Sponsor and Judges

We are grateful to Northrop Grumman Corporation for their generous sponsorship.

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Judges

A special thank you to this year’s judges:

Julie Huff, Northrop Grumman Corporation

Chris Huff, Northrop Grumman Corporation

Henry Karpf, SSAO

Jeremy Nielson, SSAO

Tony Krause, Army Corps of Engineers

Jason Boche, Union Pacific

James Foley, Johnson Controls Inc.

Thomas Lawson, NARI

Meera Singh, NARI

Sunday Carlson, First Data
Welcome Conference Participants and Guests!

On behalf of the University of Nebraska, The Peter Kiewit Institute welcomes you to the 7th annual 

PKI Student Capstone & Research Conference

The Peter Kiewit Institute in partnership with the University of Nebraska-Lincoln College of Engineering and the University of Nebraska-Omaha College of Information Science & Technology is proud to host a student focused conference which features presentations of research and projects from students based at PKI, across the University of Nebraska and from other universities and colleges. The tracks align with the academic programs based at the Institute that are central to engineering, information science and technology as well as other research areas with emerging national significance. Assessment of student presentations at the conference will be made by independent, outside judges. The Institute welcomes attendance by faculty, students, industry partners and government representatives.

The Institute expresses its grateful appreciation to the judges, faculty, staff and students who volunteered
their time to make this conference an outstanding event. PKI is also profoundly appreciative of industry companies and government agencies that generously sponsored the presentation tracks and special events of the conference. Without the support of these individuals, companies and organizations the conference would not be possible. Thank you for joining us.
Schedule of Events

8:00 a.m. -12:00 p.m.
Registration

9 a.m. -12:00 p.m.
Presentations

12:00-1:00 p.m.
Lunch Break

1:00-4:00 p.m.
Presentations

4:00-4:30 p.m.
Judges Session

4:30-5:30 p.m.
Awards Ceremony
PKI 158
Undergraduate Presentations

EDGE

Jonathan Ingram, Brian Hodges
CSCI, UN0

Abstract: EDGE is a survival game developed in Unity 3D. The player starts on an island that is floating, with absolutely nothing around it. So, the edge of the world is constantly nearby. If the player falls off the edge, they fall into oblivion. The challenge of the game is to use what is on the island at the start to create a "world" out of "nothing." The presented product is the first stage in development of this game, and we hope to get the game to be compatible with Virtual Reality (VR) in the near future.

Howard Brandston Lighting Design Competition Submission

Samantha Anderson, Cody Largent
Advisor: Dr. Michelle Eble-Hankins
AE, UNL

Abstract: Nestled in the busy downtown area of a big city, this main lobby and elevator lobby of this project provide a transition space from the
downtown to the businesses and apartments located above in the building. While this space does not serve as a destination, it still has the power to impact the people who pass through. Inspiration for this design is taken directly from those people. The space is intended to reflect the community and illustrate the story of every individual, resulting in a design concept for the space of "Collective Expression". Materials, architectural features, and lighting for the space was chosen based on the concept, with the goal of creating a place where everyone can feel welcome and everyone can have the chance to interact with the space. The architecture and lighting allows every person passing through to tell their own story, and make their own mark, within the space.

Preventative Maintenance Portal

Brandon Franklin, Derek Sims, Jackson Urrutia, Jonathan Hale

Advisor: Dr. Harvey Siy

CSCI, UNO

Abstract: In order to open up sales opportunities and sustain relations with their customers while monitoring customer servers, an internal
maintenance page must exist that allows for the detection and correction of potential issues. Currently, issues may exist with sites and servers which the supporting organization may not be aware of. To this end, technicians leverage a single portal containing information pertaining to customer resources to identify such issues and push for actions to remedy them. Integrating with the organization itself, the design of the portal supports the management and coordination of employees by which the system becomes aware of who to report to regarding servers and sites. In response to the detection of problems regarding context management system vulnerabilities or a lack of resources on a given system, sales are also recorded in order to log any action taken as a response to the given issue. To push for the early detection of any potential issues, the system generates actionable items for the support team to assess customer servers on a configurable basis. In order to identify the status of servers and sites, the developed system captures server details and usage statistics by leveraging external systems which act on its behalf. Thus, the preventative maintenance portal provides a centralized point of interaction which allows a technical support team to detect and handle any issues that may arise with respect to customer resources.
Developing an Embedded System for Rehabilitation Gaming

Jonathan Hautzinger
Advisor: Dr. Stanley Wileman
CSCI, UNO

Abstract: Rehabilitation Gaming is an increasingly popular supplement to Physical Therapy and has been shown to provide valuable feedback for both patients and physical therapists. The systems these games run on need to interact with different sensors and devices that were not designed for this purpose. To address that problem, this project sought to create an embedded system that's function was to provide an abstract layer that streams data from the device patients interact with to the device running the video game. Utilizing GPIO, UDP (for IPC), Bluetooth, and multithreading an embedded system was created to provide an abstract layer between a sensor and a video game. This enabled a machine already used for physical therapy to be used as interface for a virtual environment.
The Influence of Heavy Metal Stress Factors on Artemisinin Production in Artemisia Annua

Matthew Martens
Advisor: Dr. Dhundy Kiran Bastola
Informatics, UNO

Abstract: The medicinal herb Artemisia annua produces the compound artemisinin, a valuable secondary metabolite that has been recognized as facilitating antimalarial activity in drug-resistant strains of the malaria parasite (Plasmodium falciparum). This work aims to evaluate the propensity for heavy metal stresses in the environment to impact the production of artemisinin, focusing primarily on the divalent and trivalent ions. Computational methods included the creation of a MySQL database containing the entirety of the artemisinin biosynthetic pathway and the heavy metal stress response pathway to both find areas in which metal cofactors or associated metabolites are shared. In planta analyses were conducted over 3 weeks in the hydroponic environment of the Food Computer at ionic concentrations of 7.5 µg/mL for three metals: aluminum, manganese, and zinc. Artemisinin was extracted and quantified using an evaporation of hexane and subsequent staining with the dye safranin O in conjunction with spectrophotometric analysis at 521
nm. The results of these studies indicated that aluminum, manganese, and zinc significantly increase artemisinin production relative to the untreated control over one week, with artemisinin content doubled in the case of aluminum and increased by a factor of 1.5 in the case of manganese and zinc. However, this increase in production relative to control was shown to diminish over 3 weeks, suggesting the potential for heavy metal toxicity to eventually impact plant health. Associated pathways included superoxide radicals degradation, mevalonate, methylerythritol, artemisinin biosynthesis, and numerous others demonstrating potential areas of competition between enzymes for crucial metal cofactors.

**STEM-Meter**

Josh Hansen, Monroe Mallum, Steven Towne

Advisor: Professor Herb Detloff

**CEEN, UNL**

**Abstract:** Educators in the state of Nebraska face the problem of getting their students excited about STEM (Science, Technology, Engineering and Mathematic) topics. Students benefit in their learning and interests are peaked through hands-on experiments that reinforce the lessons they are taught in the classroom.
Currently, educators must use multiple measurement devices in their experiments to enhance different types of lessons. Effects of this requirement include increased costs and added complexity to experiments through the coordination of multiple devices. This creates a barrier for young students and takes away valuable classroom time from students at higher levels of education. The STEM – Meter solves this problem by providing educators one platform to support all their STEM lessons. The STEM – Meter platform allows different sensor modules to communicate with an application on a smartphone or tablet where students and educators can view data in numerical and graphical formats. With the STEM-Meter, educators are provided a device that will allow them to design and implement more hands-on experiments in their classrooms. These real-world experiments will assist educators to inspire their students to further explore STEM related fields and will provide students with a deeper understanding of science beyond what would be achievable with only pencil and paper. This presentation will outline the development of the STEM - Meter and show how the different features of the STEM - Meter increase the efficiency of STEM related courses.
E-PDK

Jake Weskamp, Moustafa Al Adawi, Anthony Mainelli, Avery Miller

Advisor: Professor Herb Detloff

CEEN, UNL

Abstract: Grain augers are used to fill grain silos from the trucks transporting the grain. Our client, PECK Manufacturing, has been making grain augers and auger accessories for many years. One of these accessories is the PDK (Power Drive Kit) which uses a hydronic motor to move the auger. Our product, the E-PDK (Electric Power Drive Kit), provides a similar feature set. The E-PDK allows the user wireless control of the auger using a remote control and a cross platform mobile application. It can also be operated without a tractor using the backup battery. This product will allow the user more control over their auger and the attached flood light. This improved product will give PECK a competitive advantage and improved market share in a very competitive market. The design of this system allows for controlling the auger movement from the manual switch, wireless remote, and mobile application. The system was also designed with physical specifications such to be rugged and reliable. The system was designed to withstand Nebraska weather; the system can operate at temperatures between -
30C to 45C. The system is also IP 56 certified. The product was developed using these considerations though several iterations of both hardware and software to create the best product possible for PECK. At the conclusion of the project, PECK will be ready to mass produce the E-PDK using the production files and documentation provided by the design team.

