Student Capstone & Research Conference
Engineering, Information Science, and Technology

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The University of Nebraska at Omaha is an equal opportunity educator and employer with a comprehensive plan for diversity.
Welcome Conference Participants and Volunteers!

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

*Peter Kiewit Institute Student Capstone & Research Conference in Engineering, Information Science & Technology*

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.
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2014 PKI Student Capstone & Research Conference

Schedule of Events

8:00-10:00 AM  Registration & Continental Breakfast

9:00-12:00 PM  Presentation Tracks

12:00-1:00 PM  Lunch

1:00-4:00 PM  Presentation Tracks

4:00-4:30 PM  Judges Break-out Session

4:30-5:00 PM  Social

5:00-5:30 PM  Awards Ceremony

Track 1:

Undergraduate Engineering Research
Programmable Logic Controller Concealer (PLCC)

Ian Dikeman

Computer & Electronics Engineering
University of Nebraska-Lincoln

Programmable Logic Controllers (PLCs) are used globally as controls for various electromechanical devices, but many PLCs are currently accessible via the public internet and have little to no built in security. This poses a tremendous safety and financial hazard for both individuals and businesses, as these devices are often used to control important infrastructure systems such as gas stations, water treatment facilities, and power plants. If these devices are not secured, these sensitive and critical systems will be left vulnerable to attack by any determined hacker and could be shutdown or otherwise controlled. Therefore, there is a need for better security for PLCs, especially those that control infrastructure systems, and the focus of the Programmable Logic Controller Concealer (PLCC) is to help address this need by acting as a prototype development platform to aid the security research of the University of Nebraska Omaha’s Information Assurance (IA) Department, the project’s sponsor. This development platform provides an opportunity to validate previous security research performed by the IA department using real hardware, while also opening new avenues of experimentation and research for the future.

Go-Fish

Noah Carpenter

Computer & Electronics Engineering
University of Nebraska-Lincoln

The GO-Fish provides users a new fishing experience that differs from traditional fish finders. Not only are users able to use their mobile device as the user interface for this system but they are also able to share their experience with others who have mobile devices. The system consists of a transducer, a computing hub, and a mobile application. The transducer consists of a sonar module and temperature sensor; the sonar module pings and returns a range and the temperature sensor returns a temperature reading. Those readings are then sent to the microcontroller on the computing hub for further processing and transmission. The computing hub processes the information that is sent to it and has the information properly setup for transmission to the mobile application via Bluetooth. The GO-Fish system will change the users’ fishing experience for the better. The same basic fishing data (depth, fish location, water temperature, boat location, etc.) is provided but it all will be presented in a manner different from your average fish finder. The GO-Fish interfaces with the user through a mobile application on his or her android device with Bluetooth connectivity capabilities. The mobile application displays floor depth and fish locations on a real time graph. The mobile application can also display the devices current location and keep a history of previous fishing locations. This system is not meant for one sole user’s gain, it’s meant to share and it shares by connecting up to three different android devices via Bluetooth to the main computing hub.
CeeNC
James Gehringer
Computer & Electronics Engineering
University of Nebraska-Lincoln

The CeeNC is designed to be a network enabled, configurable Computer Numerical Control (CNC) interface that is compact and affordable. The CeeNC accurately and safely drives a set of motors based on G-code files uploaded over the network. The file will be interpreted in a single board computer and a microcontroller. The microcontroller then correctly controls the motors through the motor driver board. Multiple alternatives were considered and reviewed during the design process. The system costs less than $100 and can be used to drive a variety of devices, for example a CNC Mill or a Three-Dimensional (3-D) printer, through a web interface. The CeeNC meets the requirements for the Senior Design Capstone Project. This report will suggest price reduction by reducing hardware for system improvement.

Toward a Mind Controlled World
Abdulrahman Al-Abri
Computer & Electronics Engineering
University of Nebraska-Lincoln

Throughout history mankind worked hard to provide an easier life in all means of life. Washing machines, escalator, elevator, etc. were invented not because we can't do those tasks ourselves, but to save time and effort. Lights, calculators, and millions other invention were invented not because we cannot handle those tasks, but rather to take unnecessary burden from our mind so we can use that time and effort in more useful things. From the industrial revelation which allows machine to do mass production, to the digital leap. Between then and now a human interaction is required to control whatever machine or task; which a day after day proves it is impractical. The world is expecting a leap where human direct commands are no longer necessary. This is where the science of neuroelectrics takes place. Being able to read the electrical signal of the brain is big step; which known as EEG "electroencephalography". Analyzing these signals in labs and creating a pattern will allow us to control machines indirectly. The room is too cold? This feeling will create a signal to the air conditional to adjust the room temperature. Harnessing this technology will encounter every aspect in our life; driving cars, controlling wheel chairs and the list will go on. This will even allow us to interpret feelings we have which we couldn't explain before; now it easy; its matter of reading signals. The big challenge in this technology is getting a more precise signal and create pattern to link those signals.
Hydro Electric Retrofit for Existing Dam
David Lang
Construction Engineering
University of Nebraska-Lincoln

Hydroelectric Retrofit for Existing Dam The Construction Engineering Capstone students enrolled in CONE 4890 have assembled a joint venture construction project in response to a proposed dam rehabilitation project for a hydroelectric retrofit. The existing earth dam is located in a fictional location with environmental conditions very similar to those of the Kingsley Dam located in western Nebraska, retaining Lake McConaughy. The joint venture is composed of two constructors, Beavers, Inc., and Moles, Inc. Together, their proposals entail the dewatering of the appropriate work area required to install 150m of steel section pipe (10 meter inner diameter) through the existing dam. This pipe will be used to connect the hydroelectric plant upstream to the downstream turbine. Beavers will be responsible for all equipment, labor, materials, and services, including safety provisions and organization of subcontracted work, associated with dewatering the worksite. Moles will be responsible for all equipment, labor, materials, and services, including public safety provisions and organization of subcontracted work, associated with the installing the length of pipe connecting the future plant and turbine. The plant and turbine will be constructed by separate contractors following this proposed work. Each constructor will be responsible for their respective phase of the project and will summarize their approach in both proposed methods and cost analysis. This presentation and paper will outline alternative solutions to complete the retrofit project. The chosen solution was deemed best based on cost, time, and public safety considerations. These aspects will be presented in the Capstone Conference.

