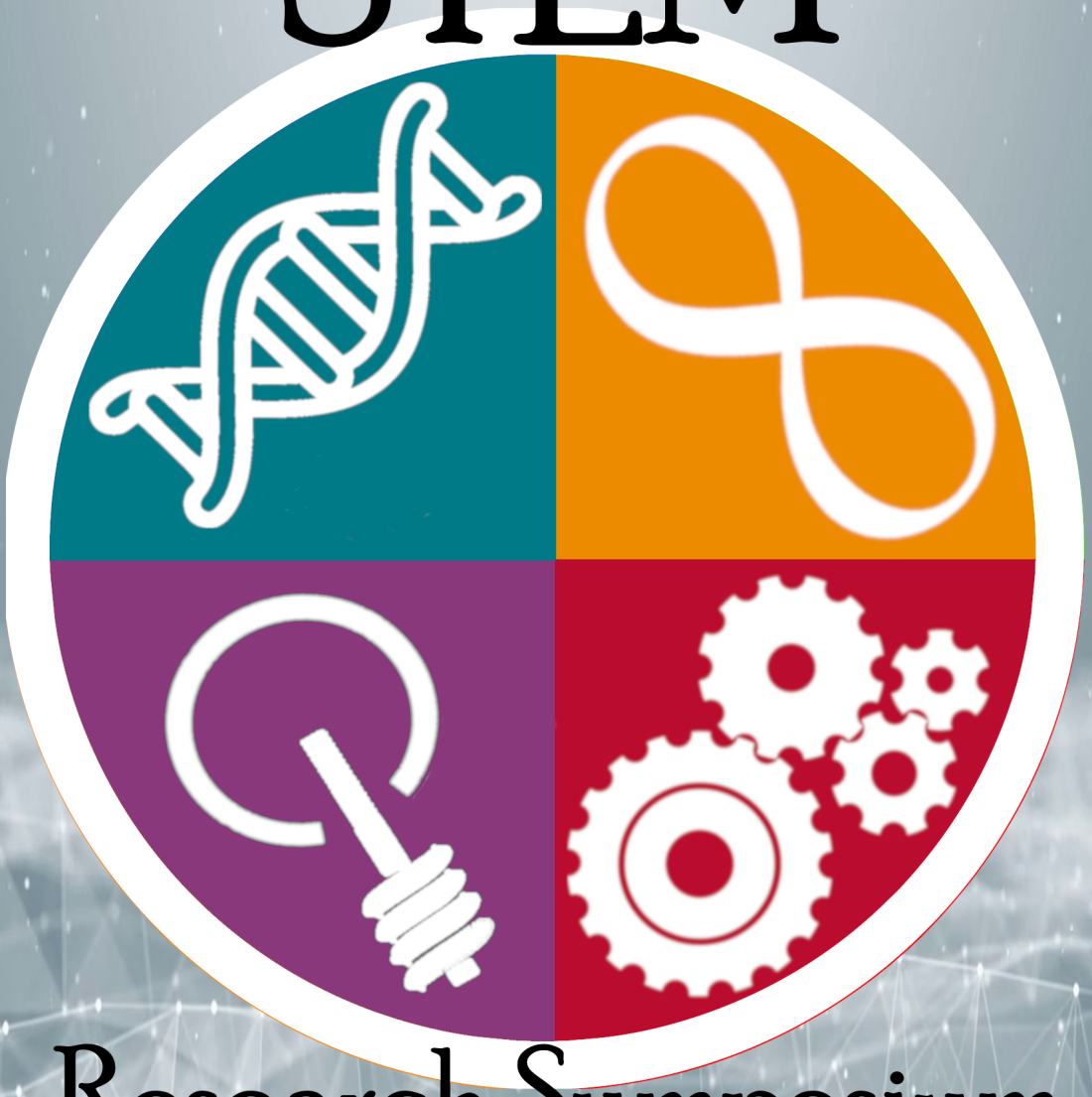
4th Annual

STEM



Research Symposium

March 2nd, 2019

March 2, 2019

Welcome to the 4th annual UNM STEM Research Symposium! As the event coordinator, I'd like to thank each one of you for attending, presenting, judging, and volunteering. Today is going to be a great day because of you.