Rehabilitation Gaming with Affordable Sensors

Jonathan Hautzinger, Andrew Susman, Cole Nardini, Adam Nasim

Advisor: Dr. Harvey Siy

CSCI, UNO

Abstract: In physical therapy, motion control systems are often been utilized to simulate patient movement in virtual environments. These systems benefit both the patient by providing a controlled environment for therapy and physical therapists by giving immediate and detailed feedback on patient performance. With increasing reliance on these systems there is a need for more affordable systems with robust virtual environments. This project seeks to provide a solution to this problem by using an array of sensors that cost roughly 10% of a motion capture system while also providing data on muscle activation. Using these sensors as an interface,
this project was able to produce a virtual environment that provides valuable feedback to both patients and physical therapists.

**Performing Arts Center Design Project**

Brenna Boyd

Advisor: Dr. Lily Wang

AE, UNL

**Abstract**: This project is based off the ASA Student Design Competition for the 2017 National ASA Meeting in Boston, Massachusetts. The parameters for design were given from the 2017 Design Competition announcement. This space was completely designed by students with consultations from leading architectural acoustic designers and mechanical systems engineers. Two rooms, the auditorium and rehearsal space, are heavily designed for exceptional acoustics. Other rooms and spaces, such as a costume shop or bathrooms, are simply designed in meaningful locations. This presentation will cover the design parameters of the project, the design process, how the two acoustically designed rooms were evaluated, and a showcase of the final product.
The Yard Mixed Use Building

Rob Truman

Advisor: Patrick Cuddigan

CONST, UNL

Abstract: "The Yard Mixed use Building" is a development in downtown Omaha off of 14th and Cumming street. The project is anticipated to be 110 apartment units, with an additional 6,000 sq. ft. of retail space contained in a 5 story building. The exterior enclosure will be primarily brick with minimal mix of other materials. The first floor will be podium construction on top of a 70 stall parking garage. The project is being delivered in a Construction Manager at Risk format. This project is a response to a request for proposal from New Street Properties LLC. Capstone Construction, a General Contractor, out of Omaha, Nebraska will be proposing on the project. The proposal will include qualifications, a detailed schedule, and a full estimate including self-performed concrete.

Inventory Database for Family Focus Federal Credit Union

Cecelia Carson

Advisor: Dr. Paul Van Vliet

MIS, UNO

Abstract: This goal for this project was document, analyze, and develop
a Microsoft Access 2013 database to solve inventory tracking inefficiencies for a local Omaha business. Family Focus Federal Credit Union has a long history of serving their customer to the best of their abilities, but the company had fallen behind when it came to keeping track of supplies and inventory inside the office. This led to issues, like poor record keeping and going over budget due to not knowing the current supplies that are in stock. A conclusion was reached that an item database management system should be installed, as this would allow for better tracking of supplies and help to reduce costs. My team worked closely with Family Focus FCU to ensure that their needs were documented and analyzed. The solution proposed a user-friendly interface that allowed Family Focus to input and track their inventory information. The Access 2013 data captured data for tables and reports that will allow the Credit Union to track their supply costs and needs more efficiently. My team’s solution facilitated a quick and easy implementation to also include training and a digital workbook.

**Westwood Golf Course and Hell Creek Rehabilitation**

Dakoda Kilzer, Andrew Wicks

Advisor: Dr. George Hunt

CIVE, UNL
Abstract: The Hell Creek and Westwood Golf Course area is being negatively affected by continual flooding. Golfers, residents, and landowners in the neighborhood are frustrated with the frequent flooding during large rain events. The safety of the public and property owners is vital, and our team has a proposal design to help the neighborhood. The scope of our proposal includes an altered stream path that will diminish flooding in the region. This stream path will feature native Nebraska grasses to promote a habitat in the creek. Also, a small ponding feature in the stream path will reduce flooding and control water flow throughout the year. Due to the construction on Hell Creek, the existing pedestrian bridges will be demolished and replaced with a reinforced concrete slab bridge. This bridge design will promote minimal long term maintenance. Finally, Westwood Lane Bridge will be redesigned to accommodate a failing structural analysis. To couple the structural modifications, a traffic analysis will be performed along with pavement design. Overall, these modifications to the existing property will rehabilitate the golf course and creek to better serve its occupants.
Nebraska Schools Account Provisioning (NSAP) Project

Brian Wolatz

Advisor: Dr. Harvey Siy

CSCI, UNO

Abstract: The Nebraska Schools Account Provisioning (NSAP) project is a collaboration of the UNO capstone team members and the Nebraska Educational Service Unit Coordinating Council (ESUCC) and Sponsor (Scott Isaacson). ESUCC has identified a statewide technology standard for school districts student records called Ed-Fi. The Ed-Fi Data Standard is the widely-adopted, CEDS-aligned, open-source data standard developed by the educational community for the betterment of the community. The Ed-Fi Data Standard serves as the foundation for enabling interoperability among secure data systems and contains a Unifying Data Model designed to capture the meaning and inherent structure in the most important information in the K–12 education enterprise. This NSAP project will provide an account management tools set to work in conjunction with the Ed-Fi data standard. The NSAP project provides an account management tool set for the Nebraska Educational Service Unit Coordinating Council (ESUCC). This ESUCC tool set will be provided by ESUCC for use by the 17 Nebraska
Comparison of Organisms that Contribute to Metabolic Function in the Oral and Gut Microbiome

Jamison Linscott

Advisor: Dr. Dhundy Bastola

Informatics, UNO

Abstract: Different parts of our body are inhabited by a wide variety of microbes. Each part of our body has its own community of microbes that is specific to its location. These communities have been implicated in disease and health, which has increased the study of them in recent years. These microbe communities have been connected to health and disease and thus are important to study. To better understand the types of metabolism used in the oral and gut microbiomes a comparative study was conducted. Aerobic metabolism was found to be most present in the microbes within the oral microbiome. The results of the comparative analysis between the communities showed that there exists metabolic connections between these two microbiomes.
Howard Brandston Student Lighting Design Project

Mazoun Al Riyami, Marissa Gigantelli

Advisor: Dr. Michelle Eble-Hankins

AE, UNL

Abstract: The Howard Brandston Student Lighting Design Project was established to encourage students to create an original and unique solution to a supplied design problem. The scope of the lighting design project is the atrium and elevator lobby of a low-rise office building. With this being a multi-purpose space, located at a busy corner of a city downtown, the space is sure to receive a large amount of activity. The areas in scope must welcome individuals into the space, and provide an escape from the bustling city that surrounds. The proposed design solution is inspired by different elements within a city, with people being the main focus. The soothing atrium allows for individuals to converge within the space and restore their purpose before diverging towards their final destination. Each individual occupant brings their roots and culture to the space. Their purpose differs upon arrival, therefore flexibility is a key component. The wood panels provide a sense of strength to the space. This strength stems from the unity and values that each individual proudly carries. As the occupant proceeds to their destination
they bring with them a sense of growth and development. This is their passion, which is vivid and bright just as the artwork seen behind the reception desk.

**Paths**

Aaron Cloet

Advisor: Dr. Doug Derrick

IT Innovation, UNO

**Abstract**: Paths is a 2D top down RPG video game. Players take on the role of a new arrival in an abandoned city. There they meet other teenagers around their age who have been disappeared from earth and have been brought here. The city is divided into factions that are battling for control of the city with their Spirits. Spirits are mysterious beings that are given to the people who arrive after completing a test. Paths will include turn based battles similar to Pokémon and Final Fantasy, puzzle solving, open world exploration, and quests that will have an impact on the game's story and ending.