An Interactive Simulation Model for Construction Education
Saeed Rokooei
Computer & Electronics Engineering
University of Nebraska-Lincoln

This paper illustrates the design procedure, implementation and findings of a research project at UNL. Virtual Interactive Construction Education (VICE) is a project-based pedagogical model that uses a simulated environment to alter traditional subject-based lectures into virtual project-based interactive learning methods in construction engineering and management programs. The context of construction engineering and management curricula were aggregated into six construction project prototypes. VICE-Bridge is the first of these six prototypes that exposes players to experiential problem solving activities toward achieving a goal situation (construct the bridge) from an initial situation (start of construction). Achievement was measured by increases in construction knowledge gain, level of engagement, perceived construction knowledge gained as a result of the VICE intervention. A mixed methodology of both quantitative and qualitative methods was utilized in this research. The data of pre-game quiz and actual performance of players were extracted and compared to show the difference between the knowledge gained through the VICE. In addition, participants responded to a retrospective pre- and post-self-assessment survey of six main areas of construction knowledge. The sample included 40 high school students which had very little to no construction experience. The self-reported level of engagement showed players to be “mildly” to “very engaged”. The results showed improved performance as an outcome of the VICE intervention. Players also indicated that they perceived an increase in knowledge for the six major areas. These results support development of more construction education and indicate that this particular simulation is an effective tool for this purpose.
Hydro Electric Retrofit for Existing Dam
David Lang
Construction Engineering
University of Nebraska-Lincoln

Hydroelectric Retrofit for Existing Dam: The Construction Engineering Capstone students enrolled in CONE 4890 have assembled a joint venture construction project in response to a proposed dam rehabilitation project for a hydroelectric retrofit. The existing earth dam is located in a fictional location with environmental conditions very similar to those of the Kingsley Dam located in western Nebraska, retaining Lake McConaughy. The joint venture is composed of two constructors, Beavers, Inc., and Moles, Inc. Together, their proposals entail the dewatering of the appropriate work area required to install 150m of steel section pipe (10 meter inner diameter) through the existing dam. This pipe will be used to connect the hydroelectric plant upstream to the downstream turbine. Beavers will be responsible for all equipment, labor, materials, and services, including safety provisions and organization of subcontracted work, associated with dewatering the worksite. Moles will be responsible for all equipment, labor, materials, and services, including public safety provisions and organization of subcontracted work, associated with the installing the length of pipe connecting the future plant and turbine. The plant and turbine will be constructed by separate contractors following this proposed work. Each constructor will be responsible for their respective phase of the project and will summarize their approach in both proposed methods and cost analysis. This presentation and paper will outline alternative solutions to complete the retrofit project. The chosen solution was deemed best based on cost, time, and public safety considerations. These aspects will be presented in the Capstone Conference.
Rainwater Harvesting System Collaboration
Shaylea Valentine
Civil Engineering
University of Nebraska-Lincoln

Through the course titled Sustainable Infrastructure Engineering, the University of Nebraska is partnering with City Sprouts Community Garden to provide them with a rainwater harvesting system. The system will serve as a supplemental water supply for the garden, as well as an educational tool to raise awareness of water conservation. The project as a whole is a practice in the application of community development and appropriate technologies. The project includes the design of gutter systems, piping, a first-flush system, storage, overflow protection, and an operation and maintenance plan for the client. The report also includes a budget, construction scale, and educational materials for the client.

Rainwater Harvesting System
Scott Matson
Civil Engineering
University of Nebraska-Lincoln

The focus of my project was to assist in the design and implementation of a rainwater harvesting system for use at the City Sprouts community garden in Omaha, NE. This system will serve as a supplementary water source to the site, as it has recently acquired primary water services. The mission of City Sprouts is to foster community bonds while providing a safe place for residents to learn about gardening using sustainable techniques. The rainwater harvesting system will primarily serve as a learning tool to teach future generations the importance of sustainable practices, as well as to serve as a design model for residents wishing to implement similar systems on their own homes. The system will also aid the non-profit garden economically by reducing their water consumption from municipalities. In order to achieve the desired result, my team maintained contact with garden leaders throughout the entire design phase, and made multiple visits to the site location to assess possible concerns. The finished project should provide enough water storage to serve the needs of 18 fruit trees during drought conditions, and will have an excess water balance to use on other crops during years of average or high rainfall.
The goal of the project is to provide a cheap, scalable, and robust way of measuring the effectiveness of a radio frequency (RF) shield. RF shields are important to protect electronics from attack by an outside source. These attacks can include: malicious wiretapping, espionage, or electromagnetic Pulse (EMP). It is necessary that all sensitive and critical information is protected by an RF shield. This project ensures that the shield is working properly under all conditions. The SHIELD project sends a strong 900MHz signal through the shielding material and receives it on the opposing side. During this process, a single transmitter sends information to multiple strategically placed receiver nodes. Each node records its signal strength and sends the data to be aggregated and recorded in a database. A web application is provided to display the system results. This project allows a central user to easily find the weaknesses in the shielding material, as it can measure an attenuation of a signal up to -60dB, or (1/1000 th) of the original signal. The SHIELD system also provides external ports for additional frequency implementations. Therefore, this project is a scalable, accurate, and inexpensive method for determining RF protection.
Engagement of High School and Middle School Students in Robotics: Solving Space Challenges in the Zero Robotics Competition
Claire O’Connell
Computer Science
University of Nebraska-Omaha