The STEM Research Symposium, or STEMRS as we call it, grew out of a student research day between Nanoscience and Microsystems Engineering, Chemical and Biological Engineering, Chemistry and Chemical Biology, and Biomedical Engineering. That first research day had presentations from 11 students in those four departments. In 2019, we will have 70 presentations from students across 20 departments; a tremendous growth thanks to the student leaders, Adan Myers y Gutierrez and Linday Selters, who came before me and everyone working this year.

As part of how we're growing this event, we are proud to partner with the School of Engineering for the first time this year to have prospective graduate students attend. We hope today convinces you to become a lobo!

No matter why you're here, I'm sure you'll be impressed with the caliber of students and research. It is our hope to continue to grow this event each year and provide the best platform for our graduate students to present their STEM research to their peers and faculty as well as the top employers in the area. Please enjoy the day and join us again next year!

Go Lobos!

Tracy Mallette
Event Coordinator
tracymallette@unm.edu

Table of Contents

Schedule of Events

All Sessions Located on the 3rd floor of the Student Union Building

9:00 AM - 9:30 AM	Registration / Breakfast in Lobo A&B
9:30 AM - 10:30 AM	Poster Session 1 - Acoma A&B, Fiesta A&B, Santa Ana A&B
10:30 AM - 11:30 AM	Oral Session 1 - Acoma A&B, Fiesta A&B, Santa Ana A&B
11:30 AM - 12:30 PM	Lunch and Guest Speaker: Gabriel P. López, UNM Vice President for Research Lobo A&B
12:30 PM - 1:30 PM	Poster Session 2 - Acoma A&B, Fiesta A&B, Santa Ana A&B
1:30 PM - 2:30 PM	Oral Session 2 - Acoma A&B, Fiesta A&B, Santa Ana A&B
2:30 PM - 3:15 PM	Guest Speaker: Rochelle Larson, Senior Engineer at Carollo Engineers Lobo A&B
3:15 PM - 3:45 PM	Poster Session 3 - Acoma A&B, Santa Ana A&B
3:45 PM - 4:45 PM	Oral Session 3 - Acoma A&B, Fiesta A&B, Santa Ana A&B
4:45 PM - 5:15 PM	Guest Speaker: Lisa Kuuttila, CEO and Chief Economic Development Officer of STC.UNM Lobo A&B
5:15 PM - 6:30 PM	Dinner in Lobo A&B
6:00 PM	Awards

Acknowledgements

We thank the following departments

SCHOOL OF ENGINEERING

GPSA Graduate and Professional Student Association

NANOSCIENCE & MICROSYSTEMS ENGINEERING

BIOMEDICAL ENGINEERING

CHEMICAL & BIOLOGICAL ENGINEERING

As well as the Graduate Student Associations of Chemical, Biological, and Biomedical Engineering, Nanoscience and Microsystems, and Organization, Information & Learning Sciences for their financial support.

This event would not be possible without the countless hours contributed by our student volunteers. A sincere thank you to:
Committee Members: Lorraine Mottishaw, Kalin Baca, and Mary Louise Gucik
Volunteers: Trey Alexanderson, David Arredondo , Kolten Baca, Tori Balise, Peter Davenport, Matthew Ellis, Taryn McCue, Sasha Medina, Leo Miroshnik, Danika Nelson, Samantha Patterson, Marissa Perez, Adam Quintana, Malcolm Reese, Brian Rummel, Matthew Rush, Hannah Russer, Celine West

Thank you to our judges from:

Sandia National Laboratories

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Guest Speaker – 11:45 AM-12:30 PM – Lobo A&B

I'm Rubber and You're Glue: Soft Robotic Elastomeric Systems for Control of Biofouling