**Database of Secondary Metabolite Production in Medicinal Plants**

Allyshia Brown

Advisor: Dr. Kiran Bostola

Informatics, UNO
Abstract: Medical use of plant chemicals and enzymes in drug formulation is a promising area of research when cheaper drug treatment options are desired. Many research efforts have documented the effects different environmental stresses have on secondary metabolite production in plants. Knowledge related to secondary metabolite production can be found in research papers that are not explicitly related to this subject. In order to gather as much of this knowledge as possible, a searchable and user-friendly database is a convenient storage device for such stress-metabolite relationships. Using MySQL and PHP scripts, queries can be executed and output can be displayed depending on the knowledge desired by the user, whether it be any environmental stress producing more metabolite or the country of origin of a particular plant. The database has proven to display the effects of multiple environmental stresses on secondary metabolite production based on the preliminary research into published research papers. Along with this feature comes the implementation of a user registration system with encrypted passwords, Google maps API, and a user-friendly design. Future suggestions stem from the need to incorporate new information into the existing database. In order to do so,
text mining techniques could extract related knowledge much more quickly than a human. Also, the implementation of a user contribution feature would allow qualified users to input their own research findings in order to contribute to the growing knowledge in stress-related secondary metabolite production in plants.

The Influence of Drought Stress on Anthocyanin Production in Coriandrum Sativum

Jacob Bliss
Advisor: Dr. Kiran Bostola
Informatics, UNO

Abstract: The annual herb Coriandrum sativum has been used in a variety of capacities since antiquity including as a flavoring agent, a dye, and in a variety of medicinal treatments. Secondary metabolites are compounds that are not considered to play a primary role in the growth and development of an organism; however, the levels of these compounds are known to vary greatly in response to abiotic stress. One such secondary metabolite is the flavonoid anthocyanin, which is a bioactive compound that is considered to be beneficial to humans in fighting many chronic diseases due to its antioxidant properties. This work aims to elucidate the response of coriander to a drought stress protocol by
examining anthocyanin levels before and after treatment. Computational methods included the creation of a MySQL database containing the entire anthocyanin biosynthesis pathway, as well as several different pathways involved in drought stress response, in order to find areas where common enzymes or cofactors exist. Three rounds of in planta experiments were conducted over a three-week period and anthocyanin levels were measured by a spectrophotometer at 520nm following treatment. The results of these studies indicated that anthocyanin levels remained similar or possibly decreased slightly in coriander following a 5-day drought stress protocol, which goes against the literature based hypothesis. Some of the associated pathways are suberin monomers biosynthesis, flavonoid biosynthesis, leucopelargonidin biosynthesis, leucyanidin biosynthesis, coumarins biosynthesis, phenylpropanoid biosynthesis, and trans-cinnamoyl-CoA biosynthesis.

The Effect of the Quality and Quantity of Light Production of Artemisinin in Artemisia annua

Connor Phipps

Advisor: Dr. Kiran Bostola

Informatics, UNO
Abstract: The effects of long term exposure to solely red and blue light on the production of artemisinin in Artemisia annua were studied. Adolescent sample plants were exposed to red, blue, or white light for 13.5 hours for three weeks. Samples were collected twice over the following two weeks and analyzed for artemisinin concentration. Concentration levels were found to not be statistically significant in mean artemisinin concentration when compared to the control, but pathway and literary analysis propose undiscovered mechanisms of artemisinin production regulation based off HMG-CoA reductase control. HMG-CoA reductase inhibition by the presence of phytochrome metabolites and acetyl-CoA concentration show evidence of being mechanisms of control for artemisinin biosynthesis, due to the dependence shift from light to dark metabolism.

Vietnamese Immersive Language in Learning

Vincent Ha

Advisor: Dr. Doug Derrick

IT Innovation, UNO

Abstract: Vietnam is one of the fastest growing economy in Asia while leading market like Japan and China had been tap out. However, Vietnamese is a difficult language to
learn which restricted English
speakers to travel and invest in
Vietnam market. On top of that, the
way of learning a new language right
now is not effective since nobody like
to learn boring vocabularies and
phrases. Introducing Vietnamese
Immersive Language Learning
software that can work with VR
devices like Oculus Rift or HTC Vive.
This software will let users immerse
themselves in the Vietnamese
language and culture.

Project HALON

Joshua Smrcina

Advisor: Jim Taylor

AE, UNL

Abstract: Project High Altitude
Learning Over Nebraska (HALON) is a
Science, Technology, Engineering and
Mathematics (STEM) outreach effort
that allows teams of junior high and
high school students to get hands on
experience working on a NASA-
sponsored project. Working together,
these teams will utilize the Space
Systems Engineering Process to
design a near-space experiment with
specific requirements that need to be
met. During their design, teams get
hands-on exposure with hardware
fabrication, software development,
protocols and testing procedures, as
well as trouble shooting. Once fully
designed, the experiments are flow to
near-space where they will be put to the true test. Upon completion, the results of the experiment will be analyzed and a report is developed discussing the findings, and present them to the Project HALON sponsors and mentors.

**The Bus Factor**

Nathan Pettepier, Donald Steffensmeier, Remy Patterson, Chen Chen

Advisor: Professor Herb Detloff

**Abstract:** The students at the University of Nebraska-Omaha (UNO) who commute cross-campus via shuttle services have no means of determining the amount of time they will wait at a shuttle stop for the arrival of a bus. These students have expressed a desire, via survey, for technology that gives them shuttle location and arrival information. The Bus Factor team utilized the engineering design process as well as multi-disciplinary team concepts and behaviors to develop a solution to this problem. The proposed solution is a proof-of-concept design that will track one shuttle bus on one route as it travels throughout campus picking up students. The solution presented to the students displays to them a map indicating the location of their desired shuttle as well as an estimated time of arrival for that shuttle. The Bus Factor acquires GPS coordinates from
connected satellites, parses desirable data, and transmits the data wirelessly via GSM (2G) to a centralized server. The server displays the pertinent location information to the student. Students can access this server in the form of a webpage that presents a user interface with a map and estimated wait time for shuttle arrival. The product is successful in its implementation and could be improved upon by expanding tracking functionality to more than one shuttle on the UNO campus.

**Design of a Three-Story Diaphragm Structure**

Anthony McWilliams

Advisor: Dr. Gary Krause

**AE, UNL**

**Abstract:** The project called for modeling and design of a three-story steel frame building. The building consisted of five bays in the North-South direction, and four bays in the East-West direction. A concrete slab and metal deck was necessary for the design, covering the entirety of each floor. The loads were to be determined using ASCE 7-10, Minimum Design Loads for Buildings and Other Structures, and the structure was assumed to be a hospital with emergency treatment facilities in Omaha, Nebraska. Along with these assumptions, wind exposure C was
assumed and to resist lateral loading there were two moment frames in the North-South direction as well as two braced frames in the East-West direction. Yield strength of steel is 60 kips per square inch, and compressive strength of concrete is three kips per square inch. The bases of all columns were assumed to be pinned, except for moment frames. Roof and floor decks both need two-hour fire rating, and were rigid diaphragms. Design requirements included selection of decks for both roof and floors, roof and floor beams, all girders, as well as all columns and braces. Column sections were limited to W12 shapes, and diagonal braces were limited to Hollow Structural Steel (HSS) shapes. The RAM designs for all members were to be verified, as well as load-deflection effects, notional loads, and wind loads. RAM Structural modeling software was used for most of the design work. Hand calculations were performed to verify the computer’s process.

**Robot Swarm Modeling, Tracking and Analysis**

Brandon Kirk, Jordan Nash, Mark Peters, Robert Gibbs

Advisor: Dr. Raj Dasgupta, Dr. Harvey Siy

CSCI, UNO

**Abstract:** This project focuses on swarm robotics in two connected
sections. First of all, using the Webots development environment we modeled some basic flocking swarm behaviors. These include linear and torus flocking in a tree-like formation. In both cases, the robots in the swarm follow a designated leader until an obstacle is reached, at which point a new leader and trajectory are chosen. Secondly, utilizing the OpenCV library we developed an application to track e-puck robots as they execute any planar swarm behavior. This is accomplished with red circular markers and blob tracking, or alternatively with AprilTags. Once tracked the swarm’s movement data is stored and analyzed for macroscopic parameters of the swarm’s movement as well as identifying individual members with the greatest activity in the swarm. The resulting analysis data is exported for later use, and in the future such data will be utilized to help identify key features of various swarm behaviors and potentially classify the behavior of some unidentified swarm.