The goal of this project is to engage Omaha middle and high school students into University of Nebraska at Omaha programs through competing in an international robotics tournament. The aim of this project is to build and prepare a team(s) of middle and high school students to compete successfully in the 2014 Zero Robotics challenge. This tournament is a program organized by MIT and NASA and it provides high school and middle school students an opportunity to do real space research. Students compete in virtual programming challenges using the SPHERES (Synchronized Position-Hold Engage Reorient Experimental Satellites) robots that were developed at MIT.

The final phase of competition takes place live aboard the International Space Station (ISS) on the real SPHERES robots that are already on board. In the 2013 tournament there were 13 European countries and 29 states from the US participating. Nebraska was not represented by any team. The importance of this endeavor is that it will provide outreach between the University of Nebraska at Omaha’s computer science department and area high schools, while also creating interest in math and computer science and keeping our best and brightest students here in Nebraska. We have built a team of students from several Omaha high schools and have begun teaching them the math, physics, and programming skills they will need for the competition. The students have shown a real interest in learning and have already improved in their skills in the robotics space challenges.

Exploitation of Allen Bradley’s Implementation of EtherNet/IP for Denial of Service Against Industrial Control Systems
Ryan Grandgenett
Information Assurance
University of Nebraska-Omaha

Supervisory Control and Data Acquisition (SCADA) systems are essential to the operation of national critical infrastructures. It is not surprising that these systems continue to be the targets of many covert and disastrous cyber-attacks. The feasibility and consequences of cyber-attacks will likely increase as more automation systems are connected to enterprise or even public computer networks. Securing SCADA communications as well as discovering and patching security bugs before a threat agent (internal or external) can exploit them is of critical importance. Unfortunately many vendor implementations of the protocols that control and manage SCADA systems assume that no threats exist on the internal “private” network. This assumption of a trusted Local Area Network (LAN) is inadequate and unacceptable given the sophistication of cyber attacks on SCADA systems. Once an attacker gains a foothold on any machine on the LAN where SCADA controllers, sensors and actuators are installed, the monitoring and disruption of cyber physical process becomes possible. To systematically discover vulnerabilities in SCADA control and management protocol design, we conducted research into the design of these protocols. This paper presents three proof-of-concept denial of service attacks discovered as a result of our study. These attacks expose inherit vulnerabilities in Allen-Bradley’s current implementation of EtherNet/IP, a widely used SCADA protocol and ODVA (Open DeviceNet Vendors Association) standard, and the RSLogix 5000 software that designs and programs SCADA system operations. The ControlLogix EtherNet/IP Web Server Module (1756-EWEB) is used in our test bed to confirm the vulnerabilities. A cyber-physical model environment was set up to monitor, analyze, and record the SCADA system’s network traffic. Reverse engineering of EtherNet/IP packets from the network traffic was performed in order to determine the structure, command options, and potential vulnerable fields. Our findings have led to the creation of three denial of service attacks: mass session request, command packet flooding, and TCP connection hoarding. These attack programs abuse Allen Bradley’s EtherNet/IP documented structure, commands, and trusting nature of internal network traffic to directly impact the availability of the SCADA system. These same attacks, executed against a real, live system, could have devastating effects; as such the failure to recognize and fix EtherNet/IP implementation shortcomings could have lasting and widespread physical impact. This paper presents the analysis, development process, results, and potential consequences of the attack programs.
Heroes of the Primal: A Small-Scale MMO Video Game
Angela Gillespie
Computer Science
University of Nebraska-Omaha

Heroes of the Primal is a small-scale massively multiplayer online (MMO) fantasy-based video game. The player’s objective is to prevent the world’s enemies from taking over. The player and other online friends will team up to fight the fire, water, air, and earth enemies to ultimately bring the world back to peace. To create this game, many different components are unified to create a product that excels in function and design, technically and artistically. The networked space consists of the game server, hosted by Photon on a laptop, and controls the player’s positions and synchronizes these positions with other online players in the game. The online database component holds and maintains updates to the user’s character data through the use of PHP scripts and give the user the ability to register, create, and save their character. The game logic involves updating statistics of the players and enemies including experience, level, health, and mana on-screen along with spawning enemies and controlling the artificial intelligence of the enemies’ attacks. The game logic also controls leveling up after the player defeats the boss of the current level. The graphics are linked with either the players’ controls which includes walking and attacking or the artificial intelligence that controls the wandering and attacking of the enemies. The animations are also closely linked to the networked space so the synchronization of updates occur in real time. Overall, the goal of creating this game for a capstone project was not only to meet the design requirements set in place by Professor Patrick Cavanaugh, the client, but also to display multiple facets of Computer Science interfacing together cohesively.

