RESEARCH DAYS 2019

GRADUATE STUDENT POSTER SESSION

March 27, 2019, 2-5pm

Hughes Trigg Student Center Ballroom

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APPLIED PHYSIOLOGY AND WELLNESS

Emily McClelland (Board #1)
Advisor: Peter Weyand
Applied Physiology and Wellness, Simmons School of Education

Getting High Under Your Own Power: The Mechanical Determinants of Jumping

Vertical jumping is performed using many different movement and approach patterns within athletic contests. It has been found that the primary determinant for countermovement jumping is the force produced during the concentric part of the movement, but when looking at different types of approach jumps, which are seen primarily in team sports, the determinants are unknown. The purpose of this pilot study was to explore the mechanical differences between the approach type jump and countermovement jump performances. The main question of this study is whether the vertical ground reaction force or the time in which the force is applied is the determinant of athletic vertical jump height. Seven participants, of varying athletic ability, performed two trials of two different jumping conditions. The jumping conditions consisted of a maximal effort countermovement jump and maximal effort, self-selected run-in jump off of a single leg. The data analyzed were stance average vertical ground reaction force above body weight, during the take-off phase, jump height, calculated via projectile motion equations and aerial time, and impulse.

Preliminary conclusions of this pilot study are that amount of force applied above body weight contributes most to vertical jumping performance of the CMJ condition and time of force application must have a role to play in the run-in 1leg jump condition.

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Claire Trotter (Board #2) Co-authors: Faith K. Pizzey; Philip M. Batterson; Robert A. Jacobs; Scott L. Davis; James Pearson
Advisor: Scott L. Davis
Applied Physiology and Wellness, Simmons School of Education

High intensity interval exercise reduces tolerance to a simulated hemorrhagic challenge relative to steady state exercise in heat stressed individuals

We investigated whether high intensity interval exercise reduces tolerance to a simulated hemorrhagic challenge (lower body negative pressure; LBNP) relative to steady state exercise in heat stressed individuals. Eight healthy participants (Age: 27±5 yrs; Ht: 179±9 cm; Wt: 78.9±18.7 kg) completed two trials (Steady state and Interval). Participants either cycled at alternating workloads between 10 and 88% (Interval) or continuously at 38% (Steady state) of the predetermined maximal aerobic power output whilst wearing a warm water perfused suit until core temperatures increased 1.4±0.2°C. Participants then underwent progressive LBNP to pre syncope. LBNP tolerance was quantified as cumulative stress index (CSI; mmHg*min). Following exercise and prior to LBNP, mean skin temperatures were similarly elevated from baseline in both trials (from 32.35±0.42 to 37.95±0.59°C, $P<0.05$). Mean arterial pressure was not different between trials prior to LBNP (Interval: 79±6 vs. Steady state: 77±7 mmHg; $P=0.57$) and at pre syncope (to 63±6 and 62±6 mmHg respectively, both $P<0.05$). CSI was lower in the interval trial relative to the steady state trial (280±204 vs. 518±285 mmHg*min, respectively; $P=0.024$). In heat stressed individuals, tolerance to a simulated hemorrhagic challenge was reduced following high intensity interval relative to steady state exercise.

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Vanessa Uzoh (Board #3) Co-authors: Megan Murphy; Courtney Roy
Advisor: Megan Murphy
Applied Physiology and Wellness, Simmons School of Education

Wellness for Her: A Faith-Based Wellness Program for Women

A. Description of the Organization/Community

Covenant Church is surrounded by a community with a higher percentage of minority residents compared to the entire state of Texas. There is no established regimen to foster complete well-being for women in this community. A partnership was formed with Covenant Church to provide wellness education to these women.

B. Summary of the Primary Program with Core Elements

The program, Wellness for Her, highlights the importance of physical, mental, social, and emotional health within a spiritual framework. Each woman that enters the program chooses a verse of influence to use as a guide to achieve her goal. Participants meet bi-weekly for small group discussion, where scripture is explained in connection to wellness practices.

C. Explanation of the Evaluation Plan

Progress is recorded using qualitative surveys and participant journals every other week. Attendance is monitored by organizational request, with workshops and discussion included as educational measuring tools.

D. Summary of the Program Impact

To date, 10 women have joined the program, and have made steps to achieving their wellness goals. By the study's conclusion in May 2019, the goal is for 20 women to incorporate faith and wellness tools to improve the community.

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BIOLOGY

Hind Alkhaldi (Board #4)
Advisor: Steven Vik
Biology, Dedman College

Assembly and Clinical Mutations of the Peripheral Arm Subunits of Bacterial Complex I

Complex I (NADH: ubiquinone oxidoreductase) is the largest enzyme of the mammalian mitochondrial and bacteria respiratory chain. During the oxidation of NADH, hydrogen ions are translocated across the mitochondrial membrane, leading to the synthesis of ATP, the chemical energy currency of cells. Complex I in E. coli contains 13 different subunits, encoded by the nuo operon, that form an L-shaped structure: a peripheral arm, containing 6 subunits involved in electron transport, and a membrane arm containing 7 subunits involved in pumping hydrogen ions. Peripheral arm subunits can be separated into two groups E, F, and G, which form an NADH binding domain, and B, CD, and I, which interact with membrane subunits A and H. Mutations in complex I genes in humans lead to vision loss, brain dysfunction, or loss of muscle function. One issue we will address is the mutations that have been reported to cause complex I dysfunction in humans, and model them in our bacterial system. Mutations have been constructed in subunit F: R358A, R358H, T173A, T173P, R102A, R102L, E349A, E349K. Preliminary results show that expression levels of the proteins are lower, as well as the NADH oxidase activity level, as compared to wild type. We will also test groups of subunits to see if they can assemble to form sub-complexes, and compare the effects of the mutations.

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Lauren Ammerman (Board #5) Co-authors: Pia D. Vogel; John G. Wise
Advisor: John Wise
Biology, Dedman College

Explorations of Drug Transport by P-glycoprotein using Molecular Dynamics Enabled by High Resolution Crystal Structures

The efflux pump P-glycoprotein (P-gp, ABCB1) confers multidrug resistance (MDR) to a wide variety of chemotherapeutics in human cancers. Chemotherapy treatment can induce and select for the overexpression of P-gp. When P-gp is overexpressed, the pump lowers the intracellular concentration of many drugs to sub-therapeutic levels, thereby conferring MDR and rendering further treatment ineffective. The lack of human Pgp structures has hindered efforts to understand the polyspecificity and transport mechanism of the enzyme. Our research using homology models of P-gp showed that multiple transport pathways through the drug binding domains (DBDs) and variable substrate binding sites may exist. Following the release of the first human Pgp structure, we simulated the structure using four known conformations of P-gp homologues in various states along a putative catalytic efflux cycle. These simulations were done at long timescales via free and directed GPU-accelerated molecular dynamics. The simulations of the new human P-gp structure demonstrate the pumping of known P-gp substrates across the cell membrane. Simulations of molecules that are suspected transport substrates or putative inhibitors of P-gp were performed. These studies support earlier observations and explore the mechanism of P-gp-mediated substrate efflux and transport inhibition. Supported by NIH NIGMS [R15GM094771-02].

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Amila Nanayakkara (Board #7) Co-authors: Kasi Holcomb-Webb ;Beau Bequeaith ;Maha Aljowni ;Alexander Lippert; Pia Vogel; John Wise
Advisor: John Wise
Biology, Dedman College

Novel inhibitors of ABC transporters increase accumulation of transport substrates in multidrug resistant cancer cells and blood brain barrier cells

Overexpression of ATP-binding cassette (ABC) transporters, P-glycoprotein (P-gp) and breast cancer resistance protein (BCRP) are two well-studied drug transporters which are associated with Multidrug resistance (MDR) in cancers. These two transporters also act as a major functional unit of the blood brain barrier (BBB) to protect the brain from xenobiotics. Lack of clinically approved P-gp and BCRP inhibitors renders chemotherapy treatments of many MDR cancers ineffective and obstructs drug uptake into the brain. Here we describe the effects of chemical variants of the previously identified P-gp inhibitor, SMU-29. The variants were generated using computational approaches or by structure-based design. All variants showed improved efficacy in reversing paclitaxel resistance in the P-gp over-expressing prostate cancer cell line and their ability of increasing P-gp substrate calcein in these cells. Only three of them were substrates of P-gp indicating others are potential inhibitors. Three variants modulated the BCRP also and they reversed MDR in a BCRP over-expressing breast cancer cell line and increased the intracellular accumulation of BCRP substrates. The variants that affected both P-gp and BCRP also showed higher accumulation of P-gp and BCRP substrates in a BBB model cell line, showing the potential to open the BBB for increased drug uptake into the brain.

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Morgan Thompson (Board #8)
Advisor: Adam Norris
Biology, Dedman College

Genetic interactions between neuronal RNA binding proteins and transcription factors

Alternative splicing is a mechanism by which multiple distinct functional proteins can be produced from a single gene. This helps contribute to the complexity and diversity of higher organisms and is especially important for development of the nervous system. RNA binding proteins (RBPs) are known to play an important regulatory role in alternative splicing. Interestingly, our lab recently identified a neuronal alternative splicing event in C. elegans regulated by a combination of transcription factors and RBPs. It was revealed that three transcription factors regulated alternative splicing through their transcriptional control of two neuronal RBPs. This led us to question how often transcription factors and RBPs interact in the nervous system to control splicing events or the expression of other genes. We crossed ten neuronal RBP mutants with four neuronal transcription factor mutants, creating a total of forty double mutants. These double mutants were screened for unexpected phenotypes, suggesting genetic interactions between the RBP and transcription factor. We investigated the strongest interactions to determine what underlying molecular mechanisms contribute to the phenotype. Through this screen, we hope to reveal principles of genetic interaction between neuronal RBPs and transcription factors.

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Lacin Yapindi (Board #9)
Advisor: Robert Harrod
Biology, Dedman College

The high-risk human papillomavirus subtype-18 E6 oncoprotein induces the Tp53-induced glycolysis and apoptosis regulator (TIGAR), an antioxidant effector that is essential for in vivo tumorigenesis

The high-risk subtype human papillomaviruses (HPVs) infect and oncogenically-transform squamous epithelial cells and cause cervical carcinomas and head-and-neck cancers. The viral E6 oncoprotein cooperates with c-Myc and induces p53-regulated pro-survival gene expression by preventing acetylation of the p53 on K120 by the TIP60. The resulting uncontrolled cell proliferation and oncogene-activation leads to the increased accumulation of metabolic byproducts, including reactive oxygen species (ROS). Using a HeLa xenograft model of HPV18-induced tumorigenesis in NIH III-nude mice, as well as clinical patient samples of HPV-induced tumors, our preliminary data have demonstrated that the Tp53-induced glycolysis and apoptosis regulator (TIGAR) –a glycolytic antioxidant enzyme, is expressed at high levels in HPV-induced tumors and suppresses damaging ROS. Intriguingly, siRNA-knockdown of TIGAR expression significantly sensitized HPV18-positive cervical cancer cells to chemotherapy drugs which induce oxidative stress. We have further shown the inhibition of TIGAR prevented tumor formation, growth, angiogenesis, and the epithelial-mesenchymal transition (EMT) of leading-edge tumor cells in vivo. These findings suggest that TIGAR could have an essential role in HPV-induced tumorigenesis by suppressing intracellular ROS levels, and promote tumor progression and angiogenesis.

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Fang Zhang (Board #12)
Advisor: Steven Vik
Biology, Dedman College

A Study of the Assembly Pathway in Membrane Subunits of Complex I

Complex I is the first and largest enzyme of the respiratory chain and has a central role in cellular energy production. We use Complex I from E. coil as a model system, which contains 13 subunits named A-N. Subunits A, H, J, K, L, M and N, code for proteins of the membrane arm. The rest of the subunits B, CD, E, F, G, and I, code for the peripheral arm. The 3-dimensional structure of Complex I has now been determined, but the assembly pathway of the of 13 subunits of Complex I is uncertain. This study will analyze the assembly pathway of membrane subunits in Complex I. Assembly is tested by expressing these genes, and using a gentle detergent, dodecyl maltoside, to extract complexes from cellular membranes. Our results so far have indicated that expression of all subunits leads to a large complex that appears to be Complex I. Expression of LMN subunits leads to formation sub-complex MN during the assembly pathway, but subunit L is absent. L seems to form a homodimer. Expression of subunits I-N forms a sub-complex of J-K-M-N. A functional Complex I could form when expression of subunits A-K with LMN at the same time, and the efficiency was 18%-20% of the wild type. Expression of subunits A-M with N at the same time could also form a Complex I, and the activity was 26%-28% of the wild type. Expression of subunits A-K forms a sub-complex of A-H-J in the membrane fraction.

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CHEMISTRY

Maha Aljowni (Board #13) Co-authors: Amila Nanayakkara; Ammerman Lauren
Advisor: Alexander Lippert
Chemistry, Dedman College

Synthesis of anti-cancer drugs to inhibit P-gp pumping action

A problem with cancer treatment is that many cancers develop resistance to chemotherapeutic agents, causing them to fail to accumulate in resistant cancer cells long enough to have any effect. This is due to the overexpression of a plasma membrane protein called P-glycoprotein (P-gp). Generally, the role of P-gp is to protect the cells from any toxins or foreign substances by pumping these toxins (including chemotherapeutic drugs) out of the cell. I am collaborating with the Wise-Vogel laboratory at Southern Methodist University, who utilize a computer-generated model to predict the structures of P-gp inhibitors that inhibit the action of P-gp. These docking models find drug targets that slow the action of P-gp pumping, as well as help understand the underlying mechanism of how the protein effluxes toxins from the cell. My current research is focused on multiple drug analogues that are predicted to inhibit the P-gp protein based on their docking models. They are tested in cancer cell lines in combination with current chemotherapeutics to determine efficacy and strength of inhibition so that future chemotherapeutic drugs can work effectively in cells.

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Weiwei An (Board #14) Co-authors: Lucas Ryan
Advisor: Alexander Lippert
Chemistry, Dedman College

A Chemiluminescent Probe for HNO Quantification and Real-time Monitoring in Living Cells

Azanone (HNO) is a reactive nitrogen species with pronounced biological activity and high therapeutic potential for cardiovascular dysfunction. A critical barrier to understanding the biology of HNO and furthering clinical development is quantification and real-time monitoring of delivery in living systems. Here, we describe the design and synthesis of the first chemiluminescent probe for HNO, HNOCL-1, which can detect HNO generated from as low as 138 nM Angeli's salt with high selectivity based on reaction with a phosphine group to form a self-cleavable azaylide intermediate. We have capitalized on this high sensitivity to develop a generalizable kinetics-based approach, which provides real-time quantitative estimates of HNO concentration that show good agreement with computational

simulations. This method can be used to quantify picomolar HNO concentrations generated from hydrogen sulfide (H2S) and nitric oxide (NO). HNOCL-1 can monitor dynamics of HNO delivery in living cells and tissues, demonstrating the versatility of this method for tracking HNO in living systems.

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Caleb Bunton (Board #15) Co-authors: Audrey Kennedy; Trey Rose
Advisor: David Son
Chemistry, Dedman College

Additive free, Silicon-based Biodegradable Materials for Drug Delivery

Drug delivery devices have recently received a lot of attention, with many diverse types of delivery devices becoming available for use as powerful tools for researchers and medical practitioners. Material design plays a significant role in manufacture and implementation of these devices with the most common materials utilizing catalysts and fillers during their production. The focus of this research is the development of a material that may be useful for drug delivery applications, has increased biocompatibility due to the absence of catalysts and fillers, and allows for controlled drug release through differences in degradation rate. In this study, maleimide(dimethoxy)silane and furyl(methoxy)silane monomers are crosslinked via the Diels-Alder reaction using heat as the catalyst for reaction. These crosslinked materials contain no catalysts or fillers, are biodegradable, and the drug release rate is controlled via degradation rate due to the hydrophilic/hydrophobic nature of the monomers.

Commercial Viability: Many types of materials are currently available for use towards drug delivery components and devices. Most of these materials however, do not allow for controlled drug release but rather a singular release rate as specified by the material used. Furthermore, some of these materials may not be suited for use on or in certain areas of the body due to tissue incompatibility (adverse reaction) from catalysts and fillers. The design of our materials effectively fixes these problems with conventional drug delivery materials, allowing for materials that are capable of controlling drug release rate through degradation rate, as well as affording a high level of biocompatibility in all tissues due to the lack of additives.

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Jonathan Lefton (Board #16)
Advisor: Tomce Runcevski
Chemistry, Dedman College

Engineering Luminescence in Metal-Organic Frameworks

Luminescence is a process of spontaneous emission of light, which finds various applications. Numerous solid-state device rely on this phenomenon, such as light-emitting diodes (LED), phosphors, phosphor thermometers, among others. Achieving full control over the luminescent properties of a solid-state material (wavelength, intensity, quantum yield, etc.) is necessary in order to manufacture novel and advanced materials. Metal-organic frameworks (MOFs) are highly customizable, porous coordination polymers, composed of inorganic nodes (metals or clusters) connected by organic linkers in a permanently porous structure. Here, we report a novel experimental strategy to transform non-luminescent MOFs into bright luminophores. As a proof-of-principle, we engineered the crystal structure of the non-luminescent Zn2(dobdc) (H4dobdc = 2,5-dihydroxyterephthalic acid) by post-synthetic appending of organic molecules to elicited bright-light emission with a large Stokes shift. The porosity of the luminescent MOF allows us to further modify the structure, hence further control the luminescent properties. This strategy can be used in manufacturing novel devices for sensing of various analytes (gases, vapors or ions), and could be a viable route to design a solid with an intrinsic broadband white-light emission, which a long-sought after material.