Design of Evaporative System

Trevor Steinkruger

Advisor: Dr. David Yuill

AE, UNL

Abstract: The ASHRAE 2017 Applied Engineering Challenge was a competition to design a retrofit evaporative cooled system for an
existing air conditioning system. The design competition is applicable to residents in the United States that find themselves struggling to pay high utility bills during hot and humid months, which also places them at risk for heat-induced illness. If a retrofit solution can be found to reduce energy consumption, utility rates and the risk of heat-induced illness may decrease. The scope of the competition stated that the design team must design an evaporative cooled system for a typical air conditioning system serving a 1,600 square foot residence located in Atlanta, Georgia. The retrofit system uses harvested or reclaimed water, and will aide in the reduction of the air conditioning system's energy consumption. Utilities to the residence include 120V and The 2017 University of Nebraska - Lincoln team consulted with current ASHRAE member Rick Hollendieck, owner and president of SYS-KOOL, LLC, and used the information gathered and data collected to design an adaptation of an injector style cooling tower using harvested rainwater. This system collects the water using the existing gutters on the residence, and deposits it into an underground 10’ diameter cistern tank. A submersible pump is activated when the cooling demand of the home increases, pumping water from the tank to the air conditioning system.
ELM HI ASHRAE Student Design Competition

Adam Heyen

Advisor: Dr. David Yuill
AE, UNL

Abstract: The purpose of this report is to design, analyze, and select the most effective heating, ventilation and air conditioning (HVAC) system for a new meteorological station located in the Diego Ramirez Islands (Islas Diego Ramirez). This facility is a single-story meteorological outpost that includes private bedrooms, a community area, exercise space, kitchen, meeting rooms, locker rooms, laundry room, and a large repair facility for operational and automotive equipment.

The system selection seeks to fulfill requirements set out in the Owner’s Project Requirements (OPR) while also meeting ASHRAE Design Standards. The Owner requires the system design to be sustainable, energy efficient, healthy and safe, comfortable, and easily maintainable. The building’s HVAC system is designed to conform to the energy conservation requirements of ASHRAE 189.1 but additional energy conservation methods will be investigated to a higher performing building. The selected system will be chosen based on the best life cycle cost to meet the Owner’s
budget. Additionally, the design provides necessary sizing criteria, physical location, and final costs for a photovoltaic array that supports 5% of the total building energy needs. Trane TRACE 700 will be used to provide load calculations and an energy simulation for the building. To determine the best design for the HVAC system, three different systems will be modeled. An ASHRAE Standard 90.1 Baseline System will also be modeled. The baseline system will be a packaged rooftop unit with DX cooling and gas fired-furnace for heating, per ASHRAE 90.1. The three options will then be compared to the baseline and to each other. The three options considered are as follows:

Option 1: Variable air volume (VAV) system with reheat served with alternative primary components and radiant floors in the service stall area.

Option 2: Variable refrigerant flow (VRF) with a DOAS served by a water to water heat pump with sea loop, and radiant floors in the service stall area.

Option 3: Unitary heat pumps with a DOAS served by a water to water heat pump with a sea loop, and radiant floors in the service stall area. These options and the baseline system will be compared using a decision matrix. This matrix includes criteria such as life cycle cost, initial cost, operating cost, system reliability, system flexibility, sustainability,
maintenance required, and environmental impact. After running the options through the decision matrix the HVAC system with the highest point value will be then selected.

**Construction of Plant Growth Chamber and Stress Detection with Computer Vision**

David Vincent

Advisor: Dr. Kiran Bastola

Informatics, UNO

**Abstract:** Environment or abiotic factors impact the chemical processes that take place in plants. Controlling a plant's environment makes it easier to study effects of abiotic factors, such as temperature, light, and humidity. Also, sensor data can be used to help find the relationship between the environment and the plant's lifecycle. One area of interest is detecting when a plant gets stressed. In some plants, the chemical pathways activated during stress can result in a larger quantity of chemicals with medical value, such as Artemisia which produces a compound that can be used in malaria treatment. Additionally, it is conjectured that some herbs, such as Basil may have higher quality taste under stress conditions, so it is desirable to study these plants in a controlled environment. Recently, MIT created
an Open Ag initiative, which has open source designs for low cost growth chambers. In this capstone project the Open Ag growth chamber was adapted for UNO bioinformatics research interests, as well as a computer vision algorithm to predict plant stress.

**Mitochondrial Disorders and Genetic Variations**

Mahmoud Elgaray
Informatics, UNO

**Abstract**: Mitochondrial disorders result from the failure of the mitochondria, an important part of the cell that is responsible for creating the energy needed for cells to function. Mitochondrial diseases are the result of either inherited or spontaneous mutations in mtDNA or nDNA which lead to altered functions of the proteins or RNA molecules that normally reside in mitochondria. Because mitochondria perform so many different functions in different tissues, there are hundreds of different mitochondrial diseases. Because of the complex interaction between the hundreds of genes and cells that must work together to keep our metabolic functions running smoothly, identical mtDNA mutations may not produce identical diseases. On the other hand different mutations in mtDNA and nDNA can lead to the same diseases. Different databases like OMIM and
dbSNP contain information about the different genotypes and phenotypes associated with mitochondria. However, there is no single database that aggregates that information in a format that can help with studying those disorders. Here, I attempt to create a database that compiles all the information about all the known mitochondrial genotype-phenotype as well as the SNPs associated with the same genotype.

**Investigation of mRNA Localization to the Human Mitochondrion by Analysis of the COXIV Zip Code**

Kaitlin Goettsch

Advisor: Dr. Kiran Bostola

Informatics, UNO

**Abstract:** The human mitochondrion carries its own mini-genome, encoding 13 proteins. Yet, advancements in proteomic technologies have shown that modern-day mitochondria contain over 1,000 proteins. Forty percent of these mitochondrial proteins are believed to localize from the cell’s center via the well-known signal peptide mechanism, leaving 60% of mitochondrial proteins without an identified transport mechanism. Existing studies indicate that these mitochondrial proteins are involved at the cellular level in Parkinson’s disease, Alzheimer’s disease, cancer, and other serious illnesses. In the
signal peptide mechanism, an amino-terminus sequence acts as a targeting signal to alert the cell machinery to transport the peptide. Recently, researchers have shown that mRNAs contain signals similar to these which may help us identify the transport mechanism for the remainder. However, the mRNA localization’s molecular process and machinery have yet to be clearly understood. Our study analyzed a known mitochondrial localization signal to determine its role in the localization process and to define some of the protein machinery involved in mRNA transport. The mRNA used in our project is a known 38-bp long mitochondrial localization signal found in the transcript of the COXIV gene. This transcript localizes to the mitochondrion using this signal as a form of zip code. RNA binding proteins (RBPs) play an integral role in transporting mRNAs to specific sites within the cell, similar to a cellular mail carrier. Results of our study regarding a human mitochondrial localization signal and its related RBPs will be presented.

InterpME

Jorge Grimaldo

Advisor: Dr. Doug Derrick

Abstract: Communication between people is very important at all times. It can be at schools, shopping centers, hospitals or courts. InterpME is a web
site that will help people who speak different languages so that they can have a conversation without any problems. InterpME is like Uber but for interpreters if a person needs an interpreter, he/she can log in to interpME.com choose their native language and the language they need the interpreter to interpret and the web app will connect them to someone who will be able to interpret for them. If the user needs help at a hospital or at court the interpreter will need to be qualified to do so. Languages are different according to the country or location, the person that will be interpreting will need to be from the same country as the user so they can communicate easier and both will understand the words and different meanings.