Breaking Snapchat: A Mobile Forensics Investigation
Ryan Grandgenett
Information Assurance
University of Nebraska-Omaha

Computer forensics is a vital part of today’s evidence recovery process, and one that will only continue to get more important with the passage of time and advances in technology. As a subset of computer forensics, mobile device forensics is a major area of concern for forensic examiners because mobile devices operate differently than a computer. With that comes the need for forensic examiners to gain an understanding that the rapid rate of change in mobile device development is making mobile forensics very difficult. Mobile devices such as smart phones or tablets are changing the way that examiners must perform live state inspection and data recovery. This process is only made more difficult by the large range of applications that users can install and run on their devices. This paper discusses a forensics investigation of Snapchat, a popular Android/iphone application. Due to time and resource constraints our investigation was limited to only the Android platform. Snapchat is a well-known application by users, however for forensic examiners it provides many challenges. Our investigation focused on finding and recovering digital artifacts left by the Snapchat application on the mobile device including pictures, videos, SQLite databases, and Snapchat source code. Our research of the Snapchat application utilized many resources including: interviews, webinars, and online information to gain an understanding of Snapchat and how it operates. Using this information we performed a forensic investigation of Snapchat that yielded many interesting forensics results. This paper presents the analysis, key findings, and results of the digital forensic investigation of Snapchat.
Comparative Mitogenomics among Metazoan Species
Benjamin Wicks
Informatics
University of Nebraska-Omaha
The mitochondrial genome changes over time, and the rate at which it changes is a good measure of an organism's evolution. One promise of comparative genomics is to further determine the structure and function of mitochondrial DNA and to build a more complete evolutionary tree based on the iterative changes to mitochondrial genomes. The objective of my capstone project was to build upon previous knowledge obtained from comparative mitogenomic analysis. Specifically, I created a new, custom online phylogeny tool which enables evolutionary genetics researchers to examine evolutionary relationships among Metazoan mitochondrial genomes more closely.

Computational Framework to Identify Potential MRNAs Localized to the Mitochondria
Kaitlin Goettsch
Informatics
University of Nebraska-Omaha
The mitochondrion is an energy power house in a human cell. The genome present in mitochondria contain genes that code for only 13 proteins. However, with advancements in proteomic and genomic technologies, we now know that modern day mitochondria are comprised of over 1,000 proteins. After the messenger RNA (mRNA) is translated in the cytoplasm, the signal peptide at the N-terminal of the resulting protein directs the transport machinery of the cell to ship the protein to the desired location. Such a mode of localization of nuclear encoded proteins to different organelles in a cell is a well-known phenomenon. However, only 40% of human mitochondrial proteins contain such N-terminal signals. Recently researchers have shown that mRNAs could be targeted to the vicinity of mitochondria where they are translated into protein, which then gets localized into mitochondria. The goal of our study was to determine if any structural features in the 3’-UTR of mRNA represented a localization signal. Using the computational method of text-mining, we have collected 3,111 probable transcripts corresponding to 320 human genes. Results on our study to identify asymmetrically localized mRNAs based on structural signals will be presented.
Botnets are networks of malware-infected computers that are coordinated to send spam and accomplish other malicious tasks. Individual bots traditionally receive instructions from centralized command and control servers or from peers who are assumed to be trustworthy. These strategies allow botnets to be detected and taken down and their owners to be unmasked. We propose a new botnet architecture that resists these threats by communicating through dead drops. In espionage, a dead drop is a message passing technique in which one party hides a message in an inconspicuous public location for another party to retrieve at a later time. The two parties do not need to meet directly, reducing the mutual potential for betrayal. We use steganography to hide botnet instructions in ordinary images that can be uploaded to public websites by anonymous users for bots to retrieve. Each instruction contains future drop locations, described with variable precision ranging from a file URL to an entire website. Even if some drop locations are revealed, defenders cannot practically blacklist imprecise locations on popular websites without unacceptably impacting end users. The dead drop architecture is successfully demonstrated by embedding instructions in images within a series of blog comments. We are unaware of whether this architecture is already in use but hope our work will spur the proactive development of mitigation techniques.
Simultaneous Task and Motion Planning using Task Reachability Graphs
Brad Woosley
Computer Science
University of Nebraska-Omaha

Task and motion planning are two fundamental problems in robotics which are frequently encountered in many applications for robots. Task planning involves finding a sequence in a set of tasks satisfying some set of constraints. Path planning involves finding a path through the environment which is collision free between a start and goal location. Since, in most cases, a task involves going to a point in the environment to perform some operation, task and path planning are closely related. However, these two problems have been normally addressed as two separate research problems. Only recently researchers have considered combining these two topics using a technique called Simultaneous Task and Motion Planning (STAMP). In this research, I propose a new method to solve the STAMP problem using a framework called a task reachability graph (TRG). A novel feature of this approach is that it incorporates a very practical aspect of robotics - uncertainty in the robot’s motion and uncertainty in the environment into the decisions made by the robot to determine the order of performing tasks while traversing the vertices of the TRG. I will validate the proposed algorithm using two Corobot robots performing different numbers of navigation tasks within an indoor environment. I will also compared it with another recent STAMP algorithm called MRTA-RTPP and to evaluate the change in performance obtained by the TRG-based algorithm.