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Bo Li (Board #17) Co-authors: Maha Aljowni; Uroob Harris
Advisor: Alex Lippert
Chemistry, Dedman College

Volumetric Three Dimensional Photoactivatable Dye Displays

Chemically enabled volumetric 3D digital light photoactivatable dye display (3D Light PAD) is properly used for generating 3D image. Rhodamines were a class of photoactivatable compounds that can be switched from a non-fluorescent to a fluorescent isomer using ultraviolet light, which can be used in 3D Light PAD. However, the detailed mechanism of how rhodamine derivatives show 3D Light PAD is not so clear. Our group synthesized different rhodamine derivatives and took spectroscopic measurements, including turn-on kinetics, turn-off kinetics and irradiation wavelength dependence. On the other side, we also explored some factors which could affect the spectroscopic results, such as irradiation wavelength, solvent polarity. By comparing the ratio of intensities between them, we can explain the mechanism of fluorescence generation more clearly. Furthermore, these results will help us synthesize better derivatives as photoactivatable molecules in the future. Based on these results, we finally generated best images in three dimensions by digital light processing (DLP) technology.

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Mojdeh Raeisi (Board #18)
Advisor: Nicolay V. Tsarevsky
Chemistry, Dedman College

Lipoate-Based Bio-Degradable Polymer Networks for Drug Delivery

A natural, cyclic disulfide-containing compound, Lipoic acid (LpA), was used to synthesize a monomer (EtLp) and a sugar-derived crosslinker (isosorbide(Lp)2) to prepare degradable gels. At first, gelation studies were conducted by radical co-polymerization of monofunctional EtLp and difunctional crosslinker at various proportions and in bulk to obtain gels with various crosslinked densities. These gels were subjected to reducing conditions (Bu3P) to study their degradation. The crosslinked densities of the prepared gels were determined by a series of swelling ratio measurements. The radical copolymerizations were also conducted under mini-emulsion condition to prepare well-defined latexes with narrow size distribution of the particles. For this purpose, various surfactants were tested to find the most stable latex formulation. A similar mini-emulsion copolymerization was conducted in presence of a fluorescence marker (dye), which was loaded inside the particles via an incorporation method, and the release of this marker under reducing condition (Bu3P) was studied by fluorescence spectroscopy.

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Lucas Ryan (Board #19) Co-authors: Jeni Gerberich; Alexander Winters; Jian Cao;Weiwei An; Becky Jenkins; Ralph P. Mason
Advisor: Alex Lippert
Chemistry, Dedman College

Kinetics-Based Measurement of Hypoxia in Living Cells and Ani-mals Using an Acetoxymethyl Ester Chemiluminescent Probe

Oxygenation and tissue hypoxia play critical roles in mammalian biology and contribute to aggressive phenotypes in cancerous tumors, driving research to develop accurate and easy to implement methods for monitoring hypoxia in living cells and animal models. This study reports the chemiluminescent probe HyCL-4-AM, which contains a nitroaromatic sensing moiety and, importantly, an acetoxymethyl (AM) ester that dramatically improves operation in

cells and animals. HyCL-4-AM provides a selective 60,000-fold increase in luminescence emission in the presence of rat liver microsomes (RLM). For cellular operation, the chemiluminescence response kinetics are sharply dependent on oxygen levels, enabling highly significant and reproducible meas-urement of hypoxia in living cells. Whole animal imaging experiments in muscle tissue and tumor xenografts show that HyCL-4-AM can differentiate between well oxygenated muscle tissue and hypox-ic tumors, as well as demonstrating potential for monitoring tumor re-oxygenation via hyperoxic treatment.

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Kapil Dev Sayala (Board #20) Co-authors: Rajesh Kumar; Kapil Dev Sayala; Yakun Cao; Nicolay V. Tsarevsky
Advisor: Nicolay Tsarevsky
Chemistry, Dedman College

Chemical Modification of Natural Rubber Using Hypervalent Iodine Reagents

The modification of natural rubber, cis-1,4-polyisoprene (PIP), using hypervalent (HV) iodine compounds with tetrazole ligands (PhI(N4CR)2) in the presence of iodine was performed to produce iodo-tetrazolylated PIP. The pendant alkyl iodide functionalities could be converted to azides by nucleophilic substitution. The presence of azide groups in the polymers was confirmed by infrared spectroscopy. The azide- and terazole-containing PIP-derived materials were reacted with alkyne-terminated poly(ethylene glycol) in the presence of CuBr and pentamethyldiethylenetriamine to yield graft copolymers (products of click coupling), as proved by size exclusion chromatography (SEC). Further, the alkyl iodide functionalities were taken advantage of by employing th eiodo-tetrazolylated PIP as a macro-chain transfer agent for iodine-transfer polymerization of methyl mathacrylate to synthesize brush polymers with well-defined side chains. All the polymers were characterized by 1H and 13C nuclear magnetic resonance and infrared spectroscopy, SEC, differential scanning calorimetry, and thermo-gravimetric analysis. The results indicated successful modification of PIP, opening a new avenue to previously inaccessible functional and reactive (including energetic) materials.

Commercial Viability: The primary objective of natural rubber modification is to overcome the shortcomings in its properties, including easy oxidation, poor miscibility with other materials (e.g., silica particles, carbon black, polymers). We have demonstrated the modification of natural rubber by attaching polar and coordinating tetrazole groups to afford materials that would add value to the natural rubber and are expected to widen the utility of a bio-derived polymer by making it useful in applications that have been traditionally dominated by synthetic rubber. Tetrazoles are attractive candidates for use as propellants, explosives, not only due to their energetic properties (high positive enthalpy of formation) but also due to their relative stability at ambient conditions, compared to other explosives. Tetrazole-based materials have been shown to serve as binders, high-energy output applications in military/defence sector but, the preparation of such materials usually involves tedious synthetic procedures, long reaction times, high temperatures, and can be risky as it requires synthesis of specialized monomers that are sensitive to stimuli like heat and shock. The complexation ability of tetrazoles and their high polarity are other interesting aspects that can be utilized to dye natural rubber, which is commercially very significant and can be of great interest to industry.

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Tong Wu (Board #21) Co-authors: Khashayar Rajabimoghadam
Advisor: Isaac Garcia-Bosch
Chemistry, Dedman College

Redox-active tridentate Cu complexes with symmetric tunable hydrogen bonds

Copper (Cu) is one of the most abundant and less toxic transition metals compared to metals lower on the periodic table. Rich in redox chemistry, Cu complexes are able to undergo oxidation/reduction with O2 or H2O2 as oxidant to perform organic transformations. Inspired by the reactivity of previously describe bidentate Cu complexes, our lab has synthesized new tridentate Cu-complexes equipped with tunable hydrogen bonding. In this project, tridentate Cu-complexes are made with different ligand scaffolds and ancillary groups, which give various Cu-N and hydrogen bond lengths as well as various angles. These systems also show different redox potentials with the different ligands, ancillary groups and metals. After characterization and a brief study of our systems, we will turn our focus onto the catalytic properties of these complexes.

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Nassim Beiranvand (Board #22)
Advisor: Elfi Kraka
Chemistry, Dedman College

A Comprehensive Analysis of Hydrogen Bonding in Natural and "Unnatural" Basepairs

Recent experimental efforts succeeded to expand the genetic alphabet of DNA, which is originally composed of the four-letter alphabet with A-T and G-C pairs, by introducing "unnatural" base pairs (UBP)s. Several types of UBPs function as a third base pair in replication, transcription, and/or translation. Through the UBP formation, new components with different physicochemical properties can be introduced into nucleic acids and proteins site-specifically, providing a variety of increased functionalities.Our work has been aimed at a systematic quantum chemical comparison of Watson-Crick base pairs and their UBP counterparts. One of the key features of base-pairs is intermolecular hydrogen bonding (HB), classical (NH…O, OH…O, NH…N, OH…N) and non-classical (CH… O, CH… N). The Local Mode Analysis of Konkoli Cremer offers a unique tool for the quantification of the intrinsic HB strength based on local mode force constants and associated bond strength orders. We investigated a set of 40 divers UBPs and compared their inter-molecular HB strengths and other chemical properties with those of the Watson-Crick base pairs. Our results will form the basis for a genetic alphabet expansion library and shed light into the question why Nature uses only A-T and G-C pairs.

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Alexis Delgado (Board #23) Co-authors: Daniel Sethio
Advisor: Elfi Kraka
Chemistry, Dedman College

Analysis of the Intrinsic CC Bond Strengths for all CC Bond Orders, plus N2 and Cyanide Derivatives Based on Local Vibrational Modes

A set of 60 molecules with CC single, CC double, and CC, CN, and NN triple bonds was systematically investigated to uncover how the CC and CN bond strengths can be modulated with electron donating and electron accepting substituents. Substituents were selected to span a range of different electronegativities and donor/acceptor capabilities including:

-NH2, -CHO, -OH, -CH3, -CF3, and -F

The Local Vibrational Mode Analysis of Konkoli-Cremer [1,2] was used to assess the intrinsic strength of all CC, CN, and NN bonds based on the local stretching force constants. All calculations were performed at the CCSD(T)/cc-pVQZ level of theory. Our study clearly revealed that CC/CN bonds are tunable covalent bonds and that a complex interplay of steric and electronic effects as well as intra-molecular hydrogen bonding are responsible for these CC single, CC double, and CC/CN triple bond variations. Our results show that the triple bond in N2 is stronger than

the triple bond of acetylene which confront the previous work of Xu and Dunning [3]. These findings are important for the design of new materials.

[1] Konkoli, Z.; Cremer, D.;Int. J. Quant. Chem. 1998, 67, 1–9

[2] Zou. W.; Kalescky R.; Kraka E.; Cremer D.; J. Quant. Phys 2012, 137, 084114-1 – 084114-11

[3] Xu, L. T.; Dunning, T. H. Jr.; J. Phys. Chem. A, 2016, 120(26), 4526-4533

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Malgorzata Zofia Makos (Board #24) Co-authors: Marek Freindorf
Advisor: Elfi Kraka
Chemistry, Dedman College

New insights into Au(I) catalyzed hydroalkoxylation of allenes: a Unified Reaction Valley Approach study

Homogeneous gold complexes provide a rich source for novel catalytic transformations of interest to the scientific community. For the first time the reaction mechanism of the hydroalkoxylation of allenes catalyzed by [Au(I)NHC]+ is analyzed by means of the Unified Reaction Valley Approach (URVA). Several possible reaction pathways for generating two regioisomers were investigated. URVA provides a quantum chemical study of a chemical reaction at the detail never seen before. It focuses on the reaction path curvature, indicating when a chemical bond is finally formed and when the bond breaking starts. This is a reliable indicator for identifying the reaction phases of a chemical reaction. In this work, we used URVA to disclose the key features of Au(I) switching between sigma- and pi-complexations and supporting the bond breaking/forming process.

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Sadisha Nanayakkara (Board #25) Co-authors: Marek Freindorf
Advisor: Elfi Kraka
Chemistry, Dedman College

New Mechanistic Insights into the Facile Hydrogen Release from Water using Boranes and Alanes as Catalysts

Producing hydrogen from water is an attractive yet a challenging task, given the high energy requirement for the process. In this context, small hydrides as BH3, metal hydrides as AlH3 and their derivatives are viable catalysts which can accelerate the hydrogen release from water under reduced temperatures. In order to understand their reaction mechanisms and driving forces facilitating hydrogen release from water, Unified Reaction Valley Approach (URVA) was applied, in which curvature of reaction path is used to study electronic structure changes. We studied a series of reactions involving BH3, AlH3, their dimers- B2H6, Al2H6 and mixed compound AlH3BH3 with water, considering multiple reaction pathways in some cases. We were able to elucidate detailed reaction mechanisms in each case, identify different dihydrogen interactions and their role in the hydrogen transfer mechanism which will lead to the new design and concepts for most efficient catalysts promoting hydrogen release from water.

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Zilin Song (Board #26)
Advisor: Peng Tao
Chemistry, Dedman College

High Quality Force Field Development for Antibiotics

In computational chemistry, molecular dynamics (MD) simulation is a technique that simulates time dependent behavior of large size molecular systems. The MD simulations are carried out by solving equations based on the Newton's laws of motion. To achieve this goal, high quality force fields describing the inter- and intra-molecular interactions, including Coulomb and van der Waals interactions, as well as chemical bond stretching, bending, and dihedral angle rotation, are the most critical component. Although standard and transferrable force fields and parameters are available for regular biomacromolecules, including proteins, DNAs and RNAs, obtaining force fields and parameters with good quality for arbitrary organic molecules still requires special expertise and effort. Our research group recently adapted a standard development protocol for organic molecules compatible with widely applied CHARMM force field for proteins and applied it to develop force field parameters for a serial of antibiotics. In this presentation, the basic principle and practical method to develop force field parameters are introduced based on real antibiotics molecules.

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Francesco Trozzi (Board #27) Co-authors: Brian Zoltowski
Advisor: Peng Tao
Chemistry, Dedman College

Interrogating light induced allostery mechanism of a circadian protein homodimer through a computational microscope.

Protein allosterism is a dynamical phenomenon, defined as a conformational change and/or as a change of states distribution upon perturbation of a non-functional secondary site. Many cellular functions are known to be regulated through different allosteric mechanism. An example is provided by the circadian clock system in plants regulated by the Zeitelupe (ZTL) as a LOV domain protein, which undergoes allosteric changes upon light activation. It has been shown that ZTL carries out its regulation function in dimeric form via protein-protein interactions. Through computational microscope including molecular dynamics simulations and machine learning based analysis, we elucidated both conformational and dynamical changes of ZTL in either monomer or homodimer states that are closely correlated to its photo-induced allostery.

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Niraj Verma (Board #28) Co-authors: Yunwen Tao
Advisor: Elfi Kraka
Chemistry, Dedman College

Unfolding the Mysteries of Hydrogen Bonding Networks in Water via Artificial Intelligence

Understanding the underlying properties of water is an active field of study, contrary to the fact that water is the most abundant and common molecule on Earth. We are interested in the shape of water molecules, which is governed by the network of hydrogen bonds. We discovered that water forms huge clusters of hydrogen bonded water molecules. These clusters are formed by various smaller clusters of prism, cage, bag, book, chair or boat type etc. We used classical force fields including TIP5P, TIP3P-FB, TIP4P-FB, TIP4P-ew and OPC water models for the simulation of 1000 water molecules. By performing simulations with 5 different force fields, the results are more reliable and can serve as a benchmark at the same time. Each huge cluster is detected by mean shift algorithm (commonly used in machine learning). The smaller clusters however are more challenging to investigate, as this requires additional information about the shape of the rings formed by the hydrogen bonds. To find and quantify the smaller clusters, we use artificial intelligence. This work could for the first time quantitatively elucidate the hydrogen bond properties of water in a big water cluster system.

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Feng Wang (Board #29) Co-authors: Peng Tao
Advisor: Peng Tao
Chemistry, Dedman College

Machine Learning Classification Model for Functional Binding Modes of TEM-1 ß-Lactamase

TEM-1 is an enzyme belonging to ß-lactamases from gram-negative bacteria leading to antibiotic resistance. The catalysis mechanism of the TEM-1 penicillin-resistance process is essential for studying the penicillin-resistance behavior. Molecular dynamic (MD) simulations is an efficient method to provide the time dependent conformational changes in TEM-1 binding with penicillin. Machine learning classification provides novel approaches to analyze the conformational space based on the trajectories of three states of TEM-1 binding with penicillin. The three states include reactant state (TEM-1 binding with penicillin), product state (TEM-1 binding with the hydrolyzed penicillin) and apo state (TEM-1 without ligand). A random forest classification in machine learning is used to classify the three states of TEM-1. The random forest classification model provided feature importance associated with each residue related to the three states. Overall, this study provides new insights into the different dynamical function states of TEM-1, and may open a new door for ß-lactamases functional and evolutionary studies in general.

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Seth Yannacone (Board #32) Co-authors: Seth Yannacone; Vytor Oliveira; Niraj Verma; Elfi Kraka
Advisor: Elfi Kraka
Chemistry, Dedman College

New Insights in Hypervalency: An Extensive Analysis of the Bonding Nature in -Iodanes

The intrinsic bonding nature in ^3-iodanes was investigated to determine where its hypervalent bonds fit along the spectrum between halogen bonding and covalent bonding. Density functional theory with an augmented Dunning valence triple zeta basis set, (B97X-D/aug-cc-pVTZ) coupled with vibrational spectroscopy were utilized to study a diverse set of iodine-based compounds. This level of theory was rationalized by comparing computational data and experimental data for a small set of closely related and well-studied hypervalent iodine molecules. Axial bonds in ^3-iodanes fit between the 3-center 4-electron bond, as observed for the tri-halide species IF2-, and the partially covalent bond in IF. The equatorial 2-center 2-electron bond in ^3-iodanes is comparable to the IF bond. We also explored how equatorial ligands and axial substituents affect chemical properties of ^3-iodanes by analyzing Natural Bond Orbital charges, local vibrational modes, covalent/electrostatic character, and 3-center 4-electron bonding character. In summary, our results show for the first time that there is a smooth transition from halogen bonding to 3c- 4e bonding in tri-halides to 3c-4e bonding in hypervalent iodine compounds to covalent bonding, opening a manifold of new avenues for the design of hypervalent iodine compounds with specific properties.