**Sympathetic Vasomotion Observation System**

Michael Lehman, Mai Morgan, Nick Masur, Patrick Davlin

Advisor: Professor Herb Detloff

CEEN, UNL

**Abstract**: Team 2 SVOS Team

Abstract University of Nebraska Medical Center researchers are performing experiments and observations on the cardiovascular and sympathetic nervous system. The current method of experimentation uses an invasive process, the
equipment used is expensive, and does not produce real time results. The Medical Center researchers have enlisted team two to design and construct a device that will improve research methods and reduce constraints. Team Two designed the Sympathetic Vasomotion Observation System. This product uses non-invasive doppler ultrasound, it produces near-real time results, and costs less than one percent of the current equipment used to perform equivalent experiments and observations. The Sympathetic Vasomotion Observation System uses analog signal processing to condition inputs from the ultrasonic probe and the Non-Invasive Blood Pressure (NIBP) machine. An analog-to-digital converter is used to send digital data to a microcontroller. Next, the data is transmitted to a desktop computer for processing via Bluetooth technology. This report elaborates on the need and future use of this device. Other topics covered are engineering design processes and required success criteria. The success criteria will be accompanied by test data and results to verify success. Evaluations of the device such as mean time to failure, power consumption, and environmental factors. A user manual will be included to properly operate the device.
glinnO
Nicholas Lauber
Advisor: Dr. Doug Derrick
ITIN, UNO

Abstract: The music scene in Omaha Nebraska is thriving. Independent artists are everywhere, performing in venues like The Slowdown, The Waiting Room, Reverb Lounge, and more. However, how many people know when these performances are taking place? Currently you have to trudge through websites that aren't mobile-friendly, Facebook, or the newspaper to find events. This problem is even more notable if someone is trying to find something happening within the next several hours while away from the computer. The answer to this problem is glinnO. GlinnO is an online, mobile-friendly calendar of musical events featuring local artists within the Omaha community to promote artists and venues to both local fans and tourists. The online system provides accounts, the ability for artists or venues to create new events, and a calendar providing anyone with future events. Future potential features include a map with directions to an event, a feature showing events near the user that are happening within the next several hours, an implementation of ride sharing through Uber and Lyft, and dedicated mobile applications.
Graduate Abstracts

Marvel Work Order System

Pooja Singh, Chuane Li Gopinath, Vijarangan Prakruthi Viswanath
Advisor: Dr. George Royce
MIS, UNO

Abstract: Marvel Work Order System is being built for a non-profit retirement home in Omaha. This system simplifies the process of solving issues for senior citizens. Senior residents can use this app to notify the retirement center and track the progress on their complaints. This app can also be used by relatives/friend/guardian of a resident to log a complaint on behalf of the resident.

Complete Coverage of 3D Surfaces Using Autonomous Unmanned Aerial Vehicles

Venkat Rammana, Reddy Garlapati
Advisor: Dr. Prithviraj Dasgupta
CSCI, UNO

Abstract: UAVs are currently being used extensively in several applications such as aerial surveillance of high consequence regions or farmlands, monitoring of natural disaster areas following floods or wildfires, etc. In these operations,
the UAV’s objective is to cover and collect information over a 2-D region, which is usually the Earth’s terrain under the flight path of the UAV. UAV usage in complete coverage of 3-D structures has been fairly restricted, owing mainly to the difficulty to maneuver them in smaller spaces and difficulty in developing complete coverage path planning algorithms in the 3-D environment. Nevertheless, there are many applications where UAVs could provide a safe, reliable and resilient means to perform inspection operations that are difficult and dangerous for humans. Such as inspecting buildings and bridges, inspecting space crafts before and after launch, and surveying gas pipelines. We will describe a novel algorithm for complete coverage of 3-D structures that uses the technique of cellular decomposition to generate a flight coverage path for a UAV, while continuously maintaining a fixed, specified offset between the surface of the structure and the UAV. The objective of this thesis is to develop an autonomous UAV navigation system for 3-D structural inspection.

**Injury Tracking & Workflow Web App for Omaha Fire Department**

Sriram Srivivasan

Advisor: Dr. George Royce

MIS, UNO
Abstract: The Omaha Fire Department depends largely on paper records to keep track of their employee’s health and wellness forms. With this, there are many different forms that need to be recorded as well as records that are stored in an access database. This also leads to many ways to determine an employees’ status when dealing with certain areas. The University of Nebraska at Omaha Capstone class was tasked with creating a solution for this problem. Using a web based solution, they created an application to track the forms needed by each firefighter and allow for completion online, rather than in person and on paper. Using PHP, the application was based off of the previous UNO Capstone project that tracked assets for the Fire Department to keep the style the same. With the Wellness application, the Capstone class was also able to allow for electronic forms and electronic signatures of each form. The forms that this application covers are the Injury on Duty form, Vehicle Accident forms, Biological and Hazardous exposure forms. With these forms, and the need for an electronic approval, email notifications allow for the captain or chief to approve the forms for further filing. This application allows the Omaha Fire Department to accurately track the forms needed in a central repository. There is also a need to
import the previous Access database files, which allows storing even more of the previous information. This allows for more of an accurate reporting of employee forms, and covers a larger timeframe.

**Implementing Fifth Generation Wireless Systems in High Speed Train**

Subharthi Banerjee

Advisor: Dr. Hamid Sharif

CEEN, UNL

**Abstract:** 2020 is the target year for the roll out of fifth generation wireless communication methodologies. The commercial vendors have characterized 5G as a collection of disruptive set of technologies to provide high throughput, low latency communication supporting a variety of services, i.e., machine to machine communication to next generation base stations and vehicle-to-vehicle communication to radio-over-fiber and high mobility channels. High speed train communication channels as a subset of high mobility channels have their clear advantages and disadvantages considering other vehicular channels. The speed of high speed trains is going to reach 500km/hr and with Hyperloop it may reach 1000km/hr. LTE for railways (have) has been specified to support train to ground communication.
channels only up to 350km/hr and is still not future proof considering the bandwidth intensive passenger services. The next generation passenger services include conference calls, Ultra-HD video streaming, 360-degree video streaming and downloads, resource intensive multimedia services for passengers comprising of gaming, personalized advertising, virtual and augmented reality, etc. Therefore, HSTs being next generation transportation system, the services provided to passengers on-board may suffer compared to the ground. The difference in provided services may sound significant compared to in-flight infotainment services based on satellite communication and on-board Wi-Fi. In our approach we have studied the 5G physical deployment scenario without disrupting or interfering with prioritized train control communication channels. The novelty of separating train control and passenger services with different planes of 5G/LTE evolution specification and based on resource sensitive bandwidth provide an opportunity to not to compromise passenger services. Considering mm-Wave frequencies, massive MIMO, different waveforms and beamforming in high speed channel with our novel approach of multi-antenna circular FIFO mapping methodology we have shown a way forward for next generation soft-handover method and
diminishing 5G centric high handover failure and outage probability without compromising throughput at all.

**Forward Osmosis: Definition and Evaluation of FO Mass Transmission Coefficient**

Kang Rong

Advisor: Dr. Tian Zhang

CIVE, UNL

**Abstract:** Forward Osmosis (FO) usually has a measured water flux ($J_{w, exp}$) much smaller than its theoretical water flux ($J_{w, theoretical}$); the discrepancy between $J_{w, exp}$ and $J_{w, th}$ increases at a higher theoretical osmotic pressure difference ($\Delta \pi_{theoretical}$). Such discrepancy has been explained with concentration polarization (CP) and membrane resistance, together with an osmotic reflection coefficient ($\sigma$). However, it is not clear how to link the discrepancy or $\sigma$ with FO performance and process optimization in different FO systems. In this study, for the first time, a FO mass transmission coefficient was defined as $\eta_{MT} = \frac{J_{w, exp}}{J_{w, theoretical}}$. The procedure was developed for determining $\eta_{MT}$ and $A$ (water permeability coefficient) with a static FO system. Results showed that $\eta_{MT}$ decreased with an increase in concentration difference between the bulk of draw solution (CDB) and feed solution (CFB) as per $\log \eta_{MT} =$
a•log(CDB – CFB) + b for different FO systems. This study also evaluated the difference between $\sigma$ and $\eta_{MT}$.

$\eta_{MT}$ and the related equations can be used to evaluate the FO performance, predict the impacts of different test conditions on $\eta_{MT}$, and interpret implications related to $\eta_{MT}$ and osmotic efficiency of the FO systems.

