin Petersen	Cornell University
6	U	Configurable Register File Design for Flicker Processor	Adam Wojciechowski, Benjamin Roberge, David Albonesi	Cornell University
7	U	Autonomous System Design for Domestic Robotic Furnishings	Liheng Li	Cornell University
8	U	Geriatric Smart Assistant	Matthew Huber, Mitch Fronczak, Ben Nesbit, Xi Chen	SUNY Buffalo State College
9	U	Design of A Smart Home Security and Renewable Energy System Based on Internet of Things	Xi Chen Weng Yu	SUNY Buffalo State College
10	U	Who is Watching...Little Brother!	Katherine S. Arriola, John Dipasquale, DeMetrius Jennings, Donald Taggart, Michael Vangelista,	SUNY Buffalo State College
11	G	Don't Touch That Button	Alexander S Rauen, Giovanni M Villanova, Ahmed Alkhanbashi, Sourou Okouta	SUNY Buffalo State College
12	F/P	Experimental Demonstration of Temperature Control	Qing Hao	SUNY Buffalo State College
13	U *FA*	Understanding Solvent Blend Packing Around Lead Ions for Solar Cell Processing	Jason D Liu , Blaire Sorenson, Henry Herbol, *Paulette Clancy*	Cornell University
14	U	A Systems Engineering Approach to Microgrids and Transactive Energy	Radomir Pupovac, Andrew Ludtka , Kyle Nadolinski	SUNY Buffalo State College
15	U G	Reynolds Number Study of Mini Vertical Axis Wind Turbines	Timnah Zimet, Christopher LaBruna, Cristian X Alonso, Joshua Williams	Cornell University

16	U	AguaClara: Providing Safe Water on Tap	Sidney Lok, Janak Shah	Cornell University
17	U G *FA*	Optimization of Woodchip Bioreactors	Lily Falk, Matthew C. Reid, *Phillip M. McGuire*	Cornell University
18	U *FA*	Elucidating the Mechanism of von Kossa Staining of Calcium Phosphate Minerals	Chandreyee Mukherjee, Netta A Vidavsky, *Lara A Estroff*	Cornell University
19	G *FA*	Coded Aperture Ranging	Michael Wang, *Dmitry Savransky*	Cornell University
20	U	A Study of Scaling in Laboratory Fault-Like Systems	Juan I Meriles	Cornell University
21	U	Water Analogy of Electricity: Using Technology to Illustrate Concepts	Austin Snyder, Andrew Graziano, Percy Oblitas, Brian Hess, Zachery O'Connell, Brandon Parker, Severin Smith, Alexis Vasquez	SUNY Buffalo State College
22	U	Phase Transformation in Sodium-Ion Cathodes	Raghav Kumar	Cornell University
23	U *FA*	Creation of a Graphic User Interphase for Rigid Registration with CryoSTEM Data	Emily N Waite, Benjamin H Savitzkya, Ismail El Baggaria, *Lena F Kourkoutis*	Cornell University
24	U	Optical Characterization of III-Nitride Deep UV LEDs Using Photoluminescence Measurements	Vineeta Muthuraj	Cornell University
25	U *FA*	Data Synthesis to Explore Pesticide Contamination in the Water Resources of Honduras	Anya K Sherman[1], Natasha M Ramos Padilla[1,2], *Damian E Helbling[1]*	1: Cornell University 2: University of Puerto Rico - Mayagüez
26	U	Modeling Heat Transfer in Biomass Stoves	Keith Works	Cornell University
27	U *FA*	Genome-scale Metabolic Modeling of Gut Microbiota in the Fly Gut	Joan Song, *Nana Ankrah*	Cornell University
28	U FA	Adaptive Solutions to Medical Problems	Zack Salim, Jennifer Barker, Olivia J Spellicy, Jeremy M Petrotto, Megan T Yoerg , Devon Oship, Dominique Hickson, Ian Kaminer, Corey T Ropell, Sriram Subramanian, *Kris Schindler*	University at Buffalo
29		U *FA*	Kimberly Hemmerling, *Eve Donnelly*	Cornell University
#	Level	Engineering Education: Title	Authors	Organization
30	G	Built to Stand! Introducing Kindergarteners to the Fundamentals of Structural Engineering	Justyna W Kosianka, Yolanda C Lin	Cornell University
31	G	The Earthquake Engineering Research Institute's Undergraduate Seismic Design Competition:	Yolanda C Lin Daniela M Martinez Lopez	Cornell University

		An Organizer's Perspective		University of California, Berkeley
32	G *FA*	Effective Implementation and Utilization of Student Surveys to Enhance Student Learning and Course Instruction	Jared D Smith, *Jery R Stedinger*	Cornell University
33	U	Katchi: Korean Language Learning Game	Nicholas Teo	Cornell University

Combustion Characteristics of Heptane/iso-butanol Mixture Droplets

A. Dalili
J.D. Brunson
C.T. Avedisian (Faculty Adviser)

Cornell University
Sibley School of Mechanical and Aerospace Engineering

Abstract

The heptane/iso-butanol binary system represents one of the simplest conceivable mixtures that could be envisioned as a transportation fuel surrogate. Heptane, a prominent component of gasoline, captures many of the relevant combustion kinetics of gasoline while iso-butanol is representative of a biofuel additive. The study of this binary system is of particular importance when it comes to understanding the resultant effects of a standard transportation fuel and biofuel merger. The following study presents the burning characteristics of binary blends of heptane/iso-butanol in an environment which minimizes convective effects and leads to spherical combustion. Droplet burning characteristics are obtained through image analysis of small-diameter droplet combustion in free-fall experimentation performed at room temperature air and standard atmospheric pressure; such conditions promote spherical symmetry during combustion which is necessary for subsequent comparison with combustion modelling. The evolution of droplet and flame diameters are determined from comprehensive computer analysis of image data for heptane/iso-butanol mixtures of 50/50, 70/30, and 90/10 volume fractions for droplets ranging between 0.5 and 0.6 mm in diameter. The results of this study are then compared to the results of pure heptane and pure iso-butanol to note the change of burning properties with respect to the mixture fractions. It is further noted that the presence of iso-butanol in these binary mixtures strongly reduces soot formation when compared to pure heptane.