Random Path Assembly for Network Analysis
Shehla Ahmed
Computer Science
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Random Path Assembly for Network Analysis Analyzing large networks is a difficult task. To analyze a graph to its entirety we have to depend on graph traversal. During the graph traversal we do not know the procedure or pattern of how to access the data. If the data is not in cache it will take a long time to access the data (memory latency). Ordering the graph to decrease latency is not feasible and it also depends on the structure of the graph. In the parallel domain distributed memory algorithms are not always scalable, and multithreaded methods require the network to be very large. Our approach is inspired by the gene sequence assembly in which a huge gene is analyzed using a shotgun method, we use a similar approach. Instead of random pieces of the gene, we used the random walk sequences on the graph and then combine the sequence to obtain the results. Our goals are: (1) Given a set of sequences we combine them appropriately to obtain the network properties. (2) Properties analyzed are connectedness and closeness centrality. (3) We want to determine the optimal path length and the number of sequence to accurate results.
Using Surface Enhanced Raman Spectroscopy Technique for Biomedical Approaches and Breast Cancer Detection
Sara Mollamohammada
Civil Engineering
University of Nebraska-Lincoln

Cancer is defined a group of diseases characterized by unregulated cell growth. There are many different types of cancer, and each is classified according to the cell that is affected. Breast cancer is one of the common types of cancer that mostly infected women. Treatment for invasive breast cancer usually includes combination of surgery, radiation therapy and chemotherapy. One of the challenging parts of breast cancer surgeries is tumor margin detection. The techniques that are used right now are time consuming with low resolution that makes many of patients to repeat the surgery. Surface-Enhanced Raman Spectroscopy (SERS) is a powerful technique that provides unique information about a sample, and can be used to differentiate tumor from normal tissues. This study will evaluate Raman Spectroscopy technique to differentiate between normal and cancer tissues and also to detect the margin of tumor in breast cancer. At the first phase of study, thin Excised normal and cancer tissues from mouse were sliced and fixed on glass slide and coated with Silver and gold nano-particulates. SERS spectra were acquired and analyzed with a Micro-Raman Spectroscope to differentiate between normal and cancer cells. At the second phase, a database that contains Raman spectra measurements will be prepared using human tissues. This database will be worthwhile to distinguish the type of tumor, and also the similarities and differences between samples from each group.

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Within the field of computer security, digital forensics is playing an increasingly important role. While most research in this field is focused on collecting and visualizing evidence, there is a critical need to understand, by systematic argumentation on part of a forensics investigator, how detailed technical evidence is linked to high-level claims of criminal behavior. There exists a gap in how to make convincing arguments for the conclusion of an investigation based on digital forensics evidence. Using case study designed research methodology, this thesis examines the application of assurance cases to digital forensics as a way to present evidence, arguments, and claims from an investigation in such a manner as to provide a logical chain of claims connecting the low-level evidence to a top level claim, that being the conclusion of the investigation. This study of the application of assurance cases shows that they appear to have promise as an additional tool for the reporting phase of a digital forensics investigation. Compared to the traditional reporting method for digital forensics, assurance cases can provide a quick overview of the evidence and greater confidence in the conclusion of the investigation, and they can be used to present a less technical approach for discussing an investigation with lay-people.
Modeling the Effects of Microgravity on Oxidation in Mitochondria: A Content and Structural Assessment Across a Diverse Set of Life Forms

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Informatics
University of Nebraska-Omaha

Exposure to weightlessness (microgravity) or other protein stresses are detrimental to animal and human protein tissue health. Protein damage has been associated with stress and is linked to aging and the on-set of diseases such as Alzheimer’s, Parkinson’s, sepsis, and others. Protein stresses may cause alterations to physical protein structure, altering its functional identity. Alterations from stresses such as microgravity may be responsible for forms of muscle atrophy (as noted in returning astronauts), however, protein stresses come from other sources as well. Oxidative carbonylation is a protein stress which is a driving force behind protein decay and is attracted to protein segments enriched in R,K,P,T,E and S residues. Since mitochondria apply oxidative processes to produce ATP, their proteins may be placed in the same danger as those that are exposed to stresses. However, they do not appear to be impacted in the same way. Across fourteen diverse organisms, we evaluate the coverage of motifs which are high in the amino acids thought to be affected by protein stresses such as oxidation. For this study, we study RKPT and PEST motifs which are both responsible for attracting forms of oxidation across mitochondrial and non-mitochondrial proteins. We show that mitochondrial proteins have fewer of these oxidative sites compared to non-mitochondrial proteins. Additionally, we analyze the oxidative regions to determine that their motifs preferentially tend to make-up the connection points between the four kinds of structures of folded proteins (helices, turns, sheets, and coils).


Jie Xiong
Management Information Systems
University of Nebraska-Omaha

Information and Communication Technologies (ICTs) have often been touted as a means of enabling people to make their way out of poverty. While there are success stories of people in Africa who have been able to access and use mobile and internet based technologies to build businesses that give them better livelihoods, it is unclear how these technologies, are being used by African American and Native American entrepreneurs in the United States. Pockets of low connectivity and lack of awareness or technical skills, mean that some entrepreneurs are unable to take advantage of the opportunities provided by ICTs in the United States. This paper investigates the digital divide in micro-enterprises owned by African-Americans and Native Americans in a mid-western city. Data collected through three case studies are analyzed using a model previously developed to arrive at the level of ICTs needed to support and sustain the micro-enterprises.
How Personal should Personal Genomics be?
Scott McGrath
Informatics
University of Nebraska-Omaha

The consumer market place to allow the public to purchase genetic tests emerged in 2006. Companies, known as Direct-To-Consumer (DTC) genetic testing, marketed their test online, allowing customers to buy genetic tests. Would removing the supervision of medical professionals have an impact on the customer’s ability to properly comprehend his or her results? Customers of the DTC company 23andMe were invited to participate in a 27 question online survey. 122 subjects who met inclusion criteria completed the survey. Since there is a chance these test results can lead to medical or lifestyle changes, involving an honest broker, or a 3rd party medical professional, would help to reduce cases of poorly interpreted results from DTC companies by their customers.