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CIVIL AND ENVIRONMENTAL ENGINEERING

Saman Farzi Sizkow (Board #33) Co-authors: Usama El Shamy
Advisor: Usama El Shamy
Civil and Environmental Engineering, Lyle School of Engineering

DEM Simulations of the Seismic Response of Flexible Retaining Walls

In this study, the dynamic interaction of soil-retaining wall is investigated through three-dimensional simulations using Discrete Element Method. In this method, the soil is modeled by a collection of rigid spherical bodies which are

allowed to interact with each other only at contact points. Newton's second law of motion along with force-displacement laws are utilized to calculate forces and motions inside the discontinuous media. In order to simulate the flexible retaining wall a sheet of rigid balls glued together with parallel bonds is created. The strength and stiffness of these parallel bonds are adjusted in a way that the overall structure mimics the physical properties of the real wall. In order to reduce the domain size and consequently the simulation time, the high g-level concept and scaling laws for dynamic centrifuge testing are employed. Furthermore, absorbing boundaries which have damping effects on boundary particles are installed at lateral sides of the model to prevent the reflections of the propagating waves. Dynamic excitation is introduced to the system through the base wall, which represents the bedrock. Then the effects of different characteristics of the input wave on the dynamic response of the system are evaluated and data on lateral thrust on the wall and its deflection is collected.

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Zheng Li (Board #34) Co-authors: Bardia Heidari;Jessie Zarazaga; Neil Hendrick
Advisor: Barbara Minsker
Civil and Environmental Engineering, Lyle School of Engineering

Distributed Infrastructure Equity study: Dallas, TX

Distributed infrastructure: Block- and neighborhood-scale, support neighborhood well-being. Anecdotes suggest the existence of disparities in distributed infrastructure among neighborhoods with different socio-economic levels. Large-scale data collection and analysis using machine learning and computer vision. Testing the "disparity" hypothesis by evaluating common distributed infrastructure via data analysis.

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Sepide Lotfi (Board #35)
Advisor: Khaled Abdelghany
Civil and Environmental Engineering, Lyle School of Engineering

Modelling Framework and Solution Methodology for On Demand Mobility Services with Ridesharing and Transfer Options

With rising fuel costs and road congestion, ride sharing becomes a common transportation mode. Ride share systems bring together travelers with similar itineraries and time schedules that provide significant social and environmental benefits by minimizing taxi fares for passengers, reducing road congestion, and air pollution.

Optimization of ride-sharing services involves solving a complex vehicle routing problems with pickup and delivery with time windows (VRPPDTW) that consists of defining a set of routes to serve passengers that satisfies time window constraints. This paper addresses a variant of the VRPPDTW that provides option for passengers to transfer from one vehicle to another at any location of network. We conclude that in some situations a scheme allowing transfers results in better quality optimal solutions.

The problem is formulated as mixed integer program and is solved by using K-shortest route and column generation method. This approach is implemented and compared to solving full problem using CPLEX.

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Ataollah Nateghi (Board #36)
Advisor: Usama El Shamy
Civil and Environmental Engineering, Lyle School of Engineering

HPC Framework Development for Numerical Simulation of Saturated Granular Soils

Saturated granular materials are multiphase materials that present a complex modeling problem to accommodate all the components of the different phases. The Interaction between the fluid phase and the soil is one of the main challenges in such models. For representing a true interaction, particle scale models of the soil and pore scale idealization of the fluid are required.

This realistic representation makes a major computational challenge that could be handled effectively through the use of high performance computing (HPC). In this research, we present a coupled model for fluid interaction with discrete particles. Lattice Boltzmann Method (LBM), which considers the behavior for the collection of molecules or atoms instead of every single one, is used for modeling the fluid phase. Parallelized LBM, which can lead to saving in computation time, decomposes the domain of the problem to discrete subdomains and solve them simultaneously. The Message Passing Interface (MPI) scheme, which makes it possible to exchange data through sending and receiving messages between subdomains, is used in this research for parallelizing the problem.

Currently, the solid phase is being modeled using the discrete element method (DEM). On account of using HPC methods, an open-source code, YADE, for discrete numerical models focused on Discrete Element Method is being used. The envisioned coupled L

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Ehab Sabi (Board #37)
Advisor: Usama El Shamy
Civil and Environmental Engineering, Lyle School of Engineering

Energy and geotechnical behaviour of energy piles embedded in rock

Geothermal energy piles are categorized as closed systems. Energy piles are a relatively new technology which couples the structural role of traditional pile foundations to that of heat exchangers to fulfill the required energy demand of buildings and infrastructures. These foundations are equipped with pipes embedded in the concrete forming the pile. While connected to heat pump, fluid circulating inside these pipes provides the exchange of heat with the ground for heating and cooling purposes. As the undisturbed temperature at the shallower depths of the ground stays comparatively constant the whole year, being warmer than the surrounding temperature in winter and cooler in summer, the capacities of ground thermal storage are beneficial for withstanding the process of cooling and heating. In this study, heat exchange between the pile foundations and rock is investigated. The behavior of such foundation as energy pile, which are governed by their response to thermo-mechanical loads, is presently not fully understood. The influence of different pipe configurations embedded in the pile is examined while the pile is embedded in two different rock types (limestone and sandstone). It has been observed that pipe configurations strongly affect the behavior of the energy piles. An increase in the axial distributions of vertical thermal stresses has been recorded when the pile equipped with double U-pipes compared with that of the single U-pipe. The maximum value of the axial distributions of the thermal vertical displacements was observed when the pile foundation equipped with double U-pipes buried in limestone.

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Arefeh Safaei Moghadam (Board #38)
Advisor: Barbara Minsker
Civil and Environmental Engineering, Lyle School of Engineering

Real-time detection of urban flood severity using social media interactions

Flash floods are one of the most destructive natural hazards that are becoming more frequent due to increased urbanization and climate change. Flash floods can be caused by excessive rainfall or sudden release of water in

upstream reservoirs. Understanding real-time flash flood formation and its characteristics is necessary for decision-makers to increase disaster preparedness, discover the affected population, and identify safest routes for dispatching first responders. On the other hand, the spatial distribution of monitoring networks in cities is limited and measuring flow characteristics such as flood depth and inundation extent throughout the city is a challenge. The increased popularity of social media and power of artificial intelligence brings new sources of complementary flooding information. In this research, we apply text mining and image processing algorithms to Tweets posted in the City of Dallas to evaluate their benefits for use during and after floods.

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Jase Sitton (Board #39)
Advisor: Brett Story
Civil and Environmental Engineering, Lyle School of Engineering

Indirect Bridge Monitoring Using the Dynamic Response of a Passing Vehicle

Researchers have recently focused on the use of vehicles that are instrumented with electronic transducers, typically accelerometers, as mobile bridge inspection instruments. In this scenario, the vehicle plays two roles: that of the measurement device, and that of the excitation source for the bridge. In order for vehicle-based inspection to be successful, the dynamic interaction between the bridge and the vehicle must be understood. This project presents closed-form solutions for the vibration of the bridge and the vehicle for the case of a vehicle traversing a 2-span continuous bridge. Results are validated using finite element simulation. Results show that the bridge frequencies observed by the vehicle during passage are shifted, with the shift dependent upon vehicle velocity. It is shown that these shifted bridge frequencies can be used to make an accurate estimation of the fundamental bridge frequencies from the vehicle acceleration DFT without prior knowledge of the bridge properties.

Lanxi Liu (Board #50) Co-authors: Smith-Colin, Janille
Advisor: Janille Smith-Colin
Civil and Environmental Engineering, Lyle School of Engineering

Advancing Equity through Smart City Innovations

This research investigates equity-related service delivery goals and practices for smart city technologies. A state of practice review of twenty cities is used to draw direct and indirect relationships that demonstrate how smart city technologies are being used to bridge the equity gap within cities. A comprehensive model of equity is developed based on the dimensions of health, mobility, affordability, and access, and connections drawn between equity goals and smart city innovations, used to define equity-related performance measures. A case analysis of smart transportation technologies in two cities is used to demonstrate how the density and distribution of innovations can reflect inequitable service delivery. Finally, an equity road map is presented to define maturity stages for the delivery of smart city technologies. This research highlights opportunities for smart city technologies to contribute to equity goals and offers guidance for more equitable delivery of service.

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ECONOMICS

Aastha Gupta (Board #40)
Advisor: Santanu Roy
Economics, Dedman College

Consumer Naivety and Price Signaling

Firms signal their quality through prices. But are all consumers able to interpret these signals? There are some naive consumers present in the market who cannot judge the quality of the product through prices because of cognitive limitations. In a static signaling model, I analyze the pricing behavior of a monopolist, selling product of uncertain quality, in the presence of such naive consumers. In the high-quality state, the presence of naive consumers reduces the price of the product and hence improves overall welfare of the society. On the other hand, in the low-quality state, it increases the price of the product (depending on the valuations) thereby reducing social surplus. Allowing for disclosure as an alternative to communicate quality, the high-quality monopolist has no incentive to disclose in the presence of high proportion of naive consumers. This provides partial explanation for the infrequent voluntary disclosure by some industries. I further introduce competition in the market to show the combined effect of the presence of naive consumers and competition on the pricing strategies of firms with different qualities. This results in a fully revealing equilibrium in mixed strategies where the prices of both types of firms are reduced.

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PHYSICS

Peilong Wang (Board #42)
Advisor: Stephen Sekula
Physics, Dedman College

ttbar background rejection study in VHbb analysis on ATLAS experiment

The top pair background is one of the largest backgrounds in H->bb decay. Thus the study and modeling of it is critical. This poster will describe how the ttbar background is studied and rejected in VHbb analysis.

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Keping Xie (Board #43)
Advisor: Roberto Vega
Physics, Dedman College

Light Exotic Higgs Bosons at the LHC

We show that the well known Georgi-Machacek (GM) model can be realized as a limit of the recently constructed Supersymmetric Custodial Higgs Triplet Model (SCTM) which in general contains a significantly more complex scalar spectrum. We dub this limit of the SCTM as the Supersymmetric GM (SGM) model, which gives a weakly coupled origin for the GM model at the electroweak scale. We derive a mapping between the SGM and GM models using it to show how a supersymmetric origin implies constraints on the Higgs potential in conventional GM model constructions which would generically not be present. We point it out under what circumstance, the SGM can mimic the GM model, and when they can be distinguished. Then we perform the phenomenological study of the collider searches, such as the di-Boson signals (diphoton, WW, ZZ) and the global collider constraints. We also consider the possibility of the Lightest Supersymmetric Particles (LSP) in the SGM model as a Dark Matter candidate and explore the relic density and direct detection constraints.

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COMPUTER SCIENCE AND ENGINEERING

Yasamin Fozouni (Board #44)
Advisor: Eric Larson; Bruce Gnade
Computer Science and Engineering, Lyle School of Engineering

Chemical Spectroscopy-based Fingerprinting with Low-cost CMOS Sensing

This research presents methods for simulating and identifying mixtures of chemical compounds using rotational spectroscopy from a low-cost CMOS-based sensor. The use of the CMOS sensor introduces a number of stochastic processes into the observed spectral components that complicates existing spectral fingerprinting algorithms. In this work, we characterize these stochastic effects and develop an application software suite that allows simulation of the observed CMOS-based spectra from the JPL NASA Molecular Spectroscopy database. This application facilitates pattern finding between the sample data gathered from CMOS sensors and known rotational spectroscopy from JPL. We further present methods for robustly finding spectral fingerprints from the CMOS spectroscopy and evaluate our proposed methods using extensive simulations from our software suite.

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Naseer Jan (Board #45) Co-authors: Jeff Tian
Advisor: Jeff Tian
Computer Science and Engineering, Lyle School of Engineering

Classification and Analysis of Usability Issues in Software Related Safety Critical Systems

Failures in software related safety-critical systems could result in disastrous accidents, including loss of life, environmental damage and financial loss. These systems are human-machine systems designed and operated by humans for use in different critical domains, such as the nuclear industry, health sector, space industry, aviation, etc. Usability plays a significant role in such safety-critical systems, where interface, interaction, or usability problems can be contributing factors or even main causes for accidents. Although there are some general classification schemes to address usability problems, there is a need to further investigate and address usability and safety problems together in safety-critical systems in a more systematic way. In this study, we present a comprehensive classification and analysis framework to address usability issues in safety-critical systems by systematically examining the cause-effect relationship from both the designer perspective and the user/operator perspective. Our framework consists of four high level problem types: artifact related problems and task implementation problems from the designer perspective, and problems in performing tasks and learnability problems from the user/operator perspectives. Usability problems within these four types are further classified based on control theory and human-computer interaction theory.

Commercial Viability: Loss of control in flight is a major contributing factor in nearly half of general aviation accidents as reported by National Transportation Safety Board (NTSB) based on data from 2008-2014. Moreover, Federal Aviation Authority (FAA) FAA highlights differ different areas in aviation safety that needs improvement. Usability issues, results into loss of control in flight, is also explored and investigated in software related accidents from 1989-2015. Pilots need more effective and efficient user interface design that can help prevent these accidents. To address usability issues followed by human errors is a key to eliminate distraction, recovers from stall will put pilots back in control and give them better command of their outcomes.

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Hui Jiang (Board #46)
Advisor: Jennifer Dworak
Computer Science and Engineering, Lyle School of Engineering

Enhancing Cell-Aware Fault Detection through Intelligent Use of Scan Shift Cycles

Probabilistic approaches to the detection of untargeted defects, such as n-detect and standard LBIST (logic built-in-self-test), generally suffer from the need to apply very long test sets to achieve good coverage. However, more targeted approaches that attempt to explicitly model new types of defects, such as cell-aware faults, so that they can

be deterministically detected may also lead to unacceptably long test sets. Generally, when tests are applied to circuits that contain scan chains, test results are only captured once the entire pattern has been shifted in and the desired deterministic pattern has been applied. Intervening shift cycles serve only as overhead. This is done because capturing data in the circuit's scan flip-flops during scan shift would destroy the pattern being shifted in. However, if data is captured in shadow flops in a MISR instead, those shift cycles could be used to obtain additional fault coverage. In this paper, we investigate the ability of the intervening shift cycles to achieve high static cell-aware fault coverage using only the test patterns generated to detect stuck-at faults. We also investigate reducing the number of shadow flops required. Our results show that high cell-aware coverage is achievable even when only a stuck-at test set is applied—in some cases equal to the coverage obtained by a dedicated cell-aware test set.

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Myque Ouellette (Board #47)
Advisor: Corey Clark
Computer Science and Engineering, Lyle School of Engineering

Evaluating Age-Related Macular Degeneration Optical Coherence Tomography Scans using Constructivist Augmented Machine Learning to Integrate Human Intuition Filters into Deep Learning Algorithms

Researchers use optical coherence tomography (OCT) scans to evaluate the effectiveness of treatments for Age-Related Macular Degeneration (AMD), a leading cause of blindness. While automated evaluation procedures exist, many struggle to identify AMD features consistently, particularly for more advanced AMD cases. Results of automated evaluation often require verification or modification by a trained OCT evaluator. With millions of OCT scans performed each year, demand for new evaluation approaches increases. Constructivist Augmented Machine Learning (CAML) is a framework for creating collaborative learning between humans and machine learning. As part of CAML, we use the human computing to video game model to develop a human computation game, Eye in the Sky: Defender, where players interact with gameplay designed around OCT scan analysis. The aggregate of the data gathered from the play sessions produces results comparable to the error between expert reviewers. This provides sufficient accuracy to serve as a filter on the OCT images, which we integrate into the data provided to train deep learning algorithms (DLA) focused on OCT analysis and image segmentation. The filter is expected to improve the performance of the DL algorithm in both execution and accuracy, while providing it with the flexibility to adapt to new, and more complex features.

Commercial Viability: Should the results be as expected, the approach provides the foundation for a general OCT scan analysis approach providing value to research and medical fields. OCT use is not limited to AMD, and are used to evaluate many other medical conditions. In addition, the approach applies to other forms image-based analysis including other of medical imagery (e.g. CAT scans, MRIs). Given the general explosion in the applications of and demand for deep learning, the broader approach of integrating humans as a filter for DLAs, CAML, has numerous potential commercial applications across any number of fields of research, including medicine, cyber-security, and AI research in general.

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Yi Sun (Board #48)
Advisor: Jennifer Dowrak
Computer Science and Engineering, Lyle School of Engineering

Functional segment insertion bits: Reducing capture power during tests

No abstract.