Poster title: Physical, Chemical, and Compositional Properties of Calcium Phosphates Change During the In-vitro Conversion of ACP to HA

Cassidy Mileti
Erik A Taylor
Eve L Donnelly (Faculty Advisor)

Cornell University

Abstract
Raman spectroscopy can be used to characterize the physical chemical properties of native bone mineral. This study aimed to characterize the pure synthetic hydroxyapatite (HA) samples in which crystallinity was modulated by varying reaction time. The ultimate goal of this study is to validate the FTIR and Raman carbonate:phosphate ratios and contribute to the fundamental understanding of the crystallinity measures. Raman spectroscopy was used to characterize the physical chemical properties by measuring the crystallinity and the carbonate:phosphate ratio, while X ray diffraction was used to characterize changes in crystal size. It was found that the conversion from amorphous calcium phosphate to poorly crystalline HA occurs between reaction times of 60 and 120 minutes. Additionally, changes in Raman crystallinity were highly correlated to changes in crystal size (c-axis crystal length $p=<.0001$, $R^2=.9596$; a-axis crystal thickness $p=<.0001$, $R^2=.9656$).

Poster title: Synthetic Tongue: Measuring Complex Solution Composition via Multi-Material Hydrogel Electrodes

Alice Huang

Cornell University

Abstract

Hydrogels are hydrophilic gels whose chemical composition allows them to absorb a certain amount of solvent depending on the thermodynamics of the surrounding solution. The purpose of this project is to create a complex chemical sensor array out of multiple electrodes of varying hydrogel materials. Previous research has shown that individual compositions of hydrogels exhibit high levels of volumetric change in response to specific stimuli such as pH level or sugar concentration. However, any single hydrogel composition is a poor sensor for complex solutions (i.e. solutions that contain multiple solutes) owing to the complex response that cannot be easily modelled. We intend to solve that problem by collecting the conductive responses of multiple hydrogel chemistries (n = 5) to selected stimuli and convoluting the data into a meaningful signal. We have chosen five stimuli (sucrose concentration, NaCl concentration, pH, ethanol concentration, temperature) that reflect some of the sensing capabilities (sweetness, saltiness, sourness, astringency, temperature) that a human tongue exhibits, with the final goal of creating a synthetic tongue. Data was collected for five hydrogel compositions in the five different stimuli with seven replicates per solution state. Current research focuses on photopolymerizing additional hydrogel materials and measuring their responses in complex solutions where all five stimuli vary simultaneously. Working with collaborators in computer science, we intend to create a convolution algorithm from the initial data set that can be applied to any arbitrary complex solution.

Poster title: Dissecting Muscle Stem Cell Functional Variation Based on Tetraspanin Expression

Paula M Fraczek
Sharon Soueid-Baumgarten
Kun Ho Kim
Benjamin D Cosgrove (Faculty Advisor)

Cornell University

Abstract
Muscle stem cells (MuSCs) are instrumental in the repair of injured skeletal muscle tissue. With age, however, their ability to renew damaged tissue is drastically diminished, in part due to increasing functional variation with aging. This sharp decline in their function leads to muscle loss and regenerative insufficiencies in elderly populations. Prior reports indicate that tetraspanin proteins provide useful markers to delineate MuSC functional variation. Here, we aimed to elucidate the role of the tetraspanin proteins in the determination of muscle stem cell fate and function by exploring how their distinct different levels of expression affect the proliferative and self-renewal capacities of cells within each subpopulation. We isolated MuSCs from injured adult (4 month-old) and aged (24-month old) mice, divided into three groups determined by their tetraspanin expression (high, mid, or low), and cultured under various conditions to quantify the extent of proliferation in each subpopulation. We measured MuSC proliferation and differentiation status through a combination of bioluminescence imaging and fluorescent microscopy to quantify cell numbers and the expression of the muscle transcription factor Pax7. We found that an intermediate level of tetraspanin expression resulted in significantly higher cell proliferation during the culturing period, suggesting that this population is enriched for cell with MuSC self-renewal function.

Poster title: Flexible self-Organizing Robotic Modules (FORMbots)

Daniel S Kim
Claire L Chen
Kirstin Petersen

Cornell University

Abstract

We present FORMBots, a novel type of soft modular robot system. Two thriving sub-areas of robotics are soft robotics and modular robotics, which each have their own strengths and weaknesses. Soft robots can conform to the environment and typically use relatively simple and safe methods of actuation, but tend to be too slow for realistic use. Modular robot systems consist of a group of robot modules that reconfigure by selectively attaching and detaching from each other. These systems promise versatility and robustness, but often require very complicated modules that are difficult to manufacture.

Our work combines the benefits of soft robotics and modular robotics to create a robust, low-cost system capable of individual modules working as a group to perform complex tasks autonomously and efficiently. In our poster, we introduce a hardware and firmware platform for the system. Each module is a ring-shaped flexible printed-circuit-board that contains all necessary power, control, and communication circuitry, as well as means of actuation. Each module carries its own on-board power. The modules selectively attach and detach via electro-permanent magnets (EPMs) that can be switched on and off by the on-board microcontroller. Decentralized self-reconfiguration requires local communication, which the modules achieve by sending short messages between connected EPMs. To accompany this new hardware, we have also written firmware to allow a user to control the high-level behaviors of each module.

Poster title: Configurable Register File Design for Flicker Processor

Adam Wojciechowski
Benjamin Roberge
David Albonesi

Cornell University

Abstract
The objective of the research project is to develop a superscalar processor architecture which runs sequential programs with increased energy efficiency. Increased energy efficiency is highly sought after in the microprocessor industry, given the strict power budgets of microprocessors. With this goal in mind, our processor utilizes an adaptable architecture that reduces the power consumption of resources which are not performing useful work at given times through power gating.

For our specific part of the project, we implement an adaptable processor register file whose size can be changed, depending on the number of registers actually needed for specific portions of the running program. The baseline register file has 128 registers. However, if, for example, only 64 registers are being used by a given program, we would like to power-gate the other 64 unused registers, effectively turning them off. However, there is a trade-off associated with power-gating. The finer the granularity at which registers can be gated, the larger the power overhead of the logical gating mechanism and power gating transistors (collectively called the power-gating control). To overcome this problem, we propose to “turn off” multiple registers with a single power gating control. To do this, we divide the register file into equal-sized blocks (e.g., halves or quarters) and use one power-gating control for an entire block. With this approach, multiple registers are “turned off” with a single control, which can substantially improve the net power savings over single-register granularity. We compile our design assuming different register block sizes (granularities) and run tests to assess the tradeoffs in power savings, area increase, and performance impact.