How Personal should Personal Genomics be?
Ye Yuan
Civil Engineering
University of Nebraska-Lincoln

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An Auction-Based Position Selection Algorithm for Efficient Reconfiguration in Modular Robots

Ayan Dutta

Computer Science

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We consider the problem of reconfiguration in modular self-reconfigurable robots where modules, starting from arbitrary locations, are required to assume appropriate positions so that they can get into a new target configuration. This problem is non-trivial as the desired positions of different modules in the target configuration could conflict with each other resulting in occlusions and failed attempts to achieve the target configuration; modules should also select positions that reduce their energy expenditure for locomotion and communication. To address this problem, we propose an algorithm called the spot allocation (SA) algorithm that uses an utility-based model on each module to rank positions, followed by an auction-based technique to allocate positions to modules. We prove analytically that our algorithm is deterministic, complete and optimal (in case of no conflicts between modules). We have also verified the operation of our algorithm in simulation within the Webots simulator and compared the algorithm’s performance with other allocation strategies. Our results show that our proposed algorithm is able to successfully reconfigure different numbers of modules to different target configurations and performs better than the compared strategies in terms of run time, utility and violations of energy (battery) constraints.

Application of Geographic Information System in Water Resources

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Growth of population and development of urban, agricultural, and industrial activities in most parts of the world in one side, and other phenomena such as climate change and drought in the other side, have endangered waters resources in the recent years. Therefore, better water resource management and assessment is necessary in order to save the water resources. A Geographic Information System (GIS) is a powerful tool that can provide a spatial dimension of the water resources, and it is able to identify and evaluate potential solutions. This study presents the application of geographic information system in water resources, through a simple example which investigates the quality of groundwater resources in Darab plain (Dasht-e Darab) which is located in the South of Iran. In order to achieve the goal, different quality factors data from the 75 wells were used, and the concentration level of some factors such as sulfate (SO4), chloride (CL), total dissolved solids (TDS), and etc... in the Darab plain were studied. The results show that, in the most areas which have a low groundwater elevation, quality factors exceed the desirable concentration level, and groundwater does not have the sufficient quality. 

Key Words: GIS Analysis, Groundwater Quality, Darab Plain, and Groundwater Elevation.
Evaluating the Efficiency of Different Drought Indices for Drought Detection
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Drought is a repetitive climate characteristic, and as a general term it can be said that drought is a reduction in precipitation, and consequently lack of water in a region. Since Iran is located in the arid and semi-arid region, it has experienced multiple and pervasive droughts in its different parts during the recent years, in a way that drought has become a normal climate phenomena in Iran. Therefore, in order to cope with drought, and reduce its damages, drought forecasting and analyzing can be used as the most appropriate strategy especially for the arid and semi-arid regions like Fars province which has been affected by many droughts during the recent years. So finding the most appropriate drought monitoring index which can be used for drought detection would be a great help to manage drought effects. Accordingly, the purpose of this study is to study the features of the precipitation in the city of Shiraz which is the capital of Fars province, and investigating the performance of different drought indices in the Shiraz region, and choosing the most appropriate one. For doing that, Z-Score, SPI, DPI, PNPI, and RAI indices were studied, and in order to find the most appropriate index, the Spearman's Rank Correlation Coefficient was used to calculate the correlation values between drought indices ranks and the precipitation changes during the statistical period. At the end, it became clear that Deciles of Precipitation Index (DPI) is able to detect droughts in the region more efficiently than the others.

Remote Server Management Technology: Research into Potential & Existing Vulnerabilities
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Abstract- Remote server management is not an entirely new technology or concept, but developmentally it is still a rather young technology. The purpose of the first part of this paper is to recount the development of this technology and the various forms it has taken through developments with different vendors. The next section is a research into the vulnerabilities that have been discovered throughout the lifetime of some of the various forms. To avoid any ambiguity this paper looks mostly at HP’s iLO technology in its Proliant servers and DRAC from Dell, with other technologies being mentioned as necessary. The next section of the paper deals with theorizing potential new threats that may be outside the realm of the assessments researched in the previous section. The paper wraps up with a conclusion that compares and contrasts the actual previously discovered vulnerabilities with the theorized vulnerabilities and then attempts to determine the risk and threat levels if an exploit can be made against the theorized vulnerabilities. The final section of the paper is a proposal for future work to be done regarding the vulnerability assessments of existing and developing remote server management technology. This will be seen as a lab experiment and other suggestions for areas of research. As the concept of remote server management grows in popularity and implementation, it is imperative that we understand the vulnerabilities and threats that can compromise the systems that contain these servers.
Cancer research has generated a valuable body of knowledge about the mutations that play a significant role in cancer proliferation. These mutations have lead to gain of function in oncogenes where as detrimental loss of function in tumor suppressor genes. Pancreatic cancer (PC), in particular pancreatic adenocarcinoma (PA), is one of the deadliest forms of cancer, resulting in 38000 deaths in the United States per year. The current 5-year survival rate for patients treated with state-of-the-art therapies is merely 5%. To date, abnormal CA19-9 level is the most reliable diagnostic serum marker. However, it is still not effective in detecting the cancer early enough for available therapy to be effective. This lack of early diagnosis has been recognized as the major cause for the high mortality rate observed in pancreatic cancer. More recently, microRNAs have been identified as potential biomarkers in the diagnosis as well as therapeutic agents in the treatment of pancreatic cancer patients. MicroRNAs (or miRNAs) are short ~21-22 nucleotide long non-coding RNAs that act as regulators of gene expression. Gene expression studies have shown existence of deregulation of miRNA genes during tumor conditions. In this study, we developed a context-based computational approach to identify relationship between miRNAs and biological processes or pathways involved in pancreatic cancer. The long-term goal of our research is to establish a computational framework capable of integrating multiple-relevant knowledgebase (miRNA-mRNA interaction, gene expression, biological process and metabolic pathway data) to identify candidate therapeutic miRNA(s). Successful completion of this goal is expected to increase the specificity of therapeutics and reduce the side effects associated with current methods.
Self-Limiting Flux Behavior of Forward Osmosis Processes
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In the forward osmosis (FO) process, concentration polarization (CP) reduces the solute concentration difference across the membrane, thereby significantly lowering the osmotic pressure difference (Δπ). In this study, a set of experiments were conducted to study CP behavior of the FO process under static conditions. The formation and development of the concentration boundary layer at different locations in the vicinity of the FO membrane were measured with Ca-selective microelectrodes (tip diameter < 10 µm) under different concentrations of draw solution. Results indicate that water flux is related nonlinearly with time and the bulk concentration of draw solution. The concentration on the membrane surface decreases more quickly with an increase in the bulk concentration of draw solution. A 3-D model, generated from Fick’s second law and validated by the experiments, can be used to explain the CP behavior. It is concluded that the larger the initial osmotic pressure difference between the two chambers, the quicker the decrease in water flux; the influence of CP is enhanced at a higher water flux level, resulting the so-called self-limiting-flux behavior.