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Justin Wilson (Board #49)
Advisor: Suku Nair
Computer Science and Engineering, Lyle School of Engineering

Towards a Universal Latent Space for Physiological Sensing

Physical sensing is becoming more ubiquitous every day. Physiological measures such as pupillometry, gaze patterns, photoplethysmography, and electro-dermal activity can be extracted from most personal devices, and can serve as proxies to infer cognitive load, emotion, engagement, stress, strain, and arousal, among others. There is a greater potential for understanding the context of the human-in-the-loop as more sensing modalities become available. We suggest there can be a way train a universal latent space capable of delivering a dense vector representation from these multi-sensor physiological samples. Transforming observed data into a latent vector space provides the ability to encode and preserve contextual relationships among observed data. Word embeddings are a great example of this point – dimensionality reduction is achieved and much of the semantic and syntactical relationships among words are maintained within vector subspaces. We speculate that, in the same way word embeddings have accelerated research in the natural language processing community, a universal physical sensor embedding or latent space, that encodes human physiology in response to stimuli, can enable and potentially accelerate the sensing research community. The poster will discuss this vison and provide some examples of our current work. This work is done in collaboration with Dr.Suku Nair and Dr. Eric Larson.

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Matt Zaber (Board #52) Co-authors: Derek Phanekham
Advisor: Suku Nair
Computer Science and Engineering, Lyle School of Engineering

Long Term Evaluation Of Trade Offs In Resource Placement For Public Cloud Networking Features

We present an end-to-end framework for automated and repeatable cloud performance evaluation. Aligning resource requirements to a cloud provider's published SLAs can lead to over-provisioning and wasted money or under-provisioning and service disruption. In this work we demonstrate that performance can vary significantly among regions and availability zones within the same provider. Next, we establish how characterizing performance metrics across providers can be misinterpreted or intentionally misrepresented in benchmark reporting and present our solution for reproducible testing of both micro benchmarks and workload simulations. We then describe anomalies encountered during the course of long-term testing and what their significance is for cloud providers and consumers. Finally, we conclude with work performed to optimize and extend benchmark functionality and what direction this research is heading.

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EARTH SCIENCES

Kimberly DeGrandpre (Board #53) Co-authors: Helene le Mevel
Advisor: Zhong Lu
Earth Sciences, Dedman College

Multi-physics Model of Okmok Volcano

Okmok Volcano is a shield caldera on Umnak Island in the central Aleutian arc with 2 significant eruptions in the past 21 years. These eruptions both occurred inside the main caldera, but from cones on opposing sides with extremely

different seismic, geodetic, and geochemical signatures. An extensive amount of geodetic, seismic, and petrologic data and their associated models have been published regarding both of these eruptions. Models created from these various datasets all provide a general interpretation that the source of deformation and magma storage related to both these eruptions is a shallow, spherical feature located at depths of approximately 2–5 km beneath the center of the caldera and is supplied by a deeper source. These models provide valuable insight into the location of magma storage, but they do not provide any explanation as to why there was a drastic change in eruption parameters from 1997 to 2008 with no apparent change in source dynamics. To explore the mechanisms controlling eruption parameters at Okmok we must first define the local stress regime and its relationship to the geophysical mechanisms that control these variations in eruptive style, location, and timing. This study uses multi-disciplinary data to quantify the local rheologic and pressure distribution at Okmok and create a physics-based model to explore this variation in eruption mechanisms.

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Yusuf Eshqi Molan (Board #54) Co-authors: Zhong Lu
Advisor: Zhong Lu
Earth Sciences, Dedman College

Modeling of soil Moisture influence on InSAR phase and SAR intensity

In this paper, we present a new approach and a comprehensive model to estimate soil moisture induced SAR intensity and InSAR phase changes. Our model consider soil's structure as well as depth variable soil moisture changes. To this end, we model the soil as a collection of discrete coarse scatterers embedded in an attenuating dielectric medium comprising of finer soil grains. Therefore, our volume scattering model, besides providing improved estimation of soil moisture changes or soil moisture induced intensity and phase changes, can potentially be used to infer soil structure.

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SeongJu Jeong (Board #55) Co-authors: Heather DeShon
Advisor: Brian Stump
Earth Sciences, Dedman College

Spectral Characteristics of Ground Motion for Induced Earthquakes in the Fort Worth Basin, Texas

We analyze S-wave spectral amplitudes from a dataset of 127 induced earthquakes (ML 2.0-4.0) accompanying five, well-recorded seismic sequence in the Fort Worth Basin, North Texas. 31 temporary-seismic stations are used to provide physical insights into source, path, and site characteristics. A two-step generalized inversion technique (GIT) is used to separate these contributions. In the first step, the path attenuation is parameterized and estimated producing a frequency dependent quality factor as Qs(f)=36f1.4 with an assumed geometrical spreading by 1/r for distances less than 50 km and 1/r0.5 beyond 50 km. The second GIT then estimates the resulting event source spectra and site-specific transfer function. Using source spectra, we estimate a mean stress drop of ~4 MPa using the omega-squared source model formulation. These stress drops are consistent with other estimates for earthquakes near the study area as well as global averages for intraplate earthquakes. The site responses show large variability across the study area with significant amplifications between 3 and 10 Hz. The GIT site effects decay more rapidly at high frequency than those from HVSR. The high frequency differences suggest that the vertical component of the shear wave is impacted by near-surface attenuation, breaking the basic HVSR assumption that the vertical S-wave is free of site effects.

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Ya Kang (Board #56)
Advisor: Zhong Lu
Earth Sciences, Dedman College

Application of InSAR Techniques to an Analysis of the Maoxian Landslide

Maoxian landslide occurred on June 24, 2017, which caused huge casualties and property losses. Characteristics of pre-collapse deformation are keys for studying landslide collapse mechanism. The interferometric synthetic aperture radar (InSAR) technique has been widely used in landslide research owing to its broad coverage, high spatial resolution, and ability to operate under all weather conditions. In this study, archived SAR data including 44 Sentinel-1 A/B data and 21 Envisat/ASAR data are used to recover the deformation prior to the landslide occurrence through the time-series InSAR techniques. It can be found that the deformation of the landslide source area has occurred as early as ten years before the landslide collapsed, and the spatial characteristics of the deformation have changed significantly with the landslide development. The deformation rate of source area accelerates about a month before the collapse. Then an elastic dislocation model is used to estimate landslide slip surface depth, which has reached about 59 meters, and landslide deformation is modeled with a distributed set of rectangular dislocation sources. The results provide new insights into Maoxian landslide mechanism.

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Yufen Niu (Board #57) Co-authors: Daniel Dzurisin; Zhong Lu
Advisor: Zhong Lu
Earth Sciences, Dedman College

Interferometric synthetic aperture radar study of renewed activity at Shrub mud volcano, Alaska, 1996–2000 and 2006-2011

Shrub is one mud volcano in the Copper River Basin of southcentral Alaska (figure 1). Except for minor discharges in the mid-1950s, Shrub was virtually inactive prior to its reactivation in summer 1996. From 1997 to 1999, Shrub vigorously emitted CO2-rich gas and warm saline mud. We used InSAR to study Shrub volcano before, during and after its 1996–1999 activities. Included in our study, 4 different sensors SAR images collectively span 1992–2000 and 2006-2011 (figure 1). Results of the interferograms (figure 2) showed that the surface slowly uplifted with southwest flank's displacement center before 1996 (figure 3), subsided sharply during 1996-2000 (figure 4), and continued to subside with slower rate from 2006 to 2011 (figure 5). Furthermore, two Yang prolate spheroid model are used to inverse the source's location (figure 6a), depth, geometry (figure 6b), and the volume change. And examples of remodeled results are shown in figure 7 and 8. Moreover, the time series of volume change (figure 9) is calculated by the LS method. These results indicate that: 1) depth of the sources are much shallower than magma volcanoes; 2) there were one approximately vertical larger prelate ellipsoid source beneath the summit area and one smaller sub-source under the southwest flank; 3) Sources volume increased during 1992–1996, then decreased with higher rate during 1996–2000 and 2006-2011.

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Louis Quinones (Board #58) Co-authors: Heather DeShon
Advisor: Heather DeShon
Earth Sciences, Dedman College

Shear Wave Splitting and Pore Fluid Pressure in Johnson County, TX

Shear wave anisotropy observed within the Earth's crust has been associated with the presence of stress aligned microscale grain boundary cracks throughout crustal rocks. Prior observations of shear wave splitting related to

shallow crustal earthquakes show a correlation between the azimuth of the fast S-wave orientation and the stress state of the source rocks. As pore fluid pressure in the source rocks increases, we expect to observe a 90 shift in the fast S-wave orientation from aligning with the maximum horizontal stress direction to aligning with the minimum horizontal stress direction. Here, we examine the shear wave splitting observed within the data collected from the Venus earthquake sequence in Johnson County (JC), TX. The Venus earthquakes are an induced seismicity sequence associated with fluid disposal activities which have overpressured the fluid disposal formation in the JC area by 1.7-4.5 MPa. We seek to determine whether the azimuths of the fast S-wave orientations for the Venus earthquakes are representative of an overpressured system. Additionally, we examine if temporal variations in the shear wave splitting results can be observed from the Venus sequence data. Through the analysis of shear wave anisotropy, it may be possible to determine whether the source formation of any possibly induced sequence is in fact overpressured using solely seismic wave data.

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Jiahui Wang (Board #59)
Advisor: Zhong Lu
Earth Sciences, Dedman College

InSAR observation of the Okmok volcano, Aleutian Island, Alaska

Okmok, one of the most active volcanoes in the Aleutian arc, has occurred multiple eruptions since 19th century, the latest eruption was the July-August 2008 eruption, which is by far the largest one since records begin with the 1817 eruption. We investigate the post eruption deformation of the Okmok during 2014-2018 with the L-band ALOS2 and C-band Sentinel-1 A/B synthetic aperture radar (SAR) images, interferograms are generated with updated digital elevation model (DEM) which is a combination of the latest release version of ArcticDEM and the 2001 SRTM DEM. Furthermore, ramping phase are removed from the phase difference and interferometric pairs with good coherence are selected for deformation time series calculation with small baseline subset (SBAS) algorithm.

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Yuankun Xu (Board #60) Co-authors: Jinwoo Kim; David George
Advisor: Zhong Lu
Earth Sciences, Dedman College

Rainfall-triggered seasonal movement and time retardation of Lawson Creek landslide revealed by InSAR

Precipitation infiltrates into basal shearing zones triggering seasonal landslide motion by increasing pore-pressure and reducing shear resistance. This process is jointly controlled by basal depth, rainfall intensity, soil moisture, and hydraulic conductivity. Using Interferometric Synthetic Aperture Radar (InSAR), we detect and map a slow-moving transitional slide in the southwestern Oregon - Lawson Creek landslide. Its basal geometry and sliding volume are estimated using the mass conservation approach by assuming a power-law rheology. Combining InSAR-observed time lags between precipitation and the initiation of landslide, in-situ and satellite-captured soil moisture, and hydraulic conductivity, we obtain the water infiltration depth during the time-lag period, and the result of 1.4 - 9.9 m agrees well with the theoretically derived basal depth of 3.9 - 12.1 m where shearing failures commence from limit equilibrium analysis, even given the uncertainties of hydraulic conductivity and soil properties.

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Weiyu Zheng (Board #61) Co-authors: Jinwoo Kim; Tabrez Ali
Advisor: Zhong Lu
Earth Sciences, Dedman College

Possible leakage of wastewater in West Texas inferred by InSAR observation and modeling

As a byproduct of oil and gas production, the wastewater is injected into disposal wells. We use InSAR to detect the ground deformation in Ken Regan field, West Texas and find surface uplift from 2007 to 2011 near the wastewater disposal well (API NO. 38931913). The high correlation between the deformation and the injection volume suggests the uplift is caused by wastewater disposal in this well. Inversed elastic models (Mogi and Okada) and forward poroelastic models (Defmod) are conducted to simulate the surface uplift and estimate the effective injection depth and volume. Elastic models give a rough glimpse of the underground geo-mechanical process in terms of the injection depth. The poroelastic models also provide restrictions for hydrologic properties of the strata. Results from those models indicate that the effective injection depth is much shallower than the reported injection depth. The most reasonable explanation is that the well is experiencing leakage due to a failed casing or sealing problem. The leakage happened in Rustler Formation, from which the groundwater is only used for irrigation and livestock. The slow dispersion of wastewater also reduces the risk to human and environment.

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EDUCATION POLICY AND LEADERSHIP

Nancy Le (Board #62) Co-authors: Marlen Collazo; Mack Sano
Advisor: Doris Baker
Education Policy & Leadership, Simmons School of Education

The Evaluation of Automatic Scoring Sytems Compared to Human Scoring of Student Vocabulary Knowledge

The purpose of this poster is to (a) present the results of an exploratory automated system study designed to score the hand transcribed speech data, and (b) compare the accuracy of the scoring of four machine learning techniques to human scoring. Speech from 217 Hispanic English Learners who were part of a larger study were analyzed using support vector machine (SVM), tree-based regression (TBR), Random Forest (RF) and Long and Short-Term Memory (LSTM) networks. Findings indicate that human scoring was substantially higher when compared to automated scoring systems. Nevertheless, this exploration study provides recommendations for improving the accuracy and reliability of these automated systems. Implications of this study are discussed in the context of finding new ways to analyze student natural speech and impact on instruction.

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Hao Ma (Board #63) Co-authors: Akihito Kamata; Yusuf Kara
Advisor: Akihito Kamata
Education Policy & Leadership, Simmons School of Education

Evaluation of the Utility of Informative Priors in Bayesian SEM in Small Samples

Abstract: This study evaluates the performance of different estimators on factor loadings and structural coefficients in terms of bias, RMSE, and SE for CFA models and SEM models under the ML and Bayesian framework in small samples. Simulation conditions varied in sample sizes, mean factor loading, priors, and estimators.

The results showed that for one-factor CFA model, ML-CFA performs a little bit of better than Bayesian CFA with informative priors on all factor loadings estimate across all conditions for all individual parameter, while Bayesian

CFA with informative priors performed well in the aggregated parameter estimates compared to other estimation methods across conditions. Similarly, for RMSE and SE, Bayesian CFA with informative priors outperformed other estimation methods both in the aggregated and individual parameter estimates compared to other estimation methods across conditions.

The results also showed that Bayesian SEM with informative priors outperforms ML-SEM and other estimation methods on two regression coefficients with smallest bias, RMSE and SE both in the aggregated and individual parameter estimates across conditions. In addition, the performance of Bayesian SEM with informative prior on factor loading is not as satisfactory as expected compared with ML-SEM.

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Shelby Hyde (Board #64)
Advisor: Kiersten Ferguson
Education Policy & Leadership, Simmons School of Education

Post-High School Graduation Decisions Made by Rural High School Students in the State of Texas

This study is designed to examine the post-high school graduation decisions made by rural students in the state of Texas to investigate the factors resulting in choosing to enroll in a postsecondary institution, enlist in the military, or enter directly into the workforce. Current research literature on rural students is very limited, however of the research literature available, we know on average these students enroll in college at lesser rates than their suburban and urban peers (Koicich, 2014). Additionally, it is found when college is chosen these students tend to enroll in 2-year or less selective 4-year postsecondary institutions (Koicich, 2014). This study uses Laura Perna's (2006) college choice model as guidance to answer why rural high school students choose the post-high school trajectory they do.

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TEACHING AND LEARNING

Carlin Conner (Board #65)
Advisor: Jill Allor
Teaching & Learning, Simmons School of Education

Evaluation of a Recently Developed Observation Tool: Issues in Reliability

This poster will discuss issues in calculating interrater reliability among three raters across a recently developed observation tool, the Systematic Observation of Literacy Engagement (SOLE). The SOLE is an observation tool designed to measure aspects of literacy engagement, adapted from the Systematic Assessment of Book Reading (SABR), an observation tool that captures teacher behavior during literacy instruction. Twenty five specific behavior codes are captured on the SOLE, which are either observed (1) or not observed (0) by the rater at each 30-second time stamp.

To evaluate this observation tool, three raters independently coded video data of three students during literacy instruction. Percent agreement among the three raters was high overall (84%), but varied by construct. The problem discussed is choosing the correct test statistic when interrater reliability is high, as original calculations resulted low reliability estimates. For example, Krippendorffs alpha compares observed agreement to expected agreement; since disagreement was low, this resulted in a low reliability statistic. At times, when the prevalence of agreement is high, meaning there is a large extent of agreement between raters, this high agreement is not reflected in the test statistic (Gwet, 2008). I will further discuss these issues around interrater reliability and discuss the Gwet (2008) statistic to determine a more appropriate inter-rater reliability estimate.

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Min Wang (Board #66) Co-authors: Candace Walkington; Trevelyn Everitt-Gyure
Advisor: Candace Walkington
Teaching & Learning, Simmons School of Education

Supporting Middle School Students in Problem-Posing: A Personalized Approach

Problem posing has been identified as an important component in mathematics education (Cai et al., 2015). Posing problems about topics that students are familiar with (e.g., home or community contexts) allows students to integrate their everyday knowledge into the problem posing process which helps them to develop conceptual understanding by connecting the real-world scenarios with school mathematics (English, 1998). Even though a positive relationship between problem posing and students' mathematics learning has been documented (e.g., English, 1997; Kapur, 2015), a gap between research findings in problem posing and authentic implementation in classrooms remains. Therefore, we designed a teaching experiment study to investigate the impacts and important scaffolds when implementing personalized problem. The findings confirmed both the advantages and the challenges of the problem posing activities. Students were able to generate mathematical problems and utilize their funds of knowledge to make sense of the algebraic equations during the process. The main challenge was teacher's scaffolding during the process. In this study, the teaching researcher elicited students' interests as a general guide and scaffolded students to identify numeric information in the scenarios and bridge the gap between the algebraic reasoning and students' funds of knowledge in their topics of interest.