Poster title: Autonomous System Design for Domestic Robotic Furnishings

Liheng Li

Cornell University

Abstract

The project "Home+" is a suite of inter-networked and distributed robotics components integrated into domestic environment mainly for the purposes of aiding the elders or disabled and healthcare facilities. Our previous prototypes of two robots were manually controlled by the users via a remote controller and were unable to perform the tasks by themselves. Thus, my major objective from June to August in 2017 was to research on higher-level intelligence system implementation to augment the existing functionalities of the current model.

The working mechanism of the robot that I envisioned is as such: a user provides verbal commands to the robots by naming the item he/she wants to fetch, and the robots will start navigating through the domestic environment while performing real-time object detection to ascertain whether the items nearby include the specific target. After the robot finds the item, it will fetch the item using granular-jamming end effectors and then carry the item back to the user.

To achieve the functionality envisioned, the design pattern of this autonomous system is broken into the following three high-level categories: voice control, object detection, and navigation. I selected Raspberry Pi as the central module that connects every component of the project. For voice control, I connected Raspberry Pi with Amazon Echo®, which accepts user commands and transfer it to the board. To perform object detection, I used the Tensorflow platform to take in a snapshot of the surrounding environment and identify all items within the image based on an embedded model that includes all available items known. As for navigation, which is in progress, the approach is SLAM (simultaneous localization and mapping), a computational problem of constructing and updating a map of an unknown environment while keeping track of the robot's location within it at the same time.

Poster title: Geriatric Smart Assistant

Matthew Huber
Mitch Fronczak
Ben Nesbit
Xi Chen

SUNY Buffalo State College

Abstract

Continuing medical advancements have led to longer life spans and a growing elderly community across the world. As the elderly community continues to grow while trying to remain independent, there is a growing concern of serious injury from falling. To alleviate the fear that something will happen to them when left unattended, a device can be created to monitor their condition and securely locate them without leaking any sort of private patient data, allowing them to act independently. The priority of the Geriatric Smart Assistant will be to monitor the patient's Galvanic Skin response to measure the amount of pain a user is experiencing coupled with a 3-axis gyroscope as a sensor to detect falls. Additionally, the GSA could alert the proper authorities in the event of an emergency or accident.

Using a wireless transmission to complete the GSA will be accomplished with a combination of a few break-out-boards, working in conjunction with both an Arduino MCU and a PIC mid-level MPU in the form of a, microchip PIC MCU, wi-fi module, and BMICs.

The benefit of the GSA is that it is non-invasive and will not inhibit users from doing what they need to do on a daily basis. A small on-site server will be used to store output data, which can be accessed by family members for first response, and in more serious cases, to contact emergency services.

Poster title: Design of A Smart Home Security and Renewable Energy System Based on Internet of Things

Xi Chen
Weng Yu

SUNY Buffalo State College

Abstract

This project introduces a smart home system that includes several embedded microcontroller (MCU) systems for supervising lighting and cooling units, performing real-time monitoring of home environment, and securing the home through fingerprint recognition. The system can also direct efficient use of electricity by bringing in solar energy when available. MCUs are directly connected to home sensors to gather information. The MCUs can remotely transmit home information to a GSM module when it decides that a text message needs to be sent out. The MCUs can also transmit information wirelessly to a Raspberry Pi microcomputer which can then upload the information to an App that can be used by the homeowner to monitor and control the home environment. To keep the home safe from burglars, a fingerprint sensor and coded keypad prevents entry without proper touch ID or preset code. If three unmatched entry attempts are made, entry will be temporarily locked for three hours or until the owner resets the system. All emergency circumstances will trigger the GSM module to send a text to the homeowner. For example, a text message will be sent when the concentration of the combustible gas exceeds the user settable limit. The system will provide a low-power mode, including lighting and cooling adjustments to conserve power when no one is home. The solar panel control is based on the principal characteristics of photovoltaic power generation systems. The electricity converted by the solar panel is stored in rechargeable batteries. It will continue delivering power to supply the home appliances in the proper situation.

Poster title: Who is Watching...Little Brother!

Katherine S Arriola
John Dipasquale
DeMetrius Jennings
Donald Taggart
Michael Vangelista

State University of New York College at Buffalo

Abstract

One thing that will remain a problem for every college campus is safety. There are some measurements taken to improve campus safety, such as the Blue Light Kiosks in Buffalo State College Campus.

The Little Brother's project objective is to enhance the current Blue Light Telephone System by improving campus surveillance while being cost-efficient. The components of the project consist mainly of Raspberry Pi development board and camera. Little Brother will include additional features which may include a pan/tilt function, a motion sensor, and rotation capability to assist in monitoring activity on campus. Each Blue Light Kiosk currently contains a red emergency button, a microphone, a dialing pad and Blue Light that is located on top of the kiosk. Updating the school's surveillance would require budgeting and planning; Little Brother will be developed as a bench-top prototype for another team in the future to implement into the campus kiosks. One of the constraints is the learning curve required to program the Raspberry Pi. The project needs to wirelessly transmit data captured from the camera to servers located in any one of the buildings on campus. Importantly, the data will be transferred wirelessly while following Buffalo State's Video Surveillance Policy. The University Police Department will then have access to the data. After gaining access they can use the footage acquired to handle the situation. Little Brother's capabilities are based on whether it will be able to stream data, sending the footage to the nearest server on campus. The Manager of Operations and Network will have access to video and will be able to see it in the required H.264 format.

Poster title: Don't Touch That Button

Alexander S Rauen
Giovanni M Villanova
Ahmed Alkhanbashi
Sourou Okouta

SUNY Buffalo State College

Abtract
The purpose of this design project is to work together as a collaborative group to produce a fully automated projector screen often seen in educational environments. In order to accomplish this task the problem was first identified: the use of push button operated projector screens can be somewhat distracting to the educational environment because often remotes for these devices are lost or misplaced. A group of four students along with their instructor proposed the idea of accomplishing the automation of the retractable projector screen though use of light-sensing devices. With such devices, the screen apparatus will read a signal in the form of light from the projector to determine if the screen should retract (go up) or come down. As long as the projector device is outputting a video signal, the screen will stay down regardless of ambient conditions in the room. For the automatic mechanization of the projector screen to occur, a DC motor was coupled directly to an existing screen device, and the screen's vertical position is determined though use of both a DC shaft encoder and a limit switch. The various inputs and outputs defined in the design scheme require a control device. A programmable Arduino device was incorporated to allow complete automation. Within the Arduino, a coded program reads ambient light conditions though various sensing photocells and projector on/ off states though the photodiode's reading. If desired conditions are met, the Arduino will send a signal to power the screen in the up or down direction and the screen will keep retracting up or down until a limit switch is reached or an encoder value specified in the program is met. The prototype will demonstrate that the light induced projector screen can create an effortless and distraction free learning environment.