Gabriel P. López

Center for Biomedical Engineering, Chemical & Biological Engineering,

University of New Mexico, Albuquerque NM, USA

Talk Description:

It is desirable to control and prevent adhesion of biological materials to synthetic materials in a number of technological contexts. Specifically, the "biofouling problem" has been a persistent issue facing human endeavor and remains a grand challenge in biomaterials engineering. We describe a technology that uses a non-antibiotic, mechanical approach to physically remove biofouling and thereby may circumvent the failings of chemical and biological approaches. We have shown in several studies that a range of adherent bacterial films and some macroscopic biofouling organisms (e.g., barnacles) can be efficiently removed from elastomeric substrata through cyclic straining. This new approach to the control of bioadhesion has numerous potential applications.

Biography:

Gabriel P. López is Vice President for Research and Professor of Chemical and Biological Engineering at the University of New Mexico. His current research interests include biointerfacial phenomena, biomaterials, self-assembly, and bioanalytical microsystems to address problems in medicine, biotechnology, and environmental quality. His current technology transfer and translational activities include serving on the Board of Directors of STC.UNM Corp. and collaboration with several industrial partners. Prof. López' professional service activities include outreach to, and advancement of, groups under-represented in research, participation in several scientific societies, consultation on research directions for NIH, NSF, and DTRA programs, and serving on the NIH College of CSR Reviewers.

López has published ~200 peer-reviewed scientific papers and book chapters and is inventor on 42 issued U.S. Patents. He has served as a research advisor to 55 graduate students, 39 postdoctoral fellows, and 78 undergraduate students; 17 of his former research proteges have gone on to professional academic positions. He has served as PI or coPI on grants totaling ~ $46 million and his research has been supported by several sources including the NSF, NIH, DOE, NASA, DOD, industry, and nonprofit foundations. He is a Fellow of the National Academy of Inventors, a Fellow of the American Institute for Medical & Biological Engineering, an STC.UNM Innovation Fellow and the recipient of the W. Moulton Distinguished Alumni Award from the University of Washington, the Stansell Family Distinguished Research Award from Duke University's Pratt School of Engineering, an NSF Faculty Early Career Development Award, and an Outstanding University Inventor Award from the Semiconductor Research Corporation.

López earned a B.S. in chemical engineering from the University of Colorado in 1985. In 1991, he completed Ph.D. studies in chemical engineering at the University of Washington where he worked under the mentorship of Prof. Buddy D. Ratner as a Kaiser Aluminum Co. Graduate Fellow. From 1991-1993, he was an NIH and Ford Foundation Postdoctoral Fellow under the mentorship of Prof. George M. Whitesides in the Dept. of Chemistry at Harvard University. He was appointed Assistant Professor of Chemical Engineering and Chemistry at the University of New Mexico in 1993, promoted to Associate Professor in 1999, and promoted to the rank of Professor in 2004. He was the founding Director of the UNM Center for Biomedical Engineering (2005) and the UNM Biomedical Engineering Graduate Programs (2008). He moved to Duke University's Departments of Biomedical Engineering and Mechanical Engineering & Materials Science in 2010. López became the founding Director of the NSF's Research Triangle Materials Research Science and Engineering Center, which is focused on the programmable self-assembly of soft matter. He returned to UNM as Vice President for Research in 2016.

Guest Speaker – 2:30 PM-3:15 PM – Lobo A&B

The Project Life Cycle in Environmental Engineering

Rochelle Larson

Senior Engineer

Carollo Engineers, Albuquerque NM, USA

Talk Description:

The project life cycle from planning to design to construction is a process that involves various engineering disciplines and a significant amount of communication. Engineers at all levels have different roles depending on their experience and understanding of the project. The purpose of this presentation is to highlight the project life cycle through project examples. There will also be some discussion of the technical challenges that were faced.