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Sumei Wu (Board #67) Co-authors: Paige Ware; Jillian Conry
Advisor: Paige Ware
Teaching & Learning, Simmons School of Education

Examining Community-Based Field Teaching as a Source of Teacher Self-Efficacy with English Learners

This study explored two models of professional learning for pre- and in-service teachers as part of a year-long teacher professional learning program designed to strengthen teachers' expertise in working with English learners and their families. We drew on the lens of mastery experiences based on Bandura's (1977) model of self-efficacy. This mixed methods study followed a cohort of 55 teachers participating in 30 weeks of federally funded graduate coursework focused on English learner instruction. Using stratified random sampling, participants (36 in-service teachers and 28 pre-service teachers) were assigned to one of two conditions: community-based field experiences or business-as-usual university seminars. Data sources included pre/post participant surveys, teacher ratings of confidence levels, and qualitative data drawn from one-on-one semi-structured interviews. Findings highlight statistically significant positive contributions of community-based field teaching on teachers' self-reported sense of self-efficacy in working with English learners. Qualitative analyses of the interviews traced patterns that illustrated different pathways that pre- and in-service teachers followed in developing their sense of self-efficacy, even as both groups valued the opportunity to put theory into practice and gain first-hand experiences.

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ELECTRICAL ENGINEERING

Yazeed Alkhrijah (Board #68)
Advisor: Dinesh Rajan
Electrical Engineering, Lyle School of Engineering

Full Duplex Communication MAC protocol

Recent advance in self-interference suppression techniques made in band full duplex (IBFD) wireless communication feasible. In my research, I will study the Medium Access Control for IBFD where a multiple scenarios will be considered to improve the IBFD MAC efficiency.

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Wenkai Bao (Board #73)
Advisor: Dario Villarreal
Electrical Engineering, Lyle School of Engineering

Towards a Vision-Based Autonomous Walking in Lower-Limb Powered Exoskeletons

In this research, we propose a novel autonomous walking pattern generator based on visual information shared between a human and a lower-limb exoskeleton. We expect that this control scheme will understand the user's intention during walking and help him overcome daily obstacles. First, we measure and evaluate the human's gaze position in a 3D environment via an eye tracker system to detect obstacles. We formulate a model predictive controller (MPC) which modifies the footsteps and center of mass trajectory of the exoskeleton to track a reference walking pattern considering the visual feedback. Our simulation result corroborates that MPC with visual feedback is an effective method to achieve autonomous walking of lower-limb exoskeleton. Our next step is to realize the autonomous walking in an environment where obstacles are present across different locomotion tasks such as walking upstairs, downstairs, uphill, downhill, etc.

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Maryam Dezfuli (Board #74) Co-authors: Freddie Castillo II
Advisor: Gary Evans
Electrical Engineering, Lyle School of Engineering

Monolithic 10 Element Laser-Modulator for 1Tbps Data Transmission

We are developing a laser with an integrated electro-absorption modulator (EAM) that offers much greater speed (> 100Gbps NRZ) and bandwidth, reduced power consumption (0.3 pJ/bit), and lower cost for short haul data center applications, and ultra-scale computing as compared to state of the art commercial products.

Commercial Viability: We are developing a laser with an integrated electro-absorption modulator (EAM) that offers much greater speed (> 100Gbps NRZ) and bandwidth, reduced power consumption (0.3 pJ/bit), and lower cost for short haul data center applications, and ultra-scale computing as compared to state of the art commercial products.

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Mahdi Khodayar (Board #75)
Advisor: Jianhui Wang
Electrical Engineering, Lyle School of Engineering

A Deep Generative Model for Networks

Creating and modeling real-world graphs is a crucial problem in various applications of engineering; however, learning the distributions of nodes/edges and sampling from them to generate realistic graphs is still challenging. Moreover, generating a diverse set of synthetic graphs that all imitate a real network is not addressed. In this paper, the novel problem of creating diverse synthetic graphs is solved. First, we devise the deep supervised subset selection (DeepS3) algorithm; Given a dataset and a ground-truth set of data points, DeepS3 selects a diverse subset of all items

in the dataset, that best represent the items in the ground-truth set. Furthermore, we propose the deep graph representation recurrent network (GRRN) as a novel generative model that learns a probabilistic representation of a real weighted graph. Training the GRRN, we generate a large set of synthetic graphs that are likely to follow the same features and adjacency patterns as the original one. Incorporating GRRN with DeepS3, we select a diverse subset of GRRN's generated graphs that best represent the behaviors of the real graph (i.e. our ground-truth). We apply our model to the novel problem of power grid synthesis, where a synthetic power network is created with the same physical/geometric properties as a real power system without revealing the real locations of the substations (nodes) and the lines.

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Xinyun Lu (Board #76) Co-authors: Zhengshuo Li
Advisor: Jianhui Wang
Electrical Engineering, Lyle School of Engineering

Dynamic stability assessment for integrated transmission-distribution system

As distributed energy resources (DERs) are increasingly integrated into the electric power grids, distribution grid turns into a more active participant. In order to guarantee the secure and reliable grid operation, we need to examine the full-spectrum impacts of DERs on overall system stability. This research work targets to thoroughly assess the integration of DERs in power system, mainly focusing on short-term stability phenomena.

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David Wang (Board #77) Co-authors: Bradly Lega
Advisor: Carlos Davila
Electrical Engineering, Lyle School of Engineering

Cross-Region Phase-Amplitude Coupling of EEG in Episodic Memory

We introduce an EEG-based connectivity measure based on phase-amplitude coupling (PAC). Our method couples the theta phase in the hippocampus to gamma amplitude from other regions of interest (ROIs) in the brain, which we call cross-region phase-amplitude coupling (xPAC). We test xPAC on the results of episodic memory experiments on patients with intractable epilepsy. The EEG is recorded while the subject performs a verbal "free-recall" task. We find significant differences in xPAC levels during successful memory encoding compared to unsuccessful encoding.

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Yuhe Xia (Board #78) Co-authors: Chi Zhang; Lakshmi Ramakrishnan
Advisor: Gary Evans
Electrical Engineering, Lyle School of Engineering

Optical Powered Circuitry for Power Analysis Attack Resistance

Considerable attention is devoted to side channel attacks for encryption circuitry. Such attacks are possible because switching activity, input power, delay, and electromagnetic radiation are data dependent. These characteristics in an encryption circuit depend on plaintext, ciphertext and the key. Power analysis attacks extract the key by monitoring the circuit's power trace. Approaches to eliminate this dependency on the key still allow some key and data dependent switching activity to occur that may be used for key extraction. We eliminate this data dependency by providing optical power to the circuit which draws constant electrical power distinct from the power of the circuitry performing the sensitive calculations. The optical components employed are semiconductor lasers and detectors which together are expected to convert electrical to optical to electrical power at efficiencies greater than 50%. The

impact of our approach, including inter-circuit communication methods, on other security measures will be explored.

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ENGINEERING MANAGEMENT, INFORMATION, AND SYSTEMS

Hedieh Ashrafi (Board #79)
Advisor: Aurelie Thiele
Engineering Management, Information, and Systems, Lyle School of Engineering

Robust optimization in portfolio management

We consider the problem of maximizing the worst-case return of a portfolio when the manager can invest in stocks as well as European options on those stocks, and the stock returns are modeled using an uncertainty-set approach, with a range forecast for each factor driving the returns and a budget of uncertainty limiting the deviations of these factors from their nominal values. Little attention has been spent on considering options and robust optimization jointly due to the computational difficulties that arise. We present theoretical results regarding the structure of the optimal allocation and analyze how the optimal allocation varies with the budget of uncertainty. Our results provide insights into how which uncertainty protection the manager is willing to purchase at which price. We compare our robust portfolio allocation to several benchmarks in numerical experiments, which show that our approach performs very well in practice.

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Yulan Bai (Board #80) Co-authors: Eli Olinick; Yuanyuan Dong; Junfang Yu
Advisor: Eli Olinick
Engineering Management, Information, and Systems, Lyle School of Engineering

Computational Study of Two Models for the Backhaul Profit Maximization Problem

The Backhaul Profit Maximization Problem (BPMP) is a computationally challenging logistics problem. In the BPMP a freight carrier seeks to profit from an empty delivery vehicle's backhaul trip from its last scheduled delivery to its depot by allowing it to deviate from the fastest route to accept delivery requests between intermediate points as allowed by its capacity and required return time. We present techniques that significantly improve solution time for the node-arc and triples mixed integer programming formulations of BPMP in the literature. We design a series of tests to determine the best combination of techniques for each formulation and measure performance with multiple criteria. We also present a Composite Index Method (CIM) to measure the comprehensive performance of the two models in a quantitative way. The CIM reflects a model's overall performance considering problem size and multiple measures of computational effort. We demonstrate improvement in the CIM over the results in the literature (e.g., we solve instances with up to 50 nodes with node-arc formulation whereas the largest instances solved in the literature have only 20 nodes). We find that the triples formulation is more efficient than the node-arc formulation. For example, we solved 40-node instances an average of 696 times faster with the triples formulation than with the node-arc formulation.

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Sulalitha Bowala Mudiyanselage (Board #81) Co-authors: Alba Rojas-Cordova
Advisor: Alba Rojas-Cordova
Engineering Management, Information, and Systems, Lyle School of Engineering

Optimal Testing Schedules for Sequential Adaptive Clinical Trials under Different Success Criteria

Traditionally, Phase 3 clinical trials recruit a fixed sample size of patients and the results of the trial are not analyzed until the full sample size has been collected. Existing sequential testing methodologies for Phase 3 trials allow for early trial termination for benefit or futility reasons at different interim analysis points, but have two main limitations: 1) do not prescribe the number of patients to recruit in between any two interim analyses, and 2) may lead to a high risk of false negatives. We focus on parallel group settings and solve a stochastic dynamic programming model with Bayesian updates on the candidate drug's efficacy to overcome these limitations. First, we derive optimal testing schedules under different success criteria, so as to maximize expected profit from the drug's commercialization, and second, we derive optimal futility stopping boundaries. We model the success criteria as different non-decreasing functions of the cumulative number of patients recruited. In the numerical study, we assess the performance of these testing schedules and stopping boundaries by quantifying the drug misclassification risk, expected time-to-market, and expected profit resulting from their implementation.

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Shalini Dinesh (Board #82)
Advisor: Eli Olinick
Engineering Management, Information, and Systems, Lyle School of Engineering

Generating Scores for Apartments

To generate scores for apartments to provide better quality on standards of living, and to make move in/out hassle free. The scores generated will provide tenants the opportunity to raise complaint when they are billed beyond what they are required to pay, they will know what they should be provided as mandatory in every home, and the facilities they can claim, thereby providing quality home to stay.

Every apartment should be provided with scores, which will provide a measure to know the quality of the apartment and the worth for the rent a tenant pays or is willing to pay. Besides the quality, any suites filed, or negative remarks should be recorded in the history of the apartments, so that the apartments wouldn't take advantage of the tenants, nor would they fail to notice the safety measures, which might later on cause damage to life and property. The scores should be generated based on several factors of the apartment features, and facilities, which can be used by the tenants, and the creditors to analyze the quality of the apartment and their maintenance.

Commercial Viability: This is a project that is being developed based on the benefit of the public interest and if developed and launched on a big scale will pave way for various benefits which includes, safety, security, reduction of financial loses, etc.

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Farzad Kamalzadeh (Board #83) Co-authors: Vishal Ahuja; Michael Bowen
Advisor: Michael Hahsler
Engineering Management, Information, and Systems, Lyle School of Engineering

An analytics-driven approach for individualized diabetes screening

Diabetes Mellitus is a common chronic disease and a major cause of morbidity, mortality, and medical expense. Diabetes risk increases across a continuum from normal glucose to prediabetes, or blood sugars that are higher than normal but not in the diabetes range, to type 2 diabetes. We incorporate stages into a Markov chain and develop a Partially Observable Markov Decision Process (POMDP) model to both capture the natural progression of diabetes and propose an optimal policy that provides decision makers the answers to two important questions regarding diabetes screening: "whom to screen?" and "when to screen?" The framework of this research incorporates both descriptive and predictive/prescriptive tools to provide both individual and population-based policies for diabetes

screening. We utilize Hidden Markov Models and our predictive model to estimate POMDP parameters using the data provided by Parkland Health and Hospital Systems, a large safety-net hospital in Dallas. We also compare the proposed policy with national screening guidelines by conducting a simulation on a cohort of patients. The results indicate that our proposed policy outperforms all existing guidelines. Our rough estimates suggest that implementing our proposed policy would prevent on the lower end an average of 141 million dollars only in the current population of Parkland health and hospital systems.

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Nadere Mansouri (Board #84)
Advisor: Halit Uster
Engineering Management, Information, and Systems, Lyle School of Engineering

Cost-Effective Regional Evacuation Network Design under Uncertainty

We consider a strategic evacuation network design problem, whichmainly determines open potential shelter locations and evacuee routes (road segments)under uncertainty in the number of people evacuating the sources. We develop a chance-constrained two-stage mean-risk stochastic programming model. Specifically, in order to soften the road capacity limitations, we relax arc capacity constraints in a controlled fashion by both enforcing a joint chance constraint on the feasibility of the second-stage problem and penalizing the violations in the objective function. To solve our model, we devise a BD based algorithm. We also present some numerical results on the algorithmic efficiency as well as on the effectiveness of the solutions under varying problem parameters.

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Farnaz Nourbakhsh (Board #85) Co-authors: Dr. Olga Bountali
Advisor: Dr. Sila Cetinkaya
Engineering Management, Information, and Systems, Lyle School of Engineering

Process Reengineering and Optimization in Healthcare: Shifting the Way We Treat the Uninsured

Uninsured patients suffering from chronic diseases may have access to medical treatment under federal law, EMTALA, only after being evaluated as in 'emergent, life-threatening condition'. These patients seek regular, recurring treatment typically at county hospitals throughout the nation. In the case of End Stage Renal Disease (ESRD), uninsured patients receive dialysis treatment conditional on a screening assessment in the emergency room (ER). A certain fraction of these patients may be rejected to receive dialysis under the existing treatment protocol. This practice is known as "compassionate dialysis", and it is aimed at relieving congestion in the dialysis unit of county hospitals. However, the screening assessment itself may lead to severe congestion in the ER and, hence, the significant treatment delays for patients. In this work, we aim to reengineer the compassionate dialysis process under hypothetical changes to the existing process and protocol. To this end, we propose queuing theoretic and simulation optimization models informing the practice. We extend our modeling efforts to consider two alternative service protocols that rely on (i) patient scheduling and (ii) patient batching. We quantify the benefits of these alternatives relative to the congestion and treatment delays associated with the existing process and protocol.

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Zohreh Raziei (Board #86) Co-authors: Xinyi Ding; Eric Larson; Michael Hahsler; Paul Krueger
Advisor: Eli Olinick
Engineering Management, Information, and Systems, Lyle School of Engineering

Data Forensics with Machine Learning

We apply Convolutional Neural Networks (CNN) to identify fake photographs. Using medium-to-high-resolution images, we combine an auto-encoder-based neural network with explicit facial modeling to generate swapped faces of celebrities and compare the CNN's performance to the approximate ranking from pairwise comparisons inferred from the judgment of human subjects to compare the accuracy of the CNN vs. human subjects.

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Siavash Tabrizian (Board #87)
Advisor: Harsha Gangammanavar; Halit Üster
Engineering Management, Information, and Systems, Lyle School of Engineering

Adaptive Cluster Sampling-based Approximation for Two-stage Stochastic Programs

We present enhancements to the L-shaped method to solve large-scale two-stage stochastic programs (2-SLP) with continuous recourse. First, we build the theory for partitioning the sample space, and afterward, we apply sampling techniques within optimization to achieve computational improvement. We demonstrate these results on classical problems in the literature.

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Amin Ziaeifar (Board #88)
Advisor: Halit Uster
Engineering Management, Information, and Systems, Lyle School of Engineering

Strategic Design of a Relay Network under Uncertainty

The truckload industry faces a serious problem of high driver turnover rate, typically about 100%. Among the major causes of this problem are extended on-the-road times where drivers handle several truckload pickup and deliveries successively, non-regular schedules and get-home rates and low equipment's utilization. Strategic design of a relay network that may potentially help to alleviate this issue is studied in this work. Specifically, in order to explicitly address the uncertainty in truckload shipment requirements, we propose and solve a two-stage stochastic programming model to determine strategic level network design for long-run operational efficiency.

Commercial Viability: The proposed network design framework can be widely used by the US transportation industry to decrease the driver turnover rate and optimize the cost. This is an applicable framework formed based on practical assumptions.