Poster title: Experimental Demonstration of Temperature Control by Arduino® System

Qing Hao

SUNY Buffalo State College

Abstract

This poster describes the design, construction, and the programming process for an Arduino control system which can monitor and automatically maintain the temperature of thermal systems. A temperature sensor is installed in board, controlling the environment temperature by a closed loop control system. When the temperature is higher, a fan will start to speed up, increasing the heat transfer coefficient; and when the temperature is lower, a light bulb will be switched on to heat up the temperature. The control system is accomplished by Elegoo (Mega2560) Arduino programming. This project is an experimental demonstration for convection heat transfer and students can calculate the time for the thermal switch to cool down by theory and compare to this demonstration.

Poster title: Understanding Solvent Blend Packing Around Lead Ions for Solar Cell Processing

Jason D Liu
Blaire Sorenson
Henry Herbol
Paulette Clancy (Faculty Advisor)

Cornell University

Abstract

Hybrid organic inorganic perovskites (henceforth, perovskites) are promising materials for solar cells. Their efficiencies rival conventional silicon based-cells, but they are significantly cheaper to produce because they are made using room-temperature solution processing methods. However, the vast amount of combinations of possible cations, halides, and solvents used to produce these materials is largely unexplored, except by trial and error experimentation.

We focus on analyzing the solvation of the metal (lead) halide as the first step in the production of the perovskite thin film. We use a metric called a UMBO, or Unsaturated Mayer Bond Order, that describes the dative bonding of the most polar atom in the molecule. The UMBO models the solubility for lead halides in a pure solvent and can be easily obtained via computational methods. However, it is not at all clear how to extend this metric to solvent blends. From molecular simulations, we have found that the numbers of each type of solvent molecules around a lead ion does not necessarily change linearly as the overall composition of the solvent changes. We suspect that both the energy of the interactions between the solvent and the lead ion and the geometry of the solvent molecules impacts the overall interactions between lead and the solvent blend. Understanding how to quantify the interactions between solvent and solute is also critical to other problems, such as metal etching or electrolytic cells. As a result, we are working with experimental collaborators at UCLA, using similar approaches, to examine why metal oxides etch much faster than elemental metals, and the Hanrath group at Cornell, to see how the charge applied to an electrochemical cell affects the composition of the reduction products. We are making good progress on these projects and should be ready to publish by the end of the summer of 2018.

Poster title: A Systems Engineering Approach to Microgrids and Transactive Energy

Radomir Pupovac
Andrew Ludtka
Kyle Nadolinski

SUNY Buffalo State College

Abstract

Power Systems is a category of Electrical Engineering which cannot be cheaply experimented on and is difficult to understand. A microgrid at SUNY Buffalo State has been expanded to include photovoltaic power sources, variable loading represented by a variable frequency drive (VFD), controlled by a human machine interface (HMI) through a programmable logic controller (PLC), as well as microprocessor based relays for protection, monitoring, and control. Several types of Schweitzer Engineering Laboratories (SEL) relays are used to protect different segments of the microgrid. Three power sources are included within the grid, a StecaGrid 3203 power inverter is used to simulate a solar array along with, a doubly-fed induction generator (DFIG) to simulate a wind turbine, and a synchronous generator. The renewable sources have the ability to load solar and wind maps for better simulations of real world situations. The assembly and operation of this system tests the ability of students to use concepts from control, digital, and power systems courses to assemble a functional grid with state-of-the-art devices which provide opportunities for greater expansion and applications of the microgrid. Knowledge from each of these systems are tied together to achieve a system where both graduate and undergraduate students can test and experiment with. This expansion allows for graduate students to test multidisciplinary energy transfer economic problems through microgrid operations. These efforts could influence our current methods where energy is traded through the market. For example, a consumer may choose to receive all their household energy demands from renewable sources. Overall, this expansion further enhances the knowledge and ability to experiment within systems engineering concepts and provide a path for future innovation and improvements beyond undergraduate research.

Poster title: Reynolds Number Study of Mini Vertical Axis Wind Turbines

Timnah Zimet
Christopher LaBruna
Cristian X Alonso
Joshua Williams

Cornell University

Abstract

The goal of this research team is to extract energy from a mini vertical axis wind turbine array suitable for an urban setting where conventional large-scale systems are not feasible. Large-scale power production facilities are often located far from urban centers that use the most power, resulting in losses over long-distance transportation of power, so energy production within an urban environment could prove incredibly useful.

An ideal turbine design will have high power output, be self-starting, and look aesthetically pleasing. For small turbine sizes we find that the fluid mechanics are quite different from standard turbines, and so the airfoil blade design needs to take into account different effects on lift and drag of the airfoils. Varying blade shapes and sizes have been tested in the past in the research group. However, it is useful to generalize results of turbine performance using non-dimensional parameters.

For this reason, the project this semester focuses on a Reynolds number study, in which the Reynolds number is defined as function of blade chord length, wind velocity, tip speed ratio at maximum coefficient of power, and kinematic viscosity. The Reynolds number is varied by changing the turbine radius, chord length, and wind speed. An iterative process is used to vary the wind speed until the desired Reynolds number is achieved for each turbine configuration.

The first finding is that increased Reynolds numbers result in higher power coefficients, with a wider variation in power coefficient for lower chord to diameter ratios. The second finding is that, for a given Reynolds number, the maximum on the power curve occurs at a higher power coefficient and lower tip speed ratio as the chord to diameter ratio increases.

Poster title: AguaClara: Providing Safe Water on Tap

Sidney G Lok
Janak H Shah

Cornell University

Abstract

Since 2005, the Cornell Engineering AguaClara program has been conducting research, inventing new technologies, creating open source designs, and working with partner organizations who implement municipal water treatment plants for communities. Despite the critical role of water treatment technologies in healthy societies, it is not yet possible to predict treatment plant performance or optimally design main processes. More than 80 student researchers are working to develop a better understanding of flocculation, floc blankets, sedimentation, and porous media filtration to improve treatment systems.

Research is conducted by undergraduate students in Cornell University's AguaClara program as part of the team's RIDE innovation system. Student teams collaborate with partner organizations to Research, Invent, and Design improved water treatment technologies and then to Engage with implementation partners to build the plants and assist communities with installation, maintenance, and operation of water treatment systems.