How Personal should Personal Genomics be?
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The consumer market place to allow the public to purchase genetic tests emerged in 2006. Companies, known as Direct-To-Consumer (DTC) genetic testing, marketed their test online, allowing customers to buy genetic tests. Would removing the supervision of medical professionals have an impact on the customer’s ability to properly comprehend his or her results? Customers of the DTC company 23andMe were invited to participate in a 27 question online survey. 122 subjects who met inclusion criteria completed the survey. Since there is a chance these test results can lead to medical or lifestyle changes, involving an honest broker, or a 3rd party medical professional, would help to reduce cases of poorly interpreted results from DTC companies by their customers.
An Interactive Simulation Model for Construction Education
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This paper illustrates the design procedure, implementation and findings of a research project at UNL. Virtual Interactive Construction Education (VICE) is a project-based pedagogical model that uses a simulated environment to alter traditional subject-based lectures into virtual project-based interactive learning methods in construction engineering and management programs. The context of construction engineering and management curricula were aggregated into six construction project prototypes. VICE-Bridge is the first of these six prototypes that exposes players to experiential problem solving activities toward achieving a goal situation (construct the bridge) from an initial situation (start of construction). Achievement was measured by increases in construction knowledge gain, level of engagement, perceived construction knowledge gained as a result of the VICE intervention. A mixed methodology of both quantitative and qualitative methods was utilized in this research. The data of pre-game quiz and actual performance of players were extracted and compared to show the difference between the knowledge gained through the VICE. In addition, participants responded to a retrospective pre- and post-self-assessment survey of six main areas of construction knowledge. The sample included 40 high school students which had very little to no construction experience. The self-reported level of engagement showed players to be “mildly” to “very engaged”. The results showed improved performance as an outcome of the VICE intervention. Players also indicated that they perceived an increase in knowledge for the six major areas. These results support development of more construction education and indicate that this particular simulation is an effective tool for this purpose.

Adaptive Channel Allocation and Routing in Cognitive Radio Networks
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One of the biggest challenges in multi-hop cognitive radio networking is the dynamic change of channels available to secondary users. To address this challenge, we propose an adaptive channel allocation and route selection scheme in this paper. Our scheme is flexible so that it can react to the dynamic change of channel availability, and it can maximize the throughput by exploiting network coding opportunities. First, we model the primary users' activity, channel availability and the interference among the secondary users in a cognitive radio network environment, and show how to implement a backpressure algorithm and a network coding scheme in multi-hop cognitive radio networks. Second, we formulate an optimization problem to maximize the throughput of the network. We consider the channel availability constraint and the interface constraint jointly, and make use of the network coding opportunity. In order to reduce the computing complexity, we propose a distributed channel allocation and route selection algorithm. Furthermore, we compare the performance of our scheme with existing schemes for different scenarios of channel availability and network load through simulations. Our work brings insights on how to make route selection and channel allocation in multi-hop cognitive radio networks.
The Zone Temperature Prediction Accuracy Improvement of Novel Physical Linear Parametric Model Via Recursive Identification Technique

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Commonly, the model development has been developed by using an offline model which cannot automatically updates or changes the coefficients of model parameters, when system environment changes. The accurate prediction can result in better performance when the model algorithms are applied in advanced control such as model predictive control and model-based supervisory control since the aforementioned real-time controllers need the accuracy of model predictions when they are applied in supervising complex systems such as multiple package air-conditioning units installed in retail stores and/or supermarket buildings. In the building examples, they practically compose of the uncontrolled variables in terms of model uncertainties, simultaneous cooling and heating and inherent over-sizing effect leading to system performance degradation. To tackle all problems, the paper proposes the novel simplified model in terms of a physical-based linear parametric model for predicting zone temperatures by using the application of developed virtual wall surface temperature sensors. The accuracy of the model can be enhanced by a recursive identification technique that can recursively update the parameter values. As a result, the updated parameters can potentially track the true values result. In the test, the four conditions (off-control, undersized, right-sizing and over-sized conditions) are utilized to evaluate the proposed model. The improved model is validated through building simulation platform, and is also compared with the traditionally offline model; the results of the proposed terminology demonstrate excellent predictions. The easy-to-implement model can be potentially applied in the model-based supervisory control of multiple rooftop units in a future research.