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THE GUILDHALL

Kevin Nappoly (Board #93) Co-authors: Saddha Santanaporn
Advisor: Corey Clark
The Guildhall

Gameplay Data Extraction for League of Legends Through Computer Vision

Game analytics plays an important role in guiding teams in both traditional sports and electronic sports (eSports) by getting a better understanding of the opponent's strategies. Unfortunately, not every eSport game has a reliable method to extract, collect and analyze the data needed for team and player analysis. For instance, League of Legends (LoL), a popular multiplayer online battle arena video game, does not provide the ability to track gameplay data like players' position, hit points, and mana within the game without having to watch and manually encode the entire match. This poster presents a methodology to extract, collect and analyze gameplay data from LoL videos via an

automated computer vision and offline post processing techniques. We use template matching and feature matching to extract information from static UI elements. To track players' position on a dynamic minimap, we utilize object detection via convolutional neural network. Results are presented from a pre-recorded public LoL video utilizing the proposed techniques. Finally, challenges of extracting accurate data from video sources with possible solutions are presented.

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Rakhil Soman (Board #94)
Advisor: Corey Clark
The Guildhall

Machine Learning Based Real Time Strategy AI

RTS game AI architecture is mainly developed using Finite state machines or Utility based system. In a traditional RTS AI system designers are required to develop behaviors and its mathematical representation. Neural network based RTS AI architecture enables designer to add and remove new behaviors without having to understand mathematical representation. This architecture allows designers to focus on behaviors and reduces the need to have programming knowledge. This architecture also helps in finding the best mathematical formula to mimic the behaviors at the system level. The model is trained to achieve the results set by the designers in an incremental manner. These models can also adapt and learn human strategies by extracting the details of the game play. The current model is trained for nearly 15 hours to achieve 7 different rules which leads to select on 5 different behaviors. After been trained for nearly 15 hours the RTS AI's winning percent against humans increased by 75 Percentage, where as the winning percent of RTS AI against Random AI has increased by 100 percentage.

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Hongjin Yu (Board #98)
Advisor: Corey Clark
The Guildhall

Convolutional Kernel Denoising for Deep Neural Networks using K-means and Constructivist Augmented Machine Learning (CAML) methodology

Deep convolutional networks have achieved state of the art results in various areas. Specifically, Leela Zero, a reproduction of the famous AlphaGo Zero has achieved superhuman performance. Despite these recent achievements, the inner workings of these networks remain a black box. This has made it difficult to apply human knowledge directly to the networks. In this work we propose a method to introduce human knowledge directly into the network, this mimics the instructor - student relationship seen in Constructivist learning theory. We use k-means clustering on the convolution kernels to reduce the problem space. This allows the human-in-the-loop to identify key convolution kernels. We then propose to use Constructivist Augmented Machine Learning (CAML) methodology, by replacing kernels with ideal kernels constructed by humans. Our experiments show that our proposed methodology outperforms the original network without additional training.

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MATHEMATICS

James Barrett (Board #99)
Advisor: Vladimir Ajaev
Mathematics, Dedman College

Modeling of moving liquid-vapor interface in the constrained vapor bubble system.

Liquid placed in a cuvette next to a heat source can produce a central vapor bubble with liquid menisci in the corners of the cuvette, a configuration referred to as the constrained vapor bubble. A mathematical model is developed to further our understanding of the fluid dynamics associated with the constrained vapor bubble system. We incorporate the effects of surface tension, evaporation, thermocapillarity, and disjoining pressure. There have been numerous studies on the fluid mechanics behind droplets both theoretical and experimental. The current study seeks to compare previously obtained experimental data with results obtained numerically from the herein derived model. The model is developed using a one-sided lubrication-type approach to derive a partial differential equation for the film thickness.

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Jiahui Chen (Board #100) Co-authors: Johannes Tausch
Advisor: Weihua Geng
Mathematics, Dedman College

A Cartesian fast multipole method-accelerated boundary integral Poisson-Boltzmann solver for electrostatics of solvated biomolecules

The Cartesian fast multipole method-accelerated boundary integral solver calculates the electrostatics of solvated biomolecules modeled by the linear Poisson-Boltzmann (PB) equation. The surface is triangulated by MSMS and is discretized by Galerkin method on a well-conditioned boundary integral formulation with constant basis. The Cartesian fast multipole method is applied to accelerate the matrix-vector product when using GMRES iterative solver for the linear system which reduces the cost from O(N^2) to O(N), where N is the number of faces in the triangulation. In this poster, the Cartesian FMM-accelerated boundary integral PB equation is applied to compute the electrostatic solvation energy on the Kirkwood sphere, and corresponding CPU runtime, memory usage and accuracy subject to choices of parameters are presented. Furthermore, this solver will test solvated proteins. The parallel potential and preconditioning will be studied.

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Yuanting Chen (Board #101)
Advisor: Benno Rumpf
Mathematics, Dedman College

Is there a threshold between growth and decay of coherent structures surrounded by disordered waves for continuous systems?

There are a variety of systems, for example, solids, crystals, coupled optical fibers, coupled electronic devices and so on which can be described by chains of coupled ordinary differential equations. Driving phenomenon in some of the systems is that we obtain high-amplitude peaks at a small number of lattice sites while low-amplitude waves at other sites. Sometimes the high-amplitude coherent structures are eroded by surrounding disordered waves while sometimes we observe the opposite situation, in which the high-amplitude coherent structures are enhanced by surrounding waves. Where is the threshold? The question has been answered from previous research work by studying the interaction of a discrete breather with Rayleigh-Jeans distributed low-amplitude waves for the discrete nonlinear Schrodinger equation. A statistical analysis gives a criterion for growth or decay of the breather, depending on its phase frequency, and on the chemical potential for the waves. Now we focus our efforts on the continuous systems and try to find out if we can have similar results to the ones in the discrete systems.

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Rujeko Chinomona (Board #102)
Advisor: Daniel Reynolds
Mathematics, Dedman College

A New Class of High-Order Multirate Integrators for Multiphysics Applications

Differential equations that couple multiple physics phenomena together usually require special treatment of the possible different rates at which the multiphysics evolve. Work in this poster focuses on the numerical implementation of a new class of multirate time integrators called Multirate Exponential Runge Kutta (MERK) methods. In choosing test problems, special care is taken to cater to different kinds of researchers that might use these methods in their work. Convergence of up to fifth order is iillustrated, together with efficiency results that highlight the competitiveness of the methods compared to other multirate integrators.

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Brian Citty (Board #103)
Advisor: Thomas Hagstrom
Mathematics, Dedman College

Uncertainty in Far-Field Wave Propagation Problems

In this poster I will develop boundary conditions for the wave equation with uncertain wave speed outside of the region of interest. The uncertainty will be encapsulated into a boundary condition via the Dirichlet to Neumann map. Several analytical schemes will be discussed. Numerical experiments will be performed on the resulting Uncertainty Quantification problem.

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Austin Copeland (Board #104)
Advisor: Alejandro Aceves
Mathematics, Dedman College

Ground states and dynamics of unidirectional beams in media described by a fractional Laplacian

We study the ground states and propagation of unidirectional beams as described by the Schrodinger equation. We propose a novel extension to the modeling equation to include a fractional Laplacian in one spatial dimension and a standard second derivative in a second dimension. The goal is to explore novel dynamics and stability properties as a function of the degree of fractionality. For computing the ground states, we implement a fractional gradient flow with discrete normalization and discretize it by using a trapezoidal type quadrature rule and semi-implicit Euler method. For propagation of the beam, we use a time-splitting Fourier pseudo-spectral method which has high order spatial accuracy and has low computational cost. Both methods account for the nonlocal interactions from the fractional Laplacian and are applicable to the linear and nonlinear cases.

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Yu Hu (Board #105)
Advisor: Amnon Meir
Mathematics, Dedman College

Existence and uniqueness of the solutions of poroelectroelasticity

We will prove the existence and uniqueness issues of the governing equations presented by Steve Pride in 1994. We do that by specifying the initial and boundary conditions, obtaining a-priori estimates, discussing the solvability of Maxwell's equations, and then using Rothe method. We have also got the convergence of numerical solutions.

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Sasan Mohyaddin (Board #106)
Advisor: Johannes Tausch
Mathematics, Dedman College

Fast Evaluation for the Poission Equation in Three Dimensional Complex Geometries

We propose a fast method for evaluating (solving) potential equation with Dirichlet boundary condition in three dimension space 3D for complex geometry which generated by enclosing the original domain O of the model problem by a box B . To achieve this, the model problem is handled by separating it into two models homogeneous (Laplace equation with Dirichlet condition) and non-homogeneous problem with no artificial conditions imposed. Then, f = f H + f N H will be the general solution of the original model problem where (f H and f N H are solutions of homogeneous and non-homogeneous models).More precisely, the general solution is sum of layer potential and domain integral (this is the key element of this solver) which must be computed by using adaptive approximation of the source function (RHS function of the original problem) on each cube located on the boundary of O and beyond the domain O .

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Enrique Pereira Batista (Board #107)
Advisor: Barry Lee
Mathematics, Dedman College

Multigrid for the Solution of the Nonlinear Power Flow Equations

Power flow models are given by a system of complex-valued nonlinear equations known as power flow equations, which describes the flow of electric energy through a power grid. These models are extensively used to analyze the state of power grids. The practical relevance in solving this problem arises from the continuously changing structure of power grids, particularly with the inclusion of emergent energy sources and deregulation of electric markets leading to stochasticity and decentralization in the model. Newton's method is probably the best known method for solving the power flow equations. However, the increasing size of modern networks requires Newton's method to be applied to large systems, which leads to its computational inefficiency. In addition, the relatively small basin of attraction of this method requires the initial guess to be very close to the actual solution. Due to these facts, development of fast and robust solvers for this system is an active area of research, especially considering the many possible scenarios on which a power grid can operate on. The proposed research is to develop a new fast and robust, multiscale technique for solving the power flow equations.

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Duc Truong (Board #108) Co-authors: Jun Guo; Xu Wei; Andrea Barreiro
Advisor: Andrea Barreiro
Mathematics, Dedman College

Analysis of Hippocampal Calcium Imaging Data

Calcium imaging is capable of recording simultaneous activity of hundreds of neurons, resulting in complicated and high dimensional data sets. In the hippocampus, neuronal activity is known to be associated with encoding and

retrieving contextual memory, but the precise meaning of this activity is not clear. We apply novel theoretical tools to imaging data recorded during fear conditioning in two strains of mice that show different levels of ability to generalize memories. First, we apply a new algorithm to detect cell assemblies, which are groups of cells working together and being proven to associate with cognitive tasks. We show that algorithm can be applied to wider class of data sets than anticipated by the author. The result shows that cells participating in assemblies are more spatially coherent, and that the spatial coherences are different between two strains. Second, we apply Poisson linear dynamic system (PLDS) model with external input to construct a low dimensional representation of neuron population's activity. The result from analyzing latent variables show that the difference in shock responses can distinguish two strains and are significantly good predictors freezing level in the context test, and context/altered discriminant index.

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Sihao Wang (Board #113)
Advisor: Johannes Tausch
Mathematics, Dedman College

ACA-Based Fast Boundary Element Method for Heat Equation

The goal of this work is to develop a fast boundary element method for solving the heat equation which is based on the adaptive cross approximated(ACA) method in space and hierarchical(H-) matrices in time. The heat equation is a simple model problem for other types of parabolic problems. Solving the heat equation has many applications in physics and engineering.

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Ting Yan (Board #114)
Advisor: Daniel Reynolds
Mathematics, Dedman College

Reaction-Diffusion Model of Drug Concentration in a Lymph Node

We discuss a novel computational model of viral dynamics in the lymph node, to allow numerical studies of viral "reservoirs" causing reinfection once drugs are stopped (including HIV and Ebola). Our model consists of a system of reaction-diffusion partial differential equations (PDEs), where the diffusion coefficients vary between species (virus, drugs, lymphocytes) and include discontinuous jumps to capture differing properties of internal lymph node structures. In this poster, we present the mathematical model and discuss our current work on implementing this using the MFEM finiteelement infrastructure, including parallel results on Maneframe2 using both OpenMP and MPI.

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Lu Zhang (Board #116) Co-authors: Daniel Appelo; Thomas Hagstrom
Advisor: Thomas Hagstrom
Mathematics, Dedman College

An Energy-Based DG Method for Nonlinear Wave Equations

In recent years, discontinuous Galerkin methods have proven to be an effective approach to developing high-order, energy-stable discretizations of time-domain wave propagation problems in complex geometry. Here we present a new method for constructing discontinuous Galerkin methods for wave equations in second order form. The weak form works directly with the Lagrangian of the system. By Noether's Theorem, given any symmetry of the Lagrangian, one can derive a conservation law on a given element. Our method is built on such conservation laws, with the weak form chosen so that the rate of change of the conserved quantity is determined by the flux through the

element boundaries. This method has been applied to a variety of problems, such as the simple scalar wave equation \cite{AH1}, linear elasticity \cite{AH2}, convective second-order wave equation \cite{AH3}, etc. In this work, we extend its application to second order nonlinear wave equations (specifically the sine-Gordon equation and a model for nematic liquid crystals), and we present here our results using the energy-based DG method to solve the sine-Gordon equation.

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Wenzhong Zhang (Board #117) Co-authors: Bo Wang
Advisor: Wei Cai
Mathematics, Dedman College

Fast multipole method for 3-D Helmholtz equation in layered media

The fast multipole method (FMM) has been a revolutionary development in modern computational algorithms for treating many-body interactions, in fact it was considered one of the top 10 algorithms in the 20th century. This work presents a new approach to develop analytical ME and local expansion (LE) for layered Green's function as well as relevant multipole-to-local translation (M2L) operators for 3-D Helmholtz equation in layered media.

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MECHANICAL ENGINEERING

Farshid Asadi (Board #118)
Advisor: Ali Heydari
Mechanical Engineering, Lyle School of Engineering

Optimal control of a parallel manipulator

Controlling robotic manipulators is usually a complex task due to their nonlinear behavior. However it is a well-defined problem and some nonlinear control approaches have been developed for this purpose. But most of these methods just take care of stability of the system regardless of the fact that in real world systems we also care about the efficiency of the system. This motivated us in designing an optimal controller for robotics purposes, also a Delta parallel manipulator is chosen to represent a complex robotic system which has been widely used in industry and academic research. Because of highly nonlinear nature of parallel robots the appropriate choice of controller would be nonlinear optimal control. Among two approaches for nonlinear optimal control, approximate dynamic programming method is used because of its simple form of resulted control. However this method is mostly developed and implemented based on computer simulations and not many real world implementations has been done, also tracking controller design is not completely done yet in this approach. So in our ongoing research we are designing a tracking approximate optimal controller to implement it on our half printed-half machined Delta robot. The goal of this project is to successfully design a tracking controller based on ADP and to finally implement it on a complex real world robotic system.

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Hamid Bayat (Board #119) Co-authors: Paul Krueger
Advisor: David Willis
Mechanical Engineering, Lyle School of Engineering

Flow structure interaction of a directional permeability membrane

A directional permeability membrane is designed, fabricated, and tested in pressure driven flow. The membrane is made by bonding the perimeter of two porous polyimide sheets with double sided tape. The polyimide sheets have thickness of 25 μm and 125 μm and the double-side tape has thickness of 25 and 75 μm. Nine circular pores were cut in thicker polyimide sheet and four pores with smaller diameter were cut in the thinner sheet in a square arrangement. The pore dimeter on thicker sheet are 1 mm for two combination and 0.5 mm for the other two. For the thinner sheet pores diameter is selected to be 0.25 mm for all combination. Four different membranes were tested at hydrostatic pressure values ranging from 0.01 to 0.1 m H_2O. The membrane performance is calculated based on the ratio of forward to reverse flow rate. To have better understanding of membrane performance, the maximum deflection of thinner membrane was measure in both forward and reverse flow by using an imaging setup. Results show that the membrane performance depends on pore diameter, sheet thickness, the gap between porous sheets and the hydrostatic pressure head. By decreasing pore diameter from 1 mm to 0.5 mm and decreasing the gap from 75 to 25 μm membrane performance will increase. The ratio of forward/reverse flow rate were measured to be in the range of 2.61 to 2.52×10^3.

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Yubo Cui (Board #120)
Advisor: Peter Raad
Mechanical Engineering, Lyle School of Engineering

Thermal Measurements and Numerical Simulations of Silicon-based High-Power LDMOS Devices

The thermal characteristics of a micro-device are a determining factor of its performance and reliability, especially for devices operated in high-power applications, such as Silicon LDMOS. Such devices are subject to substantial self-heating effects that could alter the electrical performance and could result in degradation and even early failure. In this study, the transient temperature response of a Si LDMOS device is acquired by the use of a thermoreflectance-based imaging approach. The optical metrology system (T°Imager®) is non-contact and non-destructive and produces surface temperature maps by acquiring the temperature-induced reflectance changes at the surface. By controlling the illumination pulse-width and phase delay, the temperature at different time points within the activation cycle are captured and combined to reconstruct the transient thermal response within the active region of interest. Measurements are performed under different activation power levels, periods, and duty cycles, and are then compared to the corresponding data obtained from a three-dimensional, transient, thermal simulation engine. The simulation engine (T°Solver®) is used. The obtained simulation results show good agreement with the measured experimental response.