**Characterization of Structural Measures from Gene Co-Expression Networks**

Qianran Li

Advisor: Dr. Kathryn Cooper

Informatics, UNO

**Abstract:** Big data analysis has been adopted as a promising method to analyze the tremendous amount of high-throughput biomedical data in an efficient and accurate way. Among the tools available, the correlation network has been recognized as a powerful tool to model gene expression data. Gene expression, or the process of translating a gene into a protein product, is important in the study of disease and aging. Specifically, the correlation network has been shown to accurately identifies genes with similar expression levels by modeling pairwise gene relationships. Structures within this network (such as hubs or clusters) can then be used to identify target genes of interest. However, the utility of this model has
not been investigated when comparing the same group of genes across different tissue types. In this project, we address this issue by investigating the range of possible structural measures in a correlation network made from 5 different tissues. A total of 43 correlation networks were built by using gene expression data from 5 different tissues. Then we compared a number of network structures (degree distribution, assortativity coefficient, and clustering coefficient) across networks and tissues to identify a “typical” structural parameter range. Our results show that there are significant differences in assortativity coefficient between network types. This work can be applied in future research for a better understanding of gene co-expression relationship across tissues.

Microfinancing-We Are the Solution for your Problems!

Anindita Roy Burman, Gaurab Sanjel
Advisor: Dr. Sachin Pawaskar
MIS, UNO

Abstract: CapSphere Services is a Malaysian-based peer-to-peer (P2P) platform, connecting small & medium enterprises (SMEs) to private investors. CapSphere enables SMEs to raise capital efficiently at lower rates while offering lenders a higher return on investment. It aims to
provide services via web-based funding platform, with primary revenue streams derived through a broker, management & registration fees. CapSphere’s platform will utilize a simple and effective financing process to improve customer experience and reduce time-to-time disbursement. Therefore, CapSphere leveraged its partnership with UNO to design and develop a leading platform that is scalable, efficient and cost-effective, with long-term automation potential.

Peer-Based Benchmarking Tool for Higher Ed

Kavya Sathyanarayana, Elaine Locke
Advisor: Dr. Sachin Pawaskar
MIS, UNO

Abstract: The capstone course is the final requirement for the Master of Science in Management Information Systems (MIS) program at the University of Nebraska at Omaha (UNO). The capstone experience involves identifying a real-world problem and developing an information system to address it using the Agile Software Development Methodology. The Spring 2017 (section 3) class has developed a web-based data visualization tool that universities, journalists, legislatures, trustees, accreditation organizations, policy analysts, or students and their
families can use to measure the quality of a college or university in comparison to other schools in the same market. The data visualization tool uses data from multiple data sources and aggregates this data into a usable format. This data is plotted onto a scatterplot graph which the user can interact with by changing the selected research variables and grouping of schools. The data is also presented in a tabular format which can be sorted and analyzed by top, middle, and bottom thirds or exported to excel for additional analysis. The data visualization tool was built using the open-source Laravel Model-View-Controller (MVC) framework which is composed of the Apache, PHP, and MySQL tech stack. The tool is hosted on Heroku which is a cloud-based platform-as-a-service.

Web Based Work Order Management System for New Cassel Retirement Center

Gopinath Vijayarangan, Padmanabhan Saundararajan

Advisor: Dr. George Royce

MIS, UNO

Abstract: New Cassel Retirement Center is one of the premier retirement centers in Omaha, offering assisted living, retirement housing and franciscan day care for the elderly in the community. The center hosts a
variety of conducive activities and services tailored to the wellbeing of the residents in a friendly campus. To popularize the quality of services offered by New Cassel, Team Marvel collaborated to design and develop an innovative web based Work Order Management System, that would provide a seamless experience for the residents, resident contacts, and the administration for all maintenance activities within the campus. The new system would encourage the residents to request, monitor and track their maintenance requests with a choice of email notification. It also provides access for the resident contacts to equally utilize the system. It is a one stop console compatible with all major hand held devices that enables its users to generate dynamic reports and manage inventory from the ease of their palms. This automated system would not only be a user friendly and an efficient interface for admin and staff to assign, manage and track all work orders but also a globally secure accessible system. This would mark an end to the traditional method of creating work orders aided by call support, thus resulting a quick turnaround for maintenance activities.
Tool Support for Capturing the Essence of a Concern in Source Code

Chuntao Fu

Advisor: Dr. Harvey Siy

CSCI, UNO

Abstract: Software development is a series of incremental operations, which not only add pieces of code to the existing code base to provide comprehensive functionality, but also add extra complexity of code dependencies to the software system under development. Each time when there is an incremental operation, the software is exposed to potential bugs and degradation in code quality. With gradual complex code dependencies, software becomes harder and harder to understand. As a result, software at this stage will face to be thrown away and wasted due to high software maintenance costs, lack of software understanding, less code reuse, and less software portability. We propose an approach that allows developers to cut the complex code dependencies and capture the minimal segment of code that relates to an identified concern. The code captured in this approach can be easily analyzed, separated, and migrated from one project to another efficiently, which can reduce general software waste and improve software reusability and portability.
PhD Abstracts

Efficient Parallel Algorithms for Analyzing Dynamic Networks

Sriram Srinivasan
Advisor: Dr. Sanjukta Bhowmick
CSCI, UNO

Abstract: Network analysis is an important tool for studying large-scale systems of interacting entities that arise in diverse domains such as bioinformatics, and sociology. Properties of networks, such as connectivity, shortest paths between vertices can provide insights into the characteristics of the underlying systems. Since the networks are extremely large, parallel algorithms are essential for timely analysis. However, developing scalable parallel algorithms for networks is very challenging. This is because graph traversal is the primary component of many network algorithms. Traversal over unstructured data, such as networks, lead to irregular memory accesses resulting in low scalability and high computation costs. The problem is even more difficult when the networks are dynamic. In this poster, we present a framework for creating fast and scalable parallel algorithms for updating properties of dynamic networks. Our framework is created using an elegant technique known as graph sparsification. Graph
sparsification uses a divide and conquer approach for updating the network properties. We specifically, demonstrate how scalable algorithms for minimum spanning tree and single source shortest paths can be developed using graph sparsification.

Predicting Movement of Vertices Across Communities in Dynamic Networks

Sriram Srinivasan

Advisor: Dr. Sanjukta Bhowmick

CSCI, UNO

Abstract: As dynamic networks evolve, a certain percentage of vertices can migrate to a different community or form a new community(ies). In this presentation, we present an algorithm on how to identify such vertices. We use a metric known as permanence, which measures by how much a vertex belongs to a community. Identifying the migrating vertices can be used to predict the structure of the dynamic communities as well as the effect of the perturbation in the network.
Scalable Coherent M-ary QAM Transmitter for Next Generation Optical Networks

Naji Albakay

Advisor: Dr. Lim Nguyen

CEEN, UNL

Abstract: We present optical M-ary QAM transmitter using QPSK modulators in tandem driven by binary electrical signals. The proposed transmitter eliminates the need for complex electronics required for the generation of multiple-level signals and provides a Gray-coded constellation with high quality eye diagrams.

Real-Time Robot Path Planning Around Complex Obstacle Patterns Through Learning and Transferring Options

Olimpiya Saha

Advisor: Dr. Raj Dasgupta

CSCI, UNO

Abstract: Robot path planning has been an area of substantial interest owing to its major contribution in several real-life applications ranging from extra-terrestrial navigation to disaster robotics. For completely adopting an autonomous model, improved path planning techniques need to be developed which will invoke reliable navigation in an
unfamiliar environment without human intervention and thus avoid communication delays. We consider the problem of robot path planning in an environment where the obstacle details are initially unknown but the robot can reuse relevant knowledge about collision avoidance learned from previous experience. We propose an algorithm called Semi-Markov Decision Process with Unawareness and Transfer (SMDPU-T) that enables robots to improve their path planning capability by dynamically learning new environmental patterns and corresponding maneuvers from their past navigational experience and probabilistically predict the path to be adopted in presence of partial environmental information. We have conducted several simulated experiments and found that our algorithm takes 24% planning time and 39% total time to solve the same navigation problem compared to a recent, sampling-based path planner.