Biography:

Rochelle Larson, P.E., serves as an environmental engineer for Carollo Engineers, Inc. at the Albuquerque, New Mexico office. She is involved in various projects from utility master planning to design and construction of water and wastewater systems to regulatory compliance work for storm water and groundwater. Inherent to her role as a senior engineer, she is a project manager and works with public, private and federal entities in the Southwest region.

Rochelle has worked in consulting for over 10 years and as a Professional Engineer for over 5 years. She received her Bachelor of Science in Engineering Degree in Mechanical Engineering from Arizona State University and a Master of Science Degree in Civil Engineering from the University of New Mexico. Outside of work, she enjoys the outdoors and volunteering for STEM outreach programs.

Guest Speaker – 4:45 PM-5:15 PM – Lobo A&B

STC.UNM and the Lobo Rainforest Ecosystem

Lisa Kuuttila

CEO and Chief Economic Development Officer of STC.UNM

University of New Mexico, Albuquerque NM, USA

Talk Description:

Lisa Kuuttila, CEO & Chief Economic Development Officer of STC.UNM, the University's technology-transfer and economic-development organization, will give an overview of the history, programs, events, and resources the organization offers to UNM students through its Lobo Rainforest Ecosystem.STC has spun out more than 129 startup companies based on STEM technologies developed by students and faculty at UNM.Ms. Kuuttila will tell the story of how technologies are being commercialized by some of STC's most successful companies.

Biography:

Ms. Kuuttila joined STC.UNM (STC), the University of New Mexico's technology-transfer program, as President & CEO in 2003. She works with the STC.UNM Board of Directors in developing strategies for implementing STC's vision to play a vital role in New Mexico's economic development and to be a leader in technology commercialization. Under her leadership, STC.UNM is substantially growing its program using the Rainforest model to develop an innovation ecosystem in New Mexico. In 2013, STC.UNM was tasked by the University with implementing its economic development initiatives under Ms. Kuuttila's leadership as CEO & Chief Economic Development Officer.

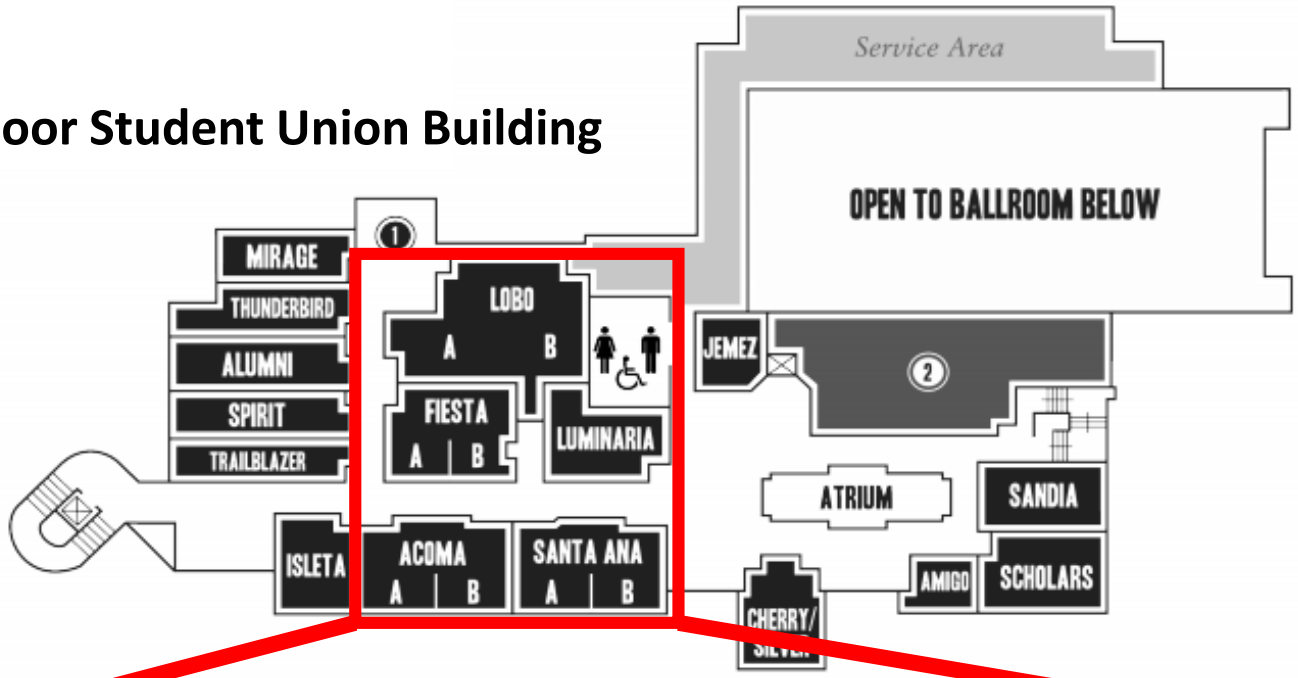
Ms. Kuuttila has more than 20 years of prior leadership experience in technology commercialization and licensing. This includes positions as Assistant Vice President for Technology Commercialization at Purdue Research Foundation; Director, Technology Commercialization, University of Georgia; and Director, Office of Technology Commercialization, Center for Advanced Technology Development, Iowa State University. Her prior experience also includes a consulting practice that provided strategic marketing and technology-transfer consulting services for a wide variety of well-known technology corporations, universities and foundations, including Stanford University. She began her career in industry in several engineering and technology-marketing positions.