The team is centered around a peer-based learning system, which empowers students to learn by doing rather than by being lectured to. Hands-on research and leadership roles help students acquire valuable skills applicable to their future careers. The entire team is managed by peer leaders who advise other students, create training materials, and handle administrative tasks.

AguaClara students have the rare opportunity to engage in meaningful work while attending university full-time. Fourteen AguaClara water treatment plants provide safe water to approximately 70,000 people, two more plants are under construction, and multiple plants are in the design phase. Students see the impact their work is making through yearly trips to the communities the team's plants are serving and communicate with stakeholders to assess and evaluate their evolving goals and projects. AguaClara teaches its students the social side of engineering and just how important it is to not just handle calculations, but understand how engineering and research can impact the world.

Poster title: Optimization of Woodchip Bioreactors

Lily Falk
Matthew C. Reid
Phillip M. McGuire

Cornell University

Abstract
Nitrous oxide is a potent greenhouse gas, accounting for 5% of total emissions in the United States. Woodchip bioreactors are a practical and effective form of green infrastructure for treating nutrient runoff from nonpoint sources. The treatment involves denitrification with nitrous oxide as an intermediate. During denitrification, when the rate of production of nitrous oxide exceeds the rate of consumption, the excess nitrous oxide is released into the atmosphere. Our goal is to better understand nitrate and nitrous oxide reduction rates, and inhibition by low oxygen concentrations in woodchip bioreactors to engineer a system that will release less nitrous oxide.

Poster title: Elucidating the Mechanism of von Kossa Staining of Calcium Phosphate Minerals

Chandreyee Mukherjee
Netta A Vidavsky
Lara A Estroff (Faculty Advisor)

Cornell University

Abstract

The von Kossa (VK) method is a pathological staining method routinely used to identify phosphate-containing minerals in tissues such as bone, cartilage and pathological lesions. VK staining is also commonly used to assess in vitro cell culture models of calcification to demonstrate the successful deposition of minerals by cells. VK staining involves adding silver nitrate ($AgNO_3$) to the mineral, then exposing the entire set up to UV light for 60 minutes after which the minerals are treated with sodium thiosulfate ($Na_2S_2O_3$). The $AgNO_3$ is added as phosphate containing minerals will turn yellow due to the formation of silver phosphate but non-phosphate containing minerals will remain unchanged in color. Although tissues may contain several types of phosphate minerals (such as apatite, whitlockite and amorphous calcium phosphate) with many possible ion substitutions, there is currently no way to distinguish between different types of phosphate-containing minerals simply by looking at the von Kossa stain. The aim of this research is to gain a deeper mechanistic understanding of the von Kossa staining, and to correlate between the staining color and the type of mineral present. Five biologically-relevant minerals (amorphous calcium phosphate, hydroxyapatite, whitlockite, magnesium phosphate and calcium oxalate monohydrate) were stained using VK staining. The mineral properties were monitored throughout the entire VK staining process (start of the experiment, after $AgNO_3$ added, at 5, 10, 25 and 60 minutes of UV exposure during 60 minutes of UV exposure, and after $Na_2S_2O_3$ was added). As expected, there was a change of coloration from white to yellow due to formation of silver phosphate upon addition of silver nitrate to the minerals and there was formation of an insoluble black compound upon exposure to UV light. Interestingly, the different types of minerals showed different colors: whitlockite was dull yellow, magnesium phosphate was black, hydroxyapatite was a mix of yellow and black, and amorphous calcium phosphate was greenish-yellow. Also, calcium oxalate, which is considered to be a negative control for VK staining, was stained in black. By correlating staining color to a type of mineral, the VK stain could be made a more robust test to differentiate

between various types of calcium phosphates. The VK staining can then potentially be used to identify the type of calcium phosphate without relying on additional testing.

Poster title: Coded Aperture Ranging

Michael Wang
Dmitry Savransky (Faculty Advisor)

Cornell University

Abstract

Coded Aperture Ranging (CAR) is an imaging technique that can extract both depth information and an all-focused image from a single captured image by making a minor modification to a conventional camera system. Unlike other camera systems that require additional apparatus for depth perception, CAR systems require only a single camera and a partially masked aperture. The masked aperture enables the generation of a depth map just from a single image. The depth map can then be used to create an all-focused image from the original blurred image. This technique has applications in systems where size and weight constraints are paramount and image depth map generation is necessary.

The main goal of this research project is to demonstrate the CAR technique in a lab environment and explore the applications of this technique in relation to spacecraft vision-based estimation. Specific tasks include manufacturing an aperture mask based on an existing design, integrating the mask with a Commercial-off-the-Shelf lens, obtaining and analyzing data in a lab setting using existing software, and making improvements to the system as necessary. The next step is to explore the applications of the CAR technique, such as estimation of the size of foreign objects such as small asteroids and Martian rocks, vision-based relative localization of a spacecraft using landmarks such as asteroids and Martian rocks, relative position and orientation estimation for formation flying spacecraft, and possibly improvements to conventional stereovision camera systems. A secondary goal for this project is to minimize the form factor of a CAR system, making it suitable as a sensor for small spacecraft. This goal is becoming more and more relevant with the advent of CubeSats, which are satellites roughly the size of a shoe box.

Poster title: A Study of Scaling in Laboratory Fault-Like Systems

Juan I Meriles

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Abstract

For research in earthquake mechanics, one of the largest issues is the scaling of a laboratory-based results. To create a scaled model of an earthquake, researchers would like to scale material properties to account for differences in length and time scales. One cannot scale the structure and fabric of rock, so it is important to understand how completely changing the material--from rock to plastic, for example--affects the mechanics of laboratory-generated earthquakes. Experiments were performed on a both a .75 m sample composed of plastic, and a 3 m sample composed of granite. To better compare the plastic and the rock, we measured h∗, the size of the nucleation zone in the fault. Depending on the sample size relative to the nucleation zone size, different types of slip events have been observed. h* depends on the shear modulus, G, which is an order of magnitude smaller in plastic than in the rock. This makes the nucleation zone size h* smaller, making the small plastic fault act like the larger rock one. Many parameters measured on the small fault were found to correspond directly to the larger fault size, and appear to have similar mechanics. These included the amount of fault slip and the slip rate, found with eddy current sensors. Furthermore, a similar correlation was found in the frictional coefficient with respect to time of slip, including small precursor events found in both samples. Though the scaling is not 1 to 1, the similarities in trends and values found in mechanical slip properties of plastic compared to those in larger granite, make plastic a potentially viable scaling material. This research also validates h∗ as a valid scaling parameter and presents the stiffness of the overall system as a potential scaling parameter.