**Toward Dynamic Programming-Based Management in Reconfigurable Battery Packs**

Ni Lin

Faculty Advisor: Dr. Song Ci

ECE, UNL

**Abstract:** Well-designed battery energy management algorithms are integral and important parts of battery
management and maintenance in various applications ranging from smart grid backup systems to Electric and Hybrid Electric Vehicles (EV/HEV). Management in smart reconfigurable battery systems tend to be more complicated, flexible, and sophisticated since the systematic ability allows access to individual cells for monitoring and control purposes in a realtime fashion. Therefore, in this study, based on our previous work on adaptive reconfigurable battery network, a dynamic programming based management strategy is proposed and validated to fully utilize systematic ability and to optimize energy efficiency while keeping cell to cell states balanced and ensuring safety. To validate the proposed algorithm, battery model is first set up using experimental data on 26650 lithium ion batteries with the help of Arbin test-bed. Simulations are then conducted using the established battery models to figure out the gain in terms of energy efficiency of the proposed algorithm compared with traditional fixed battery system design. The comparison indicates the effectiveness of the algorithm. Furthermore, the proposed method is applicable to battery packs with different types of battery cells in terms of capacity and electrochemistry, which is the key idea of software defined battery.
Energy Efficiency in Heterogeneous Networks

Dongfeng Fang

Advisor: Dr. Yi Qian

CEEN, UNL

Abstract: With the tremendous increase of data services and user equipment (UE) density over next generation cellular networks, heterogeneous network (HetNet) with deploying high density of small-cell base stations (SBSs) is a trend to not only offload the traffic from current macro base station (MBS) but also achieve higher energy efficiency (EE). However, the number and location of UEs are time variant over the cellular network. Therefore, the EE of each SBS may change drastically in different time slots. We propose a HetNet system with a cloud control center to dynamically manage SBSs based on traffic load. The cloud can provide a UE association mechanism to balance both traffic load and spectrum allocation of SBSs and MBS based on throughput requirements of uplink and downlink. Our proposed association mechanism and SBS management mechanism can optimize the EE of network and UEs by considering EE of both uplink and downlink. Device-to-device communications are adopted under service request probability of UEs and distance limitation. The EE
optimization problem is solved in two. First, a decoupled association for UEs over uplink and downlink is adopted. Least path loss criterion is used for uplink association. And priority SBS under signal-to-interference-plus-noise rate threshold and data rate requirement is applied in downlink association. After association, the small-cell base station management is implemented iteratively for adjusting the operation of SBSs to maximize the EE of both the network and UEs. Simulation results show our proposed method can improve the EE of the system with better performance on offloading traffic from MBS to SBSs.

**Correction of Perceived Visual Distortions and Correlation to Retinal Changes in Eyes with Age-Related Macular Degeneration**

Adithi Deborah Chakravarthy

Advisor: Dr. Mahadevan Subramaniam

CSCI, UNO

Abstract: AMD causes vision loss in millions due to permanently damaged photoreceptors in the macula of the eye, where the sharpest central vision occurs. Visual distortions due to damaged photoreceptors and imprecise positioning of retinal implant treatments make it difficult to perform daily activities. Our objective is to develop a wearable device that can
automatically measure distortions perceived by AMD subjects and automatically correct these distortions to restore functional vision in AMD patients. Estimation and the automated correction of visual distortions by our learning algorithms are highly promising in restoring functional vision to AMD patients. Our preliminary Phase-1 trials using our software app achieved around 75% improvement in distorted vision in all patients. Distortions measured in the trials were independently verified by multiple graders and show high correlation to the affected macular regions witnessed in the OCT images. Our image processing software that automatically superimposed the distortions from the software app to the OCT images achieved significant correlation (p < 0.05) between visual function and diseased macular regions. We are developing an improved version of the app to correct higher order visual activities such as reading and ambulation. We are enhancing our machine learning algorithms to dynamically adapt for eye movements and for the error in distortion measurement due to individual variances.
Joint Steganography and Source-Channel Coding for Physiological Signal Transmission

Nerrja Sahu

Advisor: Dr. Dongming Peng

CEEN, UNL

Abstract: We propose a novel Joint Steganography-Source-Channel Coding scheme for scalable physiological signal transmission of over an imperfect channel. Our goal is to secure patient’s confidential data in medicinal signal by using Unequally Steganography Embedding (USE) and progressively transmit it by Joint Source-Channel Coding, limiting the extent of end to end distortion in the received signal, while abating transmission energy. The performance of proposed USE approach has been assessed with the Wavelet-based Weighted Percent Root-mean-squared Difference (WWPRD). Moreover, correlation between cover and stego signal, correlation between embedded and extracted data is compared with the conventional Equal Steganography Embedding (ESE) correlation. Source coder PSNR vs steganography rate is studied and Rate Compatible Punctured Code (RCPC)/ Cyclic Redundancy Check (CRC) are used for error protection. Bit Error Rate (BER) vs. energy per bit and BER vs. channel coding rate for different energy per bit are analyzed.
End to end distortion: I) MSE between cover and stego signal, II) MSE between embedded and extracted confidential data, are analyzed. Simulation results demonstrates that USE attains very low distortion (WWPRD), in addition high correlation between cover and stego. Furthermore, low end-to-end MSE indicates strong imperceptibility and ascertains that Physiological signal remains diagnosable. Moreover, low MSE between embedded and extracted data validates that embedded confidential data can be extracted with negligible distortion. We also propose a simple yet effective Genetic Algorithm (GA) for optimization. Based on our literature reviews, the security, energy efficiency, reliability, and robustness of this proposed method are matchless in comparison with any other published approaches.

A Quantitative Comparison of Statistical and Deterministic Methods on Virtual In-Situ Calibration in Building Systems

Sungmin Yoon

Advisor: Dr. Yuebin Yu

AE, UNL

Abstract: Systematic and random errors of working sensors in building systems could significantly compromise the system’s performance
and thus indoor environmental quality. An extended virtual in-situ calibration has been suggested to solve problems regarding sensor errors and calibration. This calibration can correct these errors for all critical working sensors in building systems without removing working sensors or adding reference sensors as is done in a conventional calibration. This method is capable of estimating measurands using a parameter estimation technique based on mathematical system models. Deterministic and statistical methods can be used for conducting the estimation. In this study, genetic algorithm (GA)-based optimization is used as a deterministic method and Bayesian Markov Chain Monte Carlo (MCMC) is used as a statistical method to solve the calibration problem formulated by the extended virtual in-situ calibration. A case study of a single-effect LiBr-H2O refrigeration system illustrates the problem formulating process and compares the accuracy distributions of calibrations derived from the two different methods.
Physiologically-Aware Communication Architecture for Transmission of Biomedical Signals in SASNs for Emerging IoT Applications

Jose Santos

Advisor: Dr. Hamid Sharif

CEEN, UNL

Abstract: The future vision for IoT-based wearable/BASN devices for healthcare is for these devices to take on central roles as primary point-of-care (PoC) in healthcare management between users and their trusted clinicians with mobile devices acting as Gateways between local IoT-based wearable BASN and the cloud. This global adoption faces a few challenges. Firstly, massive volumes of biomedical data will be generated. This can be costly in use cases where continuous monitoring of an individual is required. The associated energy usage in transmitting this data can diminish the lifetime of the wearable BASN system. Also, on the cloud side, data centers would have to sift through massive amounts of data to determine those regions that are clinically significant, resulting in both time and computational waste. In this paper we investigate how we can address these challenges through our proposed physiologically-aware communication architecture. Patient health state is extracted using in-node
local pre-diagnosis to guide the system in determining when data should be transmitted as well as the format that it should be transmitted in. Furthermore, a feature-based diagnostic distortion measure is employed, which ensures retention of features with clinical significance during source coding, given biomedical signals should be treated with extra care, unlike multimedia signals. Energy savings realized in our experimental work are upwards of a factor of 30 with reduction in biomedical data volume as high as 86% for tested cases.

Transcribing Crowd Trajectories Using Video Overlays

Alexander Fuchsberger

Advisor: Dr. Brian Ricks

MIS, UNO

Abstract: Acquiring motion data of human crowds for crowd simulation research is either inaccurate (image processing), or expensive (sensors). We propose a new method that allows to manually transcribe motion data by using only Youtube videos as a source. In an interactive Web application, researchers can play through the video and place reference points that accurately represent the
current position of humans at a given time. The simulation then adds a trajectory interpolation for a smooth and realistic position estimation of all actors in the simulation. While manual transcription might be slower than e.g. image processing methods, it will be much more precise and the resulting data files are significantly smaller since they only contain key frame positions. This can lead to large performance boosts in simulation rendering.