Ms. Kuuttila has exhibited exceptional skills in the marketing and start-up company aspects of technology commercialization, having significantly increased the number of spin-off companies at each university she has served. She also has substantial expertise in university-based equity transactions and managed the seed-capital venture fund on behalf of Purdue Research Foundation.

Ms. Kuuttila has published extensively in her field, is an active speaker and has made presentations throughout her career to many organizations, such as the Association of University Technology Managers (AUTM), the Association of University Related Research Parks (AURRP), the Licensing Executives Society (LES), and other national and international conferences and forums.Ms. Kuuttila serves on the boards of the New Mexico Angels, a private membership organization for qualified angel investors, and the Coronado Ventures Forum, a non-profit corporation focused on development, education and networking opportunities for entrepreneurs and angel and professional investors.She is also affiliated with a number of other initiatives.

Map

3rd Floor Student Union Building



Poster Session 1 – Acoma

9:30 AM – 10:30 AM

Poster #	Name	Research Title	Department	Adviser
1	Chanju Fritch	C1 Decompression in Therapy of Pseudotumor Cerebri	School of Medicine	Dr. Andrew Carlson
2	Henning De May	Biomineralized cancer cells as a therapeutic vaccine for ovarian cancer	School of Medicine	Dr. Rita Serda, Dr. Sarah Adams
3	Sajjad Ahmad Khan	Lipid-coated Mesoporous Silica Nanoparticles for siRNA delivery	Nanoscience and Microsystem Engineering	Dr. Rita Serda
4	Murali Manohar Duggina	Engineering Immunogenic Nanoparticles for cancer therapy	Nanoscience and Microsystem Engineering	Dr. Rita Serda
5	Lien Tang	Nanoparticle Immunotherapy: Towards a Cancer-Curative Vaccine	Chemical and Biological Engineering	Dr. Jeffrey Brinker, Dr. Rita Serda, Dr. Achraf Noureddine
6	Gabriela Perales	MicroRNA-150-5p exerts antiangiogenic activity in brain microvascular endothelial cells during prenatal alcohol exposure	Cell Biology and Physiology; Health Sciences Center	Dr. Amy Gardiner
7	Zinia Pervin	Invasive hemodynamic measurement in large animal model of combined traumatic brain injury plus hemorrhagic shock in the consideration of care management.	Biomedical Engineering	Dr. Andrew R. Mayer