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Derli Dias do Amaral Junior (Board #121)
Advisor: Jose Lage
Mechanical Engineering, Lyle School of Engineering

Out-of-Planet-Shapend Constructal-Theory Conducting Paths: Alternative for Experimental Evaluation

The original T-shaped network design evolving from applying the Constructal theory to the conduction from volume-to-point problem has a high thermal conductivity material embedded into (in-plane) a low conductivity, heat generating material as “fissures”. The fissures then form an effective network for channeling the thermal energy out of the volume through a small side opening (a “point”) where cooling is provided. Embedding a material forming distinct networks into a heat-generating material, without disturbing the uniformity of the heat generation, is a difficult and costly proposition in practice. A more practical alternative design is achieved by placing the high thermal conductivity material network atop the surface of the heat generating material. In this way, the heat generating material can be a

commonly used electrical heating pad, for instance, which is then undisturbed in its shape and heat generating characteristics by the addition of the high thermal conductivity material. The final topology of the entire system, however, differs from the original embedded design, with the high thermal conductivity material now being out-of-plane in relation to the heat generating material. This aspect can yield different heat transfer behavior between the two designs. Numerical simulations were performed to verify the equivalency of these two designs and their similarity in cooling.

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Assaad El Helou (Board #122)
Advisor: Peter Raad
Mechanical Engineering, Lyle School of Engineering

Temperature Mapping of Threshold Switching in NbOx

There has been a consensus over the operation mechanisms of negative differential resistors. There is a consensur that the behavior is thermally driven, where some researchers attributing the NDR change to an electric field driven and thermally accelerated Poole Frenkel conduction, which occurs at moderate temperatures of around 500 Kelvin. Other researchers attribute the conductivity to a thermally induced phase change in the metal-oxide at temperatures exceeding 1000 K, with measurements and observations of the metallic formed phase. Poole Frenkel champions reason that the insulator-metal transition can occur but is not the main driving mechanism. This poster presents a thermal analysis of the mechanisms that govern electrical switching in Niobium Oxide NbOx memristor devices by conducting experimental temperature imaging. Thermoreflectance imaging is used as a submicron resolution method to characterize the temperature in the conductive filament that is electroformed in the crosspoint device. The electroforming process and the current bifurcation is observed in the different states of device activation.

Commercial Viability: Memristor devices have been postulated as the fourth fundamental circuit element since 1970 with promising applications in non-linear circuit design. More recent developments in device microfabrication revealed exceptional behavior in thin oxide films, such as electroluminescence, electron emission and most notably memristive behavior, more precisely, negative differential resistance. This control over a device's resistance proved useful in several applications such as non-volatile memory storage, and in neuromorphic computing, and leading to extensive research in the field.

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Reza Farsad (Board #123)
Advisor: Ali Heydari
Mechanical Engineering, Lyle School of Engineering

Design of a knee exoskeleton

People with neuromuscular problems in their knees can suffer from the lack of enough actuation in this critical body joint. This may result in an impaired gait which can affect the daily life and cause hazardous situation such as tripping. One solution would be to induce the required torque to the knee via an exoskeleton.

In this project, a knee exoskeleton was designed and built. A controller was designed to bring the knee angle to a desired angle. This was done by applying a torque relative to the difference between the knee angle from the desired knee angle. The torque was estimated by measuring the motor current and assuming a linear relation between the torque and the applied current. The knee angle was estimated by attaching an encoder on the knee brace joint.

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Ahmad Gad (Board #124)
Advisor: Xin-Lin Gao
Mechanical Engineering, Lyle School of Engineering

Two Extended Versions of Hill's Lemma Based on the Modified Couple Stress Theory

Hill's lemma for the Cauchy continuum has been playing a key role in homogenization of heterogeneous or composite materials. However, homogenized properties obtained using Hill's lemma do not involve any microstructure-dependent material length scale parameter. Hence, extended versions of Hill's lemma based on high-order elasticity theories are needed. In this study, two extensions of Hill's lemma are proposed using the modified couple stress theory, which contains one material length scale parameter. In the first extended version, the stiffness tensor that relates the stress to the strain is homogenized, while in the second one, the elasticity tensor that links the couple stress to the curvature is determined. It is shown that the two versions are independent of each other. The boundary conditions obtained in each version are adjusted to accommodate periodic materials or structures by introducing periodic components in the displacement and micro-rotation fields and reconstructing the Hill-Mandel condition. To illustrate the two new homogenization methods, 2D meshfree models based on radial point interpolation approximation functions are constructed using the boundary conditions newly obtained for each version of the extended Hill's lemma. The numerical results agree well with those based on existing homogenization schemes.

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Ataollah Gogani Khiabani (Board #125)
Advisor: Ali Heydari
Mechanical Engineering, Lyle School of Engineering

Planar Monopedal Control Using Adaptive Dynamic Programming

In this research, adaptive dynamic programming is utilized to control the planar monopedal hopper to hop with a desired velocity. A neural network, called critic, is used to learn the value function and choose a suitable touch-down angle by minimizing the value function.

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Abdallah Jabr (Board #126)
Advisor: Dario Villarreal
Mechanical Engineering, Lyle School of Engineering

Wireless Placement-Insensitive Wearable System for the Assessment of Gait

This work investigates a wireless and placement-insensitive inertial-based system for gait assessment. It consists of seven wireless sensor modules that can be attached to garments on the lower body. These modules transmit motion signals to a personal desktop or a laptop computer for processing into useful gait-related outputs. These gait outputs tell us about the walking nature of the human subject and can be used to assess their gait for irregularities.

Commercial Viability: One issue I try to address is cost; while inertial-based wearable(s) are typically cheaper than optical-based systems, they are still relatively expensive ranging from $3,500-$11,000 depending on the number of modules and manufacturer. I use an off-the-shelf commercial IMU that costs $10, a wireless IoT chip that costs $10, and a Li-Ion battery that costs $7 for each of the 7 modules.

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Chinh Nguyen (Board #127)
Advisor: Ali Beskok
Mechanical Engineering, Lyle School of Engineering

Charged Nanoporous Graphene Membranes for Water Desalination

Water desalination using positively and negatively charged single-layer nanoporous graphene membranes are investigated using molecular dynamics (MD) simulations. Pressure-driven flows are induced by the motion of specular reflecting boundaries with a constant speed, resulting in a prescribed volumetric flow rate. Simulations are performed for 14.40 Å hydraulic pore diameter membrane with four different electric charges distributed on the pore edges. Salt rejection efficiencies and the resulting pressure drops are compared with the previously obtained base-line case of 9.9 Å diameter pristine graphene membrane, which exhibits 100% salt rejection with 35.02 MPa pressure drop at the same flow rate. Among the positively charged cases, q = 9e shows 100% and 98% rejection for Na+ and Cl- ions respectively, with 35% lower pressure drop than the reference. For negatively charged pores, optimum rejection efficiencies of 94% and 93% are obtained for Na+ and Cl- ions for the q = -6e case, which requires 60.6% less pressure drop than the reference. The results indicate the high potential of using charged nanoporous graphene membranes in reverse osmosis (RO) desalination systems with enhanced performance.

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Elie Salameh (Board #128) Co-authors: Jaime DaSilva
Advisor: Volkan Otugen
Mechanical Engineering, Lyle School of Engineering

Enhanced Scattering-Based Speed Sensor for Space Applications

We design a speed sensor based on current LIDAR technology, with significant improvements to range and sensitivity. The chief measurement technique is performed by scattering atmospheric particles from a laser beam and measuring the wavelength shift induced by their relative motion (Doppler shift). Sensing is done through a micro-resonator assembly, about the size of a grain of salt, utilizing the principle of Whispering-Gallery Modes (WGMs) in a similar fashion to the operating principle of a Fabry-Perot Interferometer. Utilizing this type of sensor allows to eliminate traditional sensing elements like Pitot-tubes and Inertial Units that require significant post-processing and may be saturated. The ultimate goal is to create a light, small, and robust velocimeter setup that may be employed on re-entry landers at supersonic and hypersonic speeds, as well as on other space missions. The improvements over previous designs and data analysis algorithms are presented, in addition to techniques used in the elimination of signal loss sources.

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Jaime Silva (Board #133) Co-authors: Elie Salameh
Advisor: Volkan Otugen
Mechanical Engineering, Lyle School of Engineering

Computational Design of Optical Micro-Seismometer

This project aims to develop and optimize a coupled ring micro-resonator waveguide system as part of a novel miniature seismometer. The sensor is based on detecting the resonance shift due to disturbance of the evanescent field. Power loss from coupling remains a main concern in this sensor design, and thus improvements on light coupling configurations are suggested and presented. The FDTD software MEEP is employed in the sensor design to assess output signal strength, resonance quality factors and shift. A parametric study of multiple geometric aspects,

including coupling distance, ring thickness, and perturber position and shape, is performed for this purpose. The resonance shifts required are modeled through external perturbations in the ring evanescent field.

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Bin Xia (Board #134)
Advisor: Paul Krueger
Mechanical Engineering, Lyle School of Engineering

Rheology of Particulate Suspensions in Non-Newtonian Fluids, with Applications to Additive Manufacturing

Particulate suspensions occur in a variety of situations ranging from blood flow to slurries used in drilling applications. The rheology of such fluids has been investigated for many years, but existing models are generally concentrated on suspensions within Newtonian fluids and in free flowing conditions. Recently, particulate suspensions with shear thinning non-Newtonian fluids such as polymer melts and silicone (usually formulated to create a particulate composite) have been utilized in additive manufacturing. This poster will concentrate on suspensions with micron-sized particles, and discuss the rheology and overall flow behavior in capillaries scaled appropriately for additive manufacturing applications (around 1 mm ID). Micron size glass beads and shear thinning silicone are used to demonstrate the impact of particle volume fraction on the shear thinning behavior. Previous models based on Newtonian fluids will also be reviewed and compared. The impact of particle and capillary size on viscosity and jamming conditions will also be discussed.

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PSYCHOLOGY

Talha Alvi (Board #135) Co-authors: Chrystyna Kouros; Junghee Lee; Daniel Fulford; Benjamin A. Tabak
Advisor: Benjamin Tabak
Psychology, Dedman College

Social anxiety is negatively associated with theory of mind and empathic accuracy: Direct replications using multiple tasks and samples

Social anxiety is characterized by cognitive biases that interfere with accurate perceptions of others' thoughts and intentions, yet there is little research exploring the relation between social anxiety and social cognition. The present study examined the association between dimensional levels of social anxiety and several measures that assess social cognition in three studies. Study 1 revealed that higher levels of social anxiety were related to lower accuracy in an assessment of higher-level social cognition in the form of theory of mind. However, no consistent association was found between social anxiety and accuracy an assessment of lower-level social cognition in the form of emotion recognition. Results were corroborated with two direct replication studies (Studies 2 and 3) in different samples. Study 3 also revealed that higher levels of social anxiety was negatively associated with empathic accuracy (i.e., another higher-level form of social cognition), for positive, but not negative, stimuli as assessed by an empathic accuracy video task. These findings demonstrate that social anxiety is negatively associated with higher-level social cognition but not lower-level social cognition, but the specific aspect of potential social cognitive impairment (i.e., valence) may differ depending on the task/paradigm used.

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Chelsea Carson (Board #136) Co-authors: Page Hurley; Emma Coleman; Naomi Ekas
Advisor: Chrystyna Kouros
Psychology, Dedman College

How Well do Mothers and Children Perceive Each Other's Internalizing Symptoms?

There is evidence that discrepancy between parent and child perception of children's internalizing symptoms is related to adverse child outcomes, while accurate understanding of individual and family factors is related to beneficial child outcomes. However, little is known about children's view of their parents' internalizing symptoms. It is also important to understand how one's own experience of depressive symptoms may bias the perception of another's depressive symptoms within families through assumed similarity. This study assessed levels of accuracy and assumed similarity in perceptions of depressive symptoms between mothers and children. We hypothesized that both mothers and children would report significant levels of accuracy and assumed similarity. One hundred thirty mother-child dyads were drawn from two larger studies. Children were 46.9% male with a mean age of 13.63 (SD = 2.20). Both mothers and children rated child and mother depressive symptoms through self-report measures. Results provide evidence for both accurate perceptions and assumed similarity in mothers, as well as assumed similarity for children. They additionally suggest that while younger children display accurate perceptions of their mothers' depressive symptoms, there is not evidence of this in older children, perhaps because of their assumed similarity or other experiences with their mothers.

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Bree Geary (Board #137) Co-authors: Austin S. Baldwin
Advisor: Austin S. Baldwin
Psychology, Dedman College

Participation in an Employee Wellness Program: A Descriptive Analysis

Employee wellness programs promote good health decisions and aim to improve health problems. It is important to understand factors that characterize who actively engages in employee wellness programs and the effect of engagement on health outcomes. Using data (N=1,723,607) collected from a national employee wellness provider (Simply Well, Inc.), we sought to describe who is likely to actively participate in the wellness program activities. We divided participants into 3 groups based on engagement. We then compared the groups on age, gender, smoking status, and BMI. Overall, 51.3% of the sample was female. The highest percentage of women was in the highest engagement group (57.2%) compared to the other two groups and these percentages were significantly different across all three groups, ?2(2)=5,098.3,p <.001. There was a lower percentage of smokers in the highest engagement group (15.8%) compared to the minimal engagement group (18.8%), ?2(1)=665, p<.001. Mean BMI did not differ between the highest engagement group (M=29.0), the minimal engagement group (M=28.9). Based on this large sample, results suggest that females and non-smokers are more likely to actively engage. Implications include the need to develop approaches to increase active engagement in employee wellness programs among males and smokers in order to improve health outcomes, health care costs and absenteeism.

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Tricia Gower (Board #138) Co-authors: Ernest Jouriles; Caitlin Rancher; Colton Kurth; Renee McDonald
Advisor: Ernest Jouriles
Psychology, Dedman College

Adolescents' perceptions of mattering and resilience following sexual abuse: Why does caregiver social support matter?

Objective: The current study aimed to evaluate whether the protective effects of social support from a non-abusing caregiver in the aftermath of sexual abuse in adolescence are accounted for by increases in adolescents' perceived mattering (i.e., feeling loved, valued, and needed). A comprehensive assessment of adolescent resilience was utilized to reflect functioning across academic, social, and psychological domains and across adolescent and caregiver reports.

Method: The study included a sample of 321 adolescents with a recent disclosure of sexual abuse and their non-abusing primary caregivers. Families were recruited from a Children's Advocacy Center, and completed measures of social support, perceived mattering, and resilience, as well as hypothesized covariates. Results: In correlational analyses, resilience was associated with higher levels of social support and perceived mattering, and perceived mattering was associated with higher levels of social support. In hierarchical logistic regression analyses, after accounting for covariates, the effects of adolescent, but not caregiver, reports of social support on resilience were accounted for by perceived mattering. Conclusions: These findings provide initial evidence for the importance of perceived mattering in predicting resilience in adolescents with a history of sexual abuse.

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Anni Hasratian (Board #139) Co-authors: Alicia E. Meuret; Michael Chmielewski; Thomas Ritz
Advisor: Thomas Ritz; Alicia E. Meuret
Psychology, Dedman College

An examination of the tri-level model of anxiety and depression with a student and community sample

Research supporting the relation between anxiety and depression has been long standing in the field. Prenoveau et al. (2010) examined how the structural components of anxiety and depression symptoms in adolescents reflected the integrative hierarchical model proposed by Mineka et al. (1998). Their findings suggested a tri-level hierarchical model of general distress, anxious-misery and fears, and five narrow factors of depression, specific fears, anxious arousal/somatic tensions, social fears, and interoceptive/agoraphobic fears. The current study aims to test the exploratory factor analysis conducted in the tri-level model in an adult student and community sample. We selected similar, but also different, items from anxiety and depression questionnaires. We hypothesized that six factors would emerge representing the major aspects of the tri-level model. Samples were comprised of students (N=367) and community members (N=774) who completed ten self-report questionnaires that assessed depression, anxiety, and fear. We submitted questionnaire items to a principal-factor exploratory analysis with oblimin rotation separately for both samples. The most parsimonious solution extracted six factors reflecting the tri-level model factors. The results support the literature in identifying the structural similarities and differences of anxiety and depression on a symptom level.

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Emily Johnson (Board #140) Co-authors: Lorelei Simpson Rowe
Advisor: Lorelei Simpson Rowe
Psychology, Dedman College

Evaluation of a Web-Based Assertive Resistance Program for Decreasing Sexual Violence Victimization in College Women

In the United States, over 50% of women have been the victim of some form of sexual violence (Black et al., 2011). Fortunately, there is increasing evidence that assertive-resistance training programs are effective for teaching women specific skills (e.g., clearly and firmly communicating personal boundaries, or leaving the situation) to refuse unwanted sexual contact and escape potentially dangerous situations (e.g., Gidycz & Dardis, 2014; Rowe, Jouriles & McDonald, 2015). However, current programs are delivered primarily in face-to-face settings, which limits dissemination due to various logistic requirements. In contrast, a web-based program has the potential for much quicker and broader dissemination. Female college students (n = 141) completed measures of lifetime sexual victimization before being randomly assigned to either a web-based assertive-resistance training condition or an active control condition. Participants who completed a brief web-based assertive resistance program for reducing sexual victimization (n = 76) reported fewer incidents of unwanted sexual contact over 1-month than participants in an

active control condition (n = 65). This pilot evaluation of the program shows promise for reducing unwanted sexual contact.