Investigation of an Active Tuning Building Envelop based on Capillary Network

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In order to improve the efficient and significant energy saving of the buildings, an active tuning building envelop based on a novel capillary network is proposed. The proposed envelop can greatly reduce the load requirement, and also can supply the partial even the total cooling and heating energy for building. The dynamic mathematic modeling and simulation platform is built. The effect of the water temperature and the flow rate on the performance of envelop was investigated. The temperature and energy performance comparing with conventional wall were achieved. The results indicated that the multilayer wall with capillary network not only counterbalanced the cooling load through the wall and also supplied some additional energy for space cooling after embedding the capillary network..
Covert communication is a steganographic method that exploits network resources to establish hidden pathways for covert information exchanges. It encodes this covert data within the packet interarrival times (Covert Timing Channels – CTC), within packet header or payload fields (Covert Storage Channels – CSC) or a combination thereof (Covert Hybrid Channels – CHC). This type of information hiding strategy can be used to leak sensitive information, coordinate malicious activities, or communicate secretly without traditional network security mechanisms such as firewalls being able to prevent this communication. This provides significant concern and ability for harmful actions and thus, it is vital to research methods to detect and disrupt covert communication for enhanced cyber security. To successfully detect and avoid covert communication, we propose a comprehensive framework that can analyze and monitor different behaviors, characteristics, and features of all categories of covert communication algorithms. The extracted fingerprints and characteristics of various covert channel algorithms will be utilized for detecting these activities over a network and taking appropriate actions to disrupt or prevent the transmission of covert information. This framework can reliably and accurately model all types of covert channel algorithms and can be employed either in simulation or in real-world network environments.

Prion diseases are a group of fatal neurodegenerative diseases also called transmissible spongiform encephalopathies (TSEs) which impact a number of species including cattle (bovine spongiform encephalopathy, BSE or 'mad cow disease'), sheep and goats (scrapie), deer, elk and moose (chronic wasting disease, CWD), and humans (Creutzfeldt-Jakob disease, CJD, and others). Persistence of the prion agent in the environment is thought to be involved in the transmission of chronic wasting disease in cervids and scrapie in sheep and goats. While entry of prions into the environment via shedding by infected hosts and carcass decomposition and the persistence of the prion agent in the environment is well-documented, natural processes that may be involved in prion degradation have not been determined. To investigate the role of naturally-occurring environmental processes on prion fitness, we exposed elk CWD and HY TME prions to repeated cycles of wetting and drying in the presence or absence of various soils or soil minerals and determined the effect on prion replication via PMCA and infectivity via hamster bioassay. We found that subjecting soil-bound prions to 10 wetting/drying cycles significantly reduces conversion activity and prion infectivity. Differences were observed between CWD and HY TME for a given soil type, and across soil types for a single prion source. This data provides evidence that prion interactions with soil can influence prion transmission in the environment and that naturally-occurring environmental processes can influence the biology of prions shed into the environment.
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Saeed Rokooei

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Developing an Undergraduate Class Module to Evaluate Lead Uptake in Soil and Vegetables at a Local Community Garden

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Lead is a persistent and ubiquitous pollutant in urban environments and is of significant importance to public health. One potential pathway for exposure to lead can be consumption of produce grown in lead-contaminated soil, although there is relatively little information available about what types of produce accumulate more lead relative to others and the relationship between soil lead concentrations and concentration of lead in produce. This may be of increasing concern as urban community gardens experience a resurgence in popularity and demand for locally grown produce increases. It is of special concern locally due to the presence of extensive lead contamination resulting in designation as a superfund site for a large portion of the city. This provides an unparalleled educational opportunity for environmental engineering students. A project was created in 2010 where students in the introductory environmental engineering laboratory course collect and evaluate soil and vegetables from an area community garden to determine the degree of contamination and to evaluate if there is a relationship between soil lead concentrations and those found in the vegetables. The project has continued and expanded since its creation in 2010 providing a hands-on service learning opportunity for student and inspiring additional undergraduate research projects. The information the students have found has been used by the community garden to allow for more informed management decisions to minimize the amount lead in soils and vegetables grown on site. This presentation will detail the development, results, and future goals of this project with an emphasis on using service learning within the undergraduate engineering curriculum.
Fate and Transport of Testosterone in Agriculture Soils
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Presence of hormones in environment has promoted widespread concern due to their potential effects on humans and wildlife. Soil has been identified as a main medium which contains a wide range diameter size of particles that will control bioavailability, transport and ultimate fate of steroid hormones. The mobility of these soil size fractions and their contribution on the fate and transport of testosterone have not been investigated systematically. In this study, we used rainfall simulation tests on soil slab to study the mobility of different soil particle size fractions and organic matters in the soils under different rainfall events. Samples generated from both runoff and leachate were investigated, the particle size distribution, TOC, conductivity, volume of these samples were analyzed. The results show that runoff will take more soil particles and organic matters than that of leachate do for silt-clay loam soil, which may provide the clue that runoff contribute much more than leachate on promoting the transport of hormones into water bodies. Furthermore, clay particles were much easier to detach from the original soils than that of silt and sand, combined with previous results, the clay particles and organic matters may play dominant roles to facilitate the hormones transport to water bodies.