**Evaluation of Health Levels Using a Correlation Network Model Made by Gait Parameters**

Elham Rastegari

Advisor: Dr. Hesham Ali

Informatics, UNO

**Abstract:** Long-term monitoring individuals’ gait patterns seamlessly and continuously will help physicians to diagnose diseases in the early stages and help them to assess treatment options and find the best treatment. Progress in wearable sensor’s technologies has given rise to the possibility of implementing this idea. However, there is still a lack of an existing model that could assess individuals’ health levels over time by utilizing individuals’ gait patterns and help physicians to diagnose diseases in the early stages or provide them an objective and continuous measure of
the amount of progress a patient has made over a period of time. In this study, a correlation network model is proposed in which identifying various groups of people with various health conditions and identifying gait parameters associated with identified groups are two first steps. Then, a series of significance tests and post hoc tests are needed to select only those parameters that can discriminate between groups of our interest. This will be followed by a pairwise correlation analysis between individuals based on the identified parameters vector. Final step is to create a network model based on correlation results. If gait parameters of two individuals are highly correlated, there will be an edge between two associated vertices. Interpretation of the correlation network model using network properties such as clusters, cliques and gateway nodes will reveal precious health information. In this study, gait parameters of three various groups of people, including healthy younger people, geriatrics and patients with Parkinson’s Disease is used to show the feasibility and importance of the model in monitoring individuals’ health status in a long-term period.
A Comprehensive Study on Improving Supervised Feature Based Link Prediction in Social Networks

Lale Madahali

Advisor: Dr. Margaret Hall

ITIN, UNO

Abstract: Recently Social networks have attracted much attention. As a part of social network analysis, link prediction is an interesting research area. Given a snapshot of a social network it can be predicted which unconnected nodes are likely to connect. Generally, there are 3 approaches to deal with link prediction problem: feature based link prediction, Bayesian probabilistic models, and probabilistic relational models. Many link prediction scenarios, change into a class imbalance problem. There are 3 approaches to deal with classification of imbalanced data, algorithmic approach, preprocessing, and feature-selection approach. Here, reprocessing and algorithmic approach are applied to improve algorithms performance and preprocessing showed a better improvement in our experiments. In this paper, several different experiments on co-authorship networks have been done along with extracting topological features from social network graphs and appropriate data mining techniques are applied in
order to improve classification algorithms performance. As our experiments showed preprocessing approaches resulted in more improvement than other techniques. Also, trees and Naive Bayes were most suitable for prediction in these social networks as they had the best performance evaluation measures in terms of F-measure and AUC (Area Under ROC curve).

Algorithm to Determine the Location and Number of Charging Stations Placed in an Interstate and US-Highway for an Electric Vehicle

Subhaditya Shom

Advisor: Dr. Moe Alahmad

AE, UNL

Abstract: An algorithm has been developed to determine the locations and calculate the number of charging infrastructures for a particular model of an electric vehicle when traveling between two points in a particular Interstate or US-Highway. The algorithm developed is essentially a search algorithm, incorporating many constraints in its formulation, including: range anxiety, rated mileage of the electric vehicle, population of the cities near the Interstate or US-Highway, and distance between origin city and destination city. A mathematical formula is modeled which calculates the real mileage of
the electric vehicle which in turn is used in the search algorithm to determine the number of charging infrastructures to be installed. Simulations were done using the MATLAB software, for determining the location of the electric vehicles charging stations along an Interstate or US Highway. The total number of required charging stations were then calculated. This algorithm has many advantages. Once the number of charging stations and their locations are determined, the travel can be bi-directional. Also the algorithm is flexible, i.e., it can include the existing charging stations and then propose the new charging station locations. The information on the location of the charging infrastructures will help in the planning and incorporation of the charging stations in these cities. Case studies have been shown for the state of Nebraska, USA, to validate the algorithm.

Modeling Molecular Channel Using Queueing Theory Approach

Vahraz Honary

Advisor: Dr. Tad Wysocki

CEEN, UNL

Abstract: The objective of this project is to find a way for simulating the channel in molecular communication. In molecular communication, transporting the data happens through propagation of the micro-scale
particles in a fluid or gaseous medium. Molecules move through the channel due to diffusion and thus transfers the data between receiver and transmitter. In order to model this type of communication channel, diffusion characteristics should be studied. There are some models which choose a tedious and time consuming method and model this communication channel based on partial differential equations. In this project, we have chosen another approach and propose a novel method to model the molecular channel based on queueing network. Moreover, derived from the combination of the Fick’s law and the principle of queueing theory, we propose a new mathematical formula in order to model the channel in any environment for the Molecular communication. Then by implementing the derived model we have been able to simulate the channel for various one-dimensional scenarios.

**Generalized Effects of Faults on Normalized Performance Variables of Air Conditioners and Heat Pumps**

Mehdi Mehrabi

Advisor: Dr. David Yuill

AE, UNL

**Abstract:** Performance degradation of air conditioners and heat pumps due to faults has been studied in several
experiments reported in the literature. Using all available results in the literature, the effect of faults on single-speed air-cooled air-conditioners and heat pumps is summarized. Generalized relationships have been developed to describe the fault effects, and these are provided for equipment operating at ANSI/AHRI 210/240 standard test conditions. Results are presented separately for fixed orifice (FXO) and thermostatic expansion valves (TXV), for both cooling and heating modes. The variation level of the results indicates that for many applications, it is reasonable to use these generalized relationships to estimate the effect of faults on systems that have not been tested in a laboratory.

**Granularity-Aware Integration through Indirect Data Fusion**

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**Abstract:** Modern biomedical research requires integration or fusion of data sources. While the purpose of fusion is to create a more accurate picture of biological reality, latent sensitivities of the fusion process preclude precision and result in information loss, unless addressed. Biomedical data fusion is sensitive to
granularity dimensions, scales of semantic relationships across specificity and mereology. Data at high granularity is low in false-positives and useful for filtering; data at low granularity is low in false-negatives. When data fusion occurs between the two granularities, these benefits counteract each other and disappear, causing information loss. We propose a data fusion approach between gene-related domain knowledge networks as low granularity and gene expression data networks as high granularity. In our methodology, we prevent direct computational interaction between low and high granularity as an attempt at maintaining their individual advantageous aspects. We compare the information extraction of this fusion approach to a union fusion approach, expression only networks, and domain only networks in a pancreatic cancer case study. We find that this separated-granularity fusion approach outperforms the combined-granularity fusion approach, the expression only, and the domain only networks. Further, the proposed approach increases the information extraction effect size between test and control networks, allowing for a more abrupt delineation between the two conditions.
Hybrid Technology Networking: Intelligent On-board Real-Time Monitoring of Railcars

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Abstract: The advent of the Internet of Things (IoT) has proliferated the use of connected sensors to observe and control the world around us. Wireless Sensor Networks (WSN) are becoming ubiquitous tools that monitor their surroundings and also often times provide actuation to affect the state of their environment. One of the key application domains for real-time monitoring and control is the freight railroad sector in North America. North America’s freight railroad industry is responsible for transporting nearly 40% of goods, making it an inseparable aspect of national economic well-being. The current stationary wayside methodology of monitoring freight trains and the goods they transport is not effective and cannot provide the breadth of capabilities required to ensure safe and efficient operations. The use of otherwise popular existing communication technologies like ZigBee for this scenario were found to perform insufficiently due to the unique network topology imposed by the freight train. The Hybrid Technology Networking (HTN)
protocol has been proposed to alleviate these issues. A custom hardware platform is presented to optimally implement and deploy networks of sensors using the HTN protocol. A modular analytical model for predicting network performance metrics using this platform is designed that is extendable to any wireless network deployment. Custom optimization techniques are used to select best routes through the network. Field test results of the hardware with performance results of the analytical model are presented.

**Low Charge Detection and Diagnosis for Non-Critically Charged Refrigeration System**

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**Abstract:** A new set of algorithms has been developed to detect low charge fault for single compressor non-critically charged refrigeration system for both frozen and perishable goods. A mix of field units’ data and experimental data were used to build the detection algorithms. Multiple detection algorithms were devised based on the operation modes. The system operates in multiple distinctive modes. Each mode has a defining characteristic. The used data includes several healthy and predefined low
charge defected systems which gave us a prediction of the loss of charge percentage in different operational modes. This prediction provides us with a good knowledge of the system performance and operation.