Oral Session 1 – Acoma

10:30-10:50 Presentation by Muskan Floren

Impact of CD82 Expression in Acute Myeloid Leukemia

Department of Pathology, Health Sciences Center, Adviser – Dr. Jennifer Gillette

Acute myeloid leukemia (AML) is a myeloid lineage cancer that accumulates in the blood and bone marrow, interfering with the normal production of hematopoietic cells. Most patients achieve a high rate of remission with induction chemotherapy, however relapse rates remain high. This is predominantly due to a population of leukemia stems cells that seek shelter in the bone marrow, resulting in increased cell survival and resistance to chemotherapeutics. Recently, our lab identified CD82 as critical regulator of AML cell bone marrow adhesion and homing. Additionally, we identified an upregulation of CD82 gene expression and CD82 plasma membrane enrichment in AML cells following chemotherapy treatment, suggesting a potential role of CD82 in AML survival. In the current study, we test the hypothesis that CD82 overexpression in AML cells promotes protein kinase c alpha (PKCα)-mediated chemoresistance contributing to disease relapse. First, we investigated the role of CD82 expression on AML chemosensitivity using the conventional therapeutics, daunorubicin and cytarabine. Measurement of caspase activity indicates that overexpression of CD82 promotes chemoresistance in AML cells. To determine whether PKCα contributes to CD82-mediated chemoresistance, we inhibited PKCα both genetically and pharmacologically. Our data display decreased chemoresistance in AML cells overexpressing CD82 following PKCα inhibition. Additionally, RNA-Seq and western blotting analysis indicate an increase in PKCα expression and activation in CD82 overexpressing cells following chemotherapy. Collectively, our results demonstrate that CD82 overexpression promotes chemoresistance in AML cells through the sustained activation of PKCα, which stimulates downstream integrin β1 and p38 MAP kinase activation. Future studies will be directed at elucidating CD82-mediated chemoresistance and AML relapse in animal models.

10:50-11:10 Presentation by Jimin Guo

Biomineralized Cancer Cell Vaccine for Cancer Immunetherapy

Chemical and Biological Engineering, Advisers – Dr. Jeffrey Brinker & Dr. Rita Serda

Intrinsic tolerance to autologous cells limits the ability of cancer vaccines to elicit anti-cancer immunity. Immune suppression in the tumor microenvironment further limits innate immune responses to cancer neoantigens. Herein, we merge material science with immunology to propose an innovative strategy to creat a novel pathogen (bacteria) mimic cancer cell based vaccine through ex vivo tumor cell silicification and surface decoration with pathogen-associated molecular patterns (PAMPs). In this technology, silicification can help to retain innate cancer cell structure and the entire repertoire of a patient's tumor antigens, and PAMPs stimulate antigen presenting cell (APC) maturation through Toll like receptors (TLR) or other pattern recognition receptors (PRR). These activations of TLR or PRR signaling pathways promote expression of co-stimulatory molecules and stimulates antigen presentation, leading to recognition and elimination of cancer by immune system. In addition due to the biomineralization, pathogen-mimic cancer cell can also be dehydrated for long-term storage without loss of immunogenic properties. These features transform patient's cancer cells into into potent, stable, personalized immunogenic entities address the vast heterogeneity present in cancer and ideal for cancer vaccine development.

11:10-11:30 Presentation by Humayra Tasnim

Quantitative Measurement of Naïve T Cell Association With Dendritic Cells, FRCs, and Blood Vessels in Lymph Nodes

Computer Science, Adviser - Dr. Melanie E. Moses

T cells play a vital role in eliminating pathogenic infections. To activate, naïve T cells search lymph nodes (LNs) for dendritic cells (DCs). Positioning and movement of T cells in LNs is influenced by chemokines including CCL21 as well as multiple cell types and structures in the LNs. Previous studies have suggested that T cell positioning facilitates DC colocalization leading to T:DC interaction. Despite the influence chemical signals, cells, and structures can have on naïve T cell positioning, relatively few studies have used quantitative measures to directly compare T cell interactions with key cell types. Here, we use Pearson correlation coefficient (PCC) and