Poster title: Water Analogy of Electricity: Using Technology to Illustrate Concepts

Austin Snyder, Andrew Graziano, Percy Oblitas, Brian Hess, Zachery O'Connell, Brandon Parker, Severin Smith, Alexis Vasquez

SUNY Buffalo State College

Abstract

The concept of electricity is not the easiest one to grasp. Between current carrying conductors and passive components, to electrically controlled elements, the theory can be somewhat difficult to understand. SUNY Buffalo State students designed and fabricated an innovative and interactive water analogy of a generalized electrical system. This portable system is designed to help students (ranging from fifth grade to first year college students) visualize and understand how basic electrical components and concepts work. Individual components behavior and their function within the complex circuit is the primary focus of the design. The project is realized through a network of transparent plumbing, electro-mechanical components (pumps, valves, pressure gauges, etc.), a programmable logic controller (PLC), a human machine interface (HMI), and a variable frequency drive (VFD). The primary focus of this project is to encourage young students into STEM education paths with emphasis on an intuitive understanding of electricity. The project involves much more sophisticated aspects dealing with control and information processing to operate the system that enhances the knowledge base of students involved in the design and development of the project. The project also benefits industry partners by allowing them to demonstrate advanced equipment and its capabilities in the area of industrial automation (modular PLCs, interconnection of sensors, wireless and wired sensor networks, and communication protocols among others).

Poster title: Phase Transformation in Sodium-Ion Cathodes

Raghav Kumar

Cornell University

Abstract

Making the transition towards renewable energy is a profound challenge for science and technology. Sodium-ion batteries promise to revolutionize energy storage due to fundamental differences with lithium-ion batteries. Sodium is abundant, and application of sodium-ion based materials in the grid storage is possible. Electrochemically active structures from a greater number of transition metals exist, reducing the price and the environmental impact. A faster diffusion of sodium ions and a higher conductivity of sodium ion based electrolytes promise better kinetics. These and other benefits of sodium-ion batteries have generated a paramount interest in the battery community in the last few years. Despite active research, major challenges remain in optimizing sodium-ion positive electrodes. For example, the prevalent structural phase transformations are decisive for energy density and rate capability. The lack of detailed understanding how distinct phases evolve inside individual nanoparticles operando prevents us from enhancing the energy density, accelerating charge rates, and securing the sustainability of energy storage materials.

The penetrating ability of hard x-rays makes them ideal for particle characterization, while the angular sensitivity of Bragg diffraction is unique in isolating the signal from individual nanoparticles in real operating devices. In this research, we have used X rays from a particle accelerator to relate the phase transformations of a sodium-ion battery cathode to it electrochemical data. We have tried to explain the irregularities in the charging and discharging pattern of the cathode (primarily the existence of plateaus) in terms of the possible phase transformations taking place in the sample. We have traced and used the 002 and 004 peaks, studied them in reciprocal space, and have been able to straighten out the Debye Scherrer rings to get a better correlation.

Poster title: Creation of a Graphic User Interphase for Rigid Registration with CryoSTEM Data

Emily N Waite
Benjamin H Savitzkya
Ismail El Baggaria
Lena F Kourkoutis (Faculty Advisor)

Cornell University

Abstract
Registration and averaging of images from a scanning transmission electron microscope (STEM) is a crucial step in achieving high quality data, particularly when challenging experimental conditions, such as cooling the sample to cryogenic temperatures, necessitate rapid image acquisition and subsequent low signal-to-noise ratios. For difficult datasets, current methods may fail; thus, this process can be optimized. Our new rigid registration method calculates the shift between every pair of images, enabling incorrect registrations to be identified and corrected. Additionally, flexible frequency weighting in Fourier space allows for better alignment of each image relative to one another. A graphical user interface (GUI) was then implemented with this method to create an easy to use platform for STEM users to quickly use the new registration method to get better images. This GUI provided many tools necessary to check the registration and optimize it for each data set so users can quickly get high resolution data from their STEM image stacks.

Poster title: Optical Characterization of III-Nitride Deep UV LEDs Using Photoluminescence Measurements

Vineeta Muthuraj
Grace Huili Xing (Faculty Advisor)

Cornell University

Abstract

Light-emitting diodes (LEDs) emitting wavelengths in the UVC range (100 nm - 280 nm) have applications in water purification and sterilization, but there are challenges to making efficient UV LEDs. Two of the factors affecting LED efficiency are the light extraction efficiency (LEE) and internal quantum efficiency (IQE). LEE is the proportion of photons generated in the active region that are extracted from the device, and is much lower in state-of-the-art UV LED prototypes than in commercially available visible LEDs. The current limitations on LEE are related to the materials used for UV LEDs. For example, AlN, with its high bandgap, is a good barrier for quantum well active regions, but its refractive index for UV wavelengths causes total internal reflection at layer interfaces at a relatively low angle (26°), limiting the device to 5% collection of photons from the active region. The IQE of a device indicates the efficiency of charge carrier injection and recombination in the active region under applied current. It is limited by radiative and nonradiative carrier lifetimes, which are related to defect densities in the crystal.

The optical characterization of LED samples is important for understanding the performance of LEDs and determining which LED design features give the most favorable performance. Photoluminescence (PL) measurements are used to determine the polarization and efficiency of light emitted from molecular beam epitaxy (MBE)-grown samples. Information such as surface composition, bandgap, and carrier lifetime can be determined using PL spectra. PL measurements have been performed with a 193-nm excimer laser to determine peak emission wavelengths of samples, along with a series of power-dependent measurements to explore how peak shape changes with excitation power. The poster will present examples of PL spectra and what information can be obtained from them.