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Divya Kumar (Board #141) Co-authors: Thomas Ritz; David Rosenfield; Michael Treanor; Halina Dour; Michelle Craske
Advisor: Alicia Meuret
Psychology, Dedman College

Wanting versus Liking: Differential Depressive Symptom Reduction Based in Reward-System Deficits

Anhedonia, or the diminished capacity to experience pleasure from things, is frequently associated with poor treatment response. It can be parsed into deficits in two dimensions of the reward system: anticipation and consumption. The current study sought to determine whether deficits in the anticipatory and consummatory reward systems, as measured by the "Drive", "Reward", and "Fun-Seeking" sections of the Behavioral Activation Scale (BAS), differentially related to reductions in depressive symptoms following treatment, assessed via the Depression, Anxiety, and Stress Subscale. Eighty-four individuals participating in therapy were randomized to 15-week interventions to increase positive affect or decrease negative affect. Utilizing multilevel modeling, we found individuals with lower BAS-reward had better improvement in depression over time, b=.94, p=.030, as did individuals with lower BAS-fun, b=1.58, p=.000, while no differences in improvements were found for those with lower BAS-drive, b =.57, p =.166. Furthermore, BAS-reward was a moderator on the effect of treatment on improvement over time, such that those with average or low levels benefitted more from the intervention targeting positive affect than the one targeting negative affect, b=1.84, p=.034. These findings emphasize the importance of the differential effects of reward sensitivity on treatment outcome.

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Hannah Nordberg (Board #142) Co-authors: Juliet Kroll; Matti Miller; Yumna Furqan; Kayla Kostroske; Alexis Jones; Hadleigh Nelson; Thomas Ritz
Advisor: Thomas Ritz
Psychology, Dedman College

The Influence of Sleep and Negative Valence Systems on Affective Reactivity to Stress

Prior research suggests a key role of sleep in individuals' response to stress. Associations of negative valence systems, sleep, and stress reactivity have not yet been explored. We sought to examine whether sleep habits mediate the association between measures of negative valence systems and reactivity to an acute real-life stressor. We used proxy self-report measures of negative valence systems: response to acute threat, response to potential harm, and response to sustained treat. Students were assessed during an academic semester and final exam period and completed a battery of self-report measures of negative valence, sleep patterns, negative affect, stress level and demographics. Hierarchical multiple regression analyses controlling for demographics, body mass index, and mid-semester stress levels showed that greater response to sustained threat during the semester predicted greater stress reactivity during the exam period. Additionally, greater response to acute threat predicted greater negative affect and stress reactivity during the exam period. Sleep duration during the final exam period predicted negative affect and stress reactivity during the exam assessment. Mediation analyses showed that longer sleep duration during the exam assessment partially mediated the relation between stronger response to sustained threat during the term and final exam stress reactivity.

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Catherine Rochefort (Board #143)
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Predicting life satisfaction and functioning: Examining the role of experiential avoidance with neuroticism and affect

Previous research has indicated that experiential avoidance (EA) is a predictor of life satisfaction and functioning. However, in most studies, EA was assessed using the AAQ-II, which recent research suggests functions as an indicator of neuroticism and negative affect (N/NA) instead of EA. We examined whether the AAQ-II and the MEAQ (another measure of EA) predict life satisfaction and functioning above the effects of N/NA. Adult participants (MTurk; N = 643) completed the AAQ-II and MEAQ online. They also completed measures of neuroticism (BFI-N), trait positive and negative affect (TAI), life satisfaction (SWLS), and functioning (WHODAS-2.0 and SF-36). Replicating previous findings, the AAQ-II functions as a measure of N (r = .71) /NA (mean r = .62). In contrast, the MEAQ was differentiated from N (r = .39) and NA (mean r = .44), and can be considered an indicator of EA. Contrary to hypotheses, the MEAQ (i.e., EA) demonstrated limited incremental validity above N/NA in predicting life satisfaction and functioning. Although unexpected, the current results suggest EA may not influence life satisfaction or functioning, and that N/NA is the primary variable of interest. We are in the process of replication. It is important to acknowledge that the data were cross-sectional because it is likely that the negative effects of EA manifest over time.

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Stress-induced cortisol reactivity as a predictor of treatment outcome in treatment for affective disorders

Identification of moderators and mediators that can facilitate treatment success is of great scientific and clinical interest. One such candidate could be stress-induced cortisol reactivity. For instance, higher cortisol reactivity to a pretreatment stressor related to significantly worse outcome in individuals with PTSD (Norrholm et al., 2016). By contrast, greater cortisol reactivity to an acute stressor predicted greater improvements in depressive symptoms for children with anxiety (Dieleman et al., 2016) and adults with panic disorder (Wichmann et al., 2017). The aim of present study was to further examine the role of stress-induced cortisol reactivity as a predictor of outcome. The sample consisted of 32 participants who underwent a 38-minute intermittent stress induction tasks prior to a 15-session treatment for affective disorders. Using multilevel modeling we examined the associations between cortisol reactivity and slopes of improvement in affective symptoms. High levels of stress-induced cortisol response was related to greater rates of improvement. The current study adds evidence to established literature that cortisol reactivity assessed during an acute stressor before treatment can predict treatment outcome in affective disorders, including anxiety (Wichmann et al., 2017) and depression (Dieleman et al., 2016).

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Margarita Sala (Board #145)
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Mindful Physical Activity: A Pilot Randomized Controlled Trial

Background: Despite the many and varied benefits of regular exercise, less than half of U.S. adults get sufficient amounts of regular exercise (CDC, 2015). A promising intervention strategy to increase exercise behavior may be to exercise mindfully. Purpose: To conduct a small, randomized controlled pilot trial of an audio-recorded mindfulness-based exercise intervention. Methods: Community participants (N = 50) were randomized to a mindfulness intervention or active control group. Participants in the mindfulness intervention condition received instructions to exercise during an in-lab session and for at least 150 minutes throughout the next week while listening to an audio-recorded mindfulness-intervention, whereas participants in the control condition were instructed to exercise at a moderate intensity target heart rate. Results: The audio-recorded mindfulness-based exercise intervention was acceptable (M = 7.94, SD = 1.67) and feasible (M = 91.17%, SD = 13.05%). The intervention also resulted in greater MVPA minutes at one-week follow-up for participants in the mindfulness condition (M = 277.96) than participants in the control condition (M = 210.80), reflecting a moderate size effect (?2= 3.80, d = .45, p = .05). Conclusion: The audio-record mindfulness-based intervention is a feasible, acceptable, and promising approach to help individuals increase exercise behavior.

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Mayson Trujillo (Board #146) Co-authors: Michael Chmielewski
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Assessing the psychometric properties of the Dissociative Experiences Scale

It is imperative that assessments used in psychological research demonstrate excellent psychometric properties in order to increase study replicability, develop an accurate understanding of constructs, and determine the efficacy of treatment. Research has shown that the Dissociative Experiences Scale (DES), the most widely used measure of dissociation, has problematic psychometric properties, including poor test-retest reliability. The present studies aimed to elucidate potential reasons for its poor reliability. The goal of Study 1 (N = 163 undergraduates) was to determine whether respondents accurately interpret DES items. The results demonstrated that participants often did not interpret the DES items in the way intended by the measure. Moreover, participants' reports of how frequently items occurred did not align with the standard DES proportion of time ratings. In Study 2 we changed the standard DES proportion of time ratings to a 5-point Likert scale to test whether it would result in increased reliability. 447 undergraduates completed the modified DES twice over a 2-week interval. Its test-retest reliability was similar to that of the standard DES, both of which are lower than the Dissociative Processes Scale, an alternative dissociation measure. In conclusion, the DES demonstrates low reliability that appears to result, at least in part, from item wording.

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Children's Perception of Mother's Depression and Children's Internalizing Symptoms: Child Self-Blame Appraisals as a Moderator

Maternal depression has been associated with a range of negative child emotional outcomes. The way in which children appraise their mother's depressive symptoms has been proposed as a risk factor for child internalizing symptoms. Self-blame appraisals have been studied broadly in the context of interparental conflict, but not in the context of increasing risk for child internalizing symptoms. We tested children's self-blame/personal responsibility appraisals as a moderator of the relation between children's perceptions of their mother's depressive symptom severity and child internalizing symptoms. We expected higher levels of children's self-blame/personal responsibility

appraisals would exacerbate the relation between their perception of their mother's depression severity and their own internalizing symptoms. 74 mother-child dyads participated (child M age=13.7, SD=2.46). Children reported on the severity of their mother's depression and their appraisals of self-blame/personality responsibility for their mother's depression. Mothers reported on their child's internalizing symptoms. A multiple regression showed mothers' depressive symptom severity was positively related to children's internalizing symptoms, but only for children with higher levels of self-blame/personal responsibility appraisals. The findings highlight the importance of children's appraisals as a risk factor.

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Anxiety and Depression Mediate the Relation between Experiential Avoidance in Asthma and Clinical Outcomes

Research on experiential avoidance (EA) in medical populations suggests a relation to increased distress and poorer quality of life. EA has yet to be fully investigated in asthma. This study examined an asthma-specific measure of EA and its relation to clinical outcomes, with anxiety and depression as potential mediators. 476 asthma patients and their physicians completed questionnaires about their asthma history, experiential avoidance, mood symptoms, and quality of life. The EA measure had adequate internal consistency. Higher experiential avoidance predicted less asthma control, more exacerbations and emergency visits, and poorer quality of life. Anxiety and depression significantly mediated the relation between EA and quality of life and asthma-related quality of life. Depression also significantly mediated the relation between EA and asthma control. Our brief, 7-item measure of EA specific to asthma has adequate internal consistency and significant relations with various clinical outcomes such as quality of life and asthma control. Anxiety and depression were important mediators between EA and asthma outcomes. Examining EA in patients with asthma may prove informative in their overall health care. Future research may examine whether EA is able to change in response to intervention and if so, whether such change can influence clinical outcomes in this population.

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STATISTICAL SCIENCE

Michael Byrd (Board #153) Co-authors: Linh Nghiem; Monnie McGee
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Bayesian Regularization of Gaussian Graphical Models with Measurement Error

We consider a framework for determining and estimating the pairwise conditional relationships of variables observed after being contaminated with measurement error.Assuming the true underlying process is Gaussian, this problem is often solved by estimating the precision matrix under sparsity constraints. However, with even independent contamination of the observed variables, the estimate of the precision matrix is inconsistent, and leads to poor identification of relationships and estimates. We propose a procedure to correct for the contamination imposed by the mismeasured variables. This Bayesian procedure utilizes a recent variant of the spike-and-slab Lasso for a point estimate of the precision matrix, and corrects for the contamination via the recently proposed Imputation-Regularization Optimization procedure designed for missing data. Our method is shown to perform better than the naïve method in both identification and estimation accuracy in terms of the AUC and Frobenius norm, respectively.

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Xiaofei Chen (Board #154) Co-authors: Haekyung Jeon-Slaughter
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Identifying the Optimal Timing of Surgery from Observational Data

The therapy of some diseases involves multiple rounds of invasive treatment. For example, infants with hypoplastic left heart syndrome typically require an initial Norwood operation, followed some months later by a stage 2 procedure (S2P). The timing of the S2P is typically up to the surgeon and the infant's family, and the optimal timing, if one exists, is unknown. In the Single Ventricle Reconstruction (SVR) trial, the procedure used in the initial Norwood operation was randomized, but the timing of the S2P was left to the surgeon. Because there was systematic collection of surgery times and patient follow-up information, the trial database constitutes a thoroughly documented observational study. We seek to identify the optimal timing of S2P by using an extension of propensity score analysis. We describe the time to surgery as a function of confounders using a discrete competing-risk model. We then apply inverse probability weighting to estimate a spline model for predicting the time to death as a function of the time of S2P. Our analysis suggests that conducting the S2P at 7 months post-Norwood gives the patient the best chance of survival.

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Yuzhou Chen (Board #155) Co-authors: Hon Keung Tony Ng; Yulia R. Gel
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Gamma Degradation Model and Network Motif Analysis for Reliability of Power Grids

Network reliability analysis has been widely used for many real-world complex networks in understanding the adverse impacts for network degradation, as a motivating example, power system. As the demand for electricity grew, the development of a trustworthy power system requires a deeper understanding of potential impacts resulting from cascading failure. To assess the reliability from the structure of power system, conventional approaches mainly focus on the global topological measures of the power system against the effects of different attacks which ignore robustness at local level. Network motifs are subgraphs that number of appearances is statistically significantly greater than a predefined threshold in a randomized network and there exists a number of empirical studies that have proven network motifs can be used as one of the characterizations of a network geometry and hence as a characterization of robustness of the network. In this study, we propose a gamma degradation model and network motif analysis for evaluating European power systems robustness and reliability under different types of targeted attacks. To determine the performances of the proposed method, our empirical results are compared with those from the Monte Carlo simulation and Breadth-First sampling. These results have important implications for examining the reliability of modern power system.

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Zhaoce Liu (Board #156)
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Practical Approaches of Incorporating Big Data Sources into Survey Practice

Probability sampling framework has been served as the dominant paradigm for most of the survey practice over the past decades. However, this standard procedure is facing challenges such as the increasing cost and declining response

rate. On the other hand, as in the era of "Big Data", large amounts of data source are available in many forms especially from the internet, these are known as nonprobability samples. Nonprobability samples are faster and easier to collect compare to a standard probability sample. Another characteristic of these "Big Data" sources are the absence of clear selection mechanism for each in-sample unit. Directly usage of the convenience "Big Data" sources should be cautious as they could bias the statistical inference easily. One alternative is to combine different sample sources by developing pseudo-weights for the nonprobability sample and use it to augment the probability sample, as with a dual frame design. Relying on the real census data, the purpose of this study is to compare different approaches of developing pseudo-weights and provide practical suggestions on how to combine different data sources. The methods are then applied as alternatives to the currently used one for a survey conducted by National Marine Fisheries Service (NMFS) as demonstration.

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Lochana Palayangoda (Board #157) Co-authors: Hon Keung Tony Ng; Ronald Butler
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Improved Techniques for Parametric and Nonparametric Evaluations of the First-Passage Time of Degradation Processes

Determining the first-passage time (FPT) distribution is an important topic in reliability analysis based on degradation data because FPT distribution provides some valuable information on the reliability characteristics. Recently, Balakrishnan and Qin (2019; Applied Stochastic Models in Business and Industry, to appear) studied a nonparametric method to approximate the FPT distribution of the degradation processes if the underlying process type is unknown. In this paper, we propose some improved techniques based on saddlepoint approximation to improve upon the methods suggested by Balakrishnan and Qin (2019) to approximate the FPT distribution of degradation processes. Numerical examples and Monte Carlo simulation studies are used to illustrate the advantages of the proposed techniques. The limitations of the improved techniques are discussed and some possible solutions to these limitations are proposed. Some concluding remarks and practical recommendations are provided based on the results.

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Shen Yin (Board #158) Co-authors: Xinlei Wang; Gaoxiang Jia; Yang Xie
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MIXnorm: Normalizing Gene Expression Data from RNA Sequencing of Formalin-Fixed Paraffin-Embedding Samples

Formalin-Fixed Paraffin-Embedded (FFPE) tissues are routinely archived and extensively stored in biorepositories worldwide with highly-annotated demographic and clinicopathologic information, providing an invaluable resource for translational cancer research. Recent studies have shown that for a wide variety of human tumor tissues, RNA sequencing (RNA-seq) can be used to measure mRNA of sufficient quality extracted from FFPE tissues to provide biologically relevant whole-genome transcriptome analysis. RNA-seq expression data of FFPE samples often have very distinct features from those of fresh forzen (FF) samples. However, little attention has been given to the normalization of such data, a key step in the analysis pipeline that adjusts for unwanted biological and technical effects that can bias and mask the signal of interest. Existing methods, developed based on FF samples, may cause significant bias and suboptimal performance. We proposed a new normalization method, labeled MIXnorm, for RNA-seq data from FFPE samples. MIXnorm relies on a two-component mixture model, which models non-expressed genes by zero-inflated Poisson distributions and models expressed genes by truncated Normal distributions. To obtain the

maximum likelihood estimates of model parameters, we developed a nested EM algorithm, in which closed-form updates are made available within each iteration.

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Yang Yu (Board #159)
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Optimal Experiment Schemes for Multi-level Stress Testing based on n-component Systems

In the design of constant-stress life-testing experiments, the optimal allocation in a multi-level stress test with censoring based on regression model has been studied in the literature. Experimental schemes that have shorter experimental time as well as provide accurate statistical inference are desired. In this project, we consider putting the experimental units as n-component systems and propose the experimental schemes based on those n-component systems. Different experimental schemes based on n-component systems are considered and the performances of these experimental schemes are compared via mathematical analysis and Monte Carlo simulation. The merits of the proposed experimental schemes based on n-component systems are discussed and some future research directions based on the results obtained in this project are provided.

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Shalima Zalsha (Board #160)
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The Impact of Misreporting, Missing Values and Missing Value Patterns on Misclassification Rates in Record Linkage

Record linkage is a statistical matching procedure to link records in two or more files that lack unique identifiers. Its performance varies from file to file, but generally depends on the quality of the files such as the number of misreported and missing values. In this study, the impact of misreporting rates, missing value rates, and missing value patterns were examined by simulations. A data set containing 535 members of the 115th U.S. congress was obtained and treated as the population from which files were sampled and then perturbed independently. This study demonstrates that missing values have a greater impact on false positive rates than misreporting, while misreporting has a greater impact on failure to link. Furthermore, within-group failure to link rate depends on the group's frequency distribution in the population as well as the proportion of missing values within each group.

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