Poster title: Data Synthesis to Explore Pesticide Contamination in the Water Resources of Honduras

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Damian E Helbling (Faculty Advisor)

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Abstract

The application of pesticides and herbicides is unregulated and widespread throughout most of Honduras. The goal of this project is to investigate the contamination of public water supply by these pesticides and herbicides. The first part of this project was the building of hydrological models using ArcGIS. These models incorporate topography and Google Earth® land use imagery and can be used to generate watershed maps for anywhere in the country. This study focuses specifically on the watersheds of AguaClara plants, which are drinking water treatment plants designed by a team at Cornell University. The watersheds of many of these plants contain a predominance of agriculture land. As is the case with almost all drinking water treatment plants in Honduras, there is no treatment for micro-pollutants, so pesticides and herbicides will not be removed by treatment. It is possible that pesticides and herbicides will be present in drinking water at concentrations thousands of times higher than US standards. A knowledge of what chemicals are in drinking water and at what concentrations will allow the development of treatment strategies. Currently, data is being collected by researchers at Zamorano University about agricultural practices within these watersheds to determine what chemicals are being applied and this information is being sent back to our team. hose pesticides and herbicides which are applied most heavily are being researched and analyzed with EPISuite software, which estimates their mobility in soil and water. All of this information allows predictions of which chemicals will show up in drinking water at the highest concentrations. The next phase of research will be obtaining water samples from AguaClara treatment plants (before and after treatment) and using mass spectrometry to measure concentrations of these pesticides and herbicides.

Poster title: Modeling Heat Transfer in Biomass Stoves

Keith Works

Cornell University

Abstract

Biomass stoves are commonly used all over the world, yet they are still very inefficient. The present study aims to investigate how the geometry of these stoves could be altered to improve their efficiency. In order to obtain performance data for each geometry, this study conducted numerical simulations in ANSYS Fluent®, which were much less expensive and time intensive than performing physical experiments. The results were validated using numerical and experimental results obtained by Kohli, et al [1]. The model for the present study was based on their setup. The stove was modeled as air flowing through a tube and impinging on a disc, with combustion modeled as input heat through the tube wall and with efficiency defined as the ratio of input heat to output heat through the disc. The simulations considered three variables: spacing between the tube exit and the disc, radius of the disc, and the Grashof number. In addition, four main performance parameters were analyzed: spatial heat flux to the disc, total heat flow rate to the disc, total heat flow rate from the tube, and total mass flow rate through the stove. For Kohli's base geometry, a high level of agreement was achieved for all results studied once the air was modeled with temperature dependent properties. All other cases achieved a qualitative level of agreement. Once this model has been thoroughly validated, it can be used to quickly alter geometries and study the effects of the changes using the performance data from the simulations, facilitating a faster and more effective design process for the next generation of commercial biomass stoves.

References

[1]. S. Kohli, J. Srinivasan, and H. Mukunda, "Heat transfer to a horizontal disc using a buoyancy induced jet," *International Journal of Heat and Mass Transfer*, vol. 36, no. 16, pp. 4049:4066, 1993.

Poster Title: Genome-scale Metabolic Modeling of Gut Microbiota in the Fly Gut

Joan Song
Nana Ankrah (Faculty Advisor)

Cornell University

Abstract

Gut microbiota have been demonstrated to play an integral part in influencing animal nutritional health; disruptions in gut microbiota have been linked to diseases such as diabetes and obesity. To investigate the processes shaping animal-microbe metabolic interactions and their impact on host health, we reconstructed genome scale metabolic models of the bacterial community in the Drosophila gut. Our aim is to derive quantitative estimates of the composition and amount of nutrients exchanged between animal and bacterial partners and the capacity of the bacterial partners to transform host derived nutrients. Preliminary data from our model reconstruction indicate that the microbial partners encode fermentative pathways necessary for the breakdown of complex polysaccharides into short chain fatty acids which can be utilized by the host. The bacterial partners also encode metabolic pathways for the production of essential amino acids and vitamins which can be made available to the host. Our future goal is to perform simulations to make quantitative predictions about bacterial metabolite production and the consumption of metabolites produced by the animal host and other bacterial partners present in the fly gut. The use of these models will aid in elucidating the specific mechanisms underlying experimentally observed microbial contributions to host health and aid in identifying therapeutic approaches for combating metabolic diseases in humans.

Poster title: Adaptive Solutions to Medical Problems

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Olivia J Spellicy, Jeremy M Petrotto, Megan T Yoerg,
Devon Oship, Dominique Hickson, Ian Kaminer,
Corey T Ropell, Sriram Subramanian,
Kris Schindler (Faculty Advisor)

SUNY College Buffalo State

Abstract

As an interdisciplinary group of nursing, cognitive science, speech pathology, computer science, computer engineering, and mechanical engineering students, we are working to provide augmentative and alternative communication (AAC) devices personally tailored to the needs of individuals who do not have the ability to communicate verbally or through body language. Specifically, we are focusing our efforts on individuals with Amyotrophic Lateral Sclerosis (ALS) and stroke patients. ALS presents a unique challenge in that the disease is progressive. We have been able to follow the progression of the ALS and are able to adapt the alternative communication technology to any individual's needs at any stage of the disease. We are able to adapt our technology to follow the progression of the disease of ALS. As each individual stroke patient differs in their needs, we are able to use our different forms of AAC devices to amplify their abilities. Both our ALS and stroke patients have benefited from our eyegaze system to track the user's eyes as they stare at a screen. We have developed an application that responds to the user's gaze and allows them to select on-screen buttons. These buttons in conjunction with external hardware allow the application to interact with the call light and eventually other peripheral devices such as the television, fan, and lights. This solution gives the user a simple way to communicate with those around them and have some control over their environment. While this solution is quite effective and versatile, our ultimate goal is to use a Brain-Computer Interface (BCI) device which would allow the user to control the environment more easily and more completely, as well as utilize text-to-speech with their brain waves. We are currently doing research to distinguish patterns in brain waves and we hope to be able to use those patterns to recognize single letters or words.

Poster title: Effects of Glucose Intolerance on Bone Tissue Composition in Postmenopausal Women

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Abstract

Patients with type II diabetes mellitus (T2DM) have greater bone mineral densities than non-diabetic patients, but epidemiological studies show that type II diabetics also have a seemingly contradictory increase in fracture risk. The greater fracture risk could be attributed to altered compositional properties. Therefore, the objective of this study was to measure the bone tissue composition of transiliac biopsies within three groups of postmenopausal women with varying glycemic control: normal glucose tolerance, impaired glucose tolerance (IGT), and type II diabetes mellitus diagnosis. Fourier transform infrared (FTIR) imaging was used to create compositional images of multiple properties of interest, including the degree of mineralization (measured by the mineral to matrix ratio), carbonate substitution in the mineral crystals (measured by the carbonate to phosphate ratio) collagen maturity, and mineral crystallinity. Compositional property mean values and measures of heterogeneity were calculated from the FTIR images in cortical and trabecular regions of the iliac crest. The mineral to matrix ratio was greater in the cortical regions of T2DM versus normal glucose tolerance (x%, p0.05) no differences were observed between other parameters describing mineralization. The carbonate to phosphate ratio was greater in trabecular bone of T2DM versus normal glucose tolerance patients (x%, p0.05), but less in T2DM versus IGT groups. These results indicate complex effects of impaired glucose metabolism on bone tissue composition. In conclusion, our study indicates that women with type 2 diabetes have greater mineral content in comparison with women with normal glucose tolerance.

Poster title:
Built to Stand!
Introducing Kindergarteners to the Fundamentals of Structural Engineering

Justyna W Kosianka
Yolanda C Lin

Cornell University

Abstract

Through GRASSHOPR, a K-12 STEM outreach fellowship program at Cornell University, we designed a three-module course to introduce different design considerations in structural engineering to a kindergarten audience with students at vastly different academic and behavior levels. This required us to design very adaptable lessons primarily utilizing visual and tactile learning techniques through project-based activities. Our overarching learning objective was for students to learn to design creatively around given constraints to simulate the work of an engineer. By engaging students in challenging but exciting work, we also hoped to increase student interest in engineering and understand the vital role engineers play in society.

In our first lesson, we introduced students to the roles of architects, engineers, and construction in building process. We then introduced students to structurally stable simple trusses through demo models. After sketching out design plans, the students worked in small groups to build structures out of newspaper and tape in order to support the weight of an undergraduate engineering textbook. The second lesson introduced the consideration of different materials. Material flexibility was explored by examining noodle pastas with different cross-sectional areas and example models with connections made from either tape or play dough, which the students then used to build a tower of a certain height. In our final lesson, students were introduced to the effects natural hazards have on structures. The students' structures from the previous two lessons were tested against simulated earthquakes, severe snow loads, and flash floods through hands-on disaster stations. Final thoughts were collected during the third lesson and the students concluded on the importance of structural consideration. Through a teaching evaluation, their teacher commented on the development of the students group work skills and ability to abstract a design.

Poster title: The Earthquake Engineering Research Institute's Undergraduate Seismic Design Competition: An Organizer's Perspective

Yolanda C Lin
Cornell University

Daniela M Martinez Lopez
University of California, Berkeley

Abstract
Since 2004, the Earthquake Engineering Research Institute (EERI) Student Leadership Council (SLC) has organized an annual Undergraduate Seismic Design Competition for students from universities all around the world. The SLC, a subcommittee of the EERI, is made up of a group of graduate students from across the country and world who volunteer their time in order to organize the Seismic Design Competition, Post-Earthquake Reconnaissance Workshop, and other supporting functions for EERI Student Chapters. The authors of the poster are currently the Co-Presidents of EERI SLC, and, in this poster, they offer organizing insights to the Undergraduate Seismic Design Competition. The competition has grown in recent years and is expected to host in 2018 over forty student teams from eight countries, extending as far as Malaysia, Turkey, and Romania. This poster documents some key developments of the main aspects of this unique competition, as well as logistical strategies in accommodating an ever-growing interest from new student teams with each coming year. In particular, we discuss the methods behind recruiting teams, encouraging new teams to participate, proposal-based invitations, and the technical and non-technical judging at the competition. In addition, we describe the organization that directly supports this competition: the The Undergraduate Seismic Design Competition is a unique event that brings together graduate students, industry professionals, and undergraduates to promote bonds within the community of Earthquake Engineering and provide a hands-on learning experience for undergraduates interested in this field that is typically not taught in undergraduate coursework, and previously accessible mainly to graduate students and beyond. This out-of-classroom experience and international exposure is aimed to develop the future generation of earthquake engineers.

Poster title: Effective Implementation and Utilization of Student Surveys to Enhance Student Learning and Course Instruction

Jared D Smith
Jery R Stedinger (Faculty Advisor)

Cornell University

Abstract:
Student surveys are a valuable resource for feedback on course instruction. This poster summarizes data from student surveys given in a 150-student statistics class that were used to redesign the classroom learning experience; the intent was also to generate dialogue in the classroom. In the first lecture, students were informed that regular anonymous surveys with Likert scale and written response questions would be released electronically every two to three weeks to gauge attitudes toward course instruction, muddiest points, homework problems, and lecture handouts. Selected results and positive & negative survey comments were used to generate 5-minute dialogues between instructor and students in lecture. The regularity of surveys allowed for small immediate changes in instruction during the semester, like including learning objectives on lecture handouts. Over several years, such surveys documented the successes and shortcomings of the course, which led to the development of a new recitation format applied in 2016 and 2017. Survey results on recitation preferences indicate that the instruction style change was positive for student learning. Recitation evolved from a TA working problems on a blackboard to a TA summary of weekly concepts and facilitation of an active learning environment, in which groups of students solved problems. Survey questions in 2017 also addressed opinions of new homework problems that required sifting through provided literature to answer a set of conceptual questions similar to those asked in previous years. Student responses suggested improvements to the exercise, and an overall positive perception of the exercise; several students commented that they appreciated a homework assignment with a different style than monotonous calculations. Based on our experiences, a critical evaluation of data generated by students is an informative exercise to gauge the effectiveness of changes in course structure, and should be a means of continued course and instructor improvement.

Poster title: Katchi: Korean Language Learning Game

Nicholas Teo

Cornell University

Abstract

Learning a new language can often be difficult and cumbersome. What if you could learn a new language through a fun and simple game? Professor Anderson's research group has worked on gamifying language through a 3D immersion game, *Crystallize*. This game is revolutionary in its concept of teaching a new language through placing the player in a Japanese society and learning Japanese in order to progress through the game. By having the player learn the language through self-discovery, our group has changed the way language can be taught and using the medium of a game to do so. My part of the project is separate from Crystallize and was inspired by the 2016 movie *Arrival*, where humans tried to understand an alien language through observation. The two main objectives of the project are to discover the most effective sequence of language content to show the user and to construct interactive spaces that allow for self-discovery (to observe and learn a variety of things to say). The project is unique from existing language learning software like Rosetta Stone® in that there is space for experimentation and discovery. This summer, my research team and I created *Katchi*, an intuitive Korean learning language game that allows users to play without any language barriers. Created in Unity, this game currently has two different mechanics. One is selecting and the other is drag and drop. In selection levels, users will be presented with a goal and then they are left to select the correct object that matches that goal. In drag and drop levels, users must drag the correct Korean characters into the slots to match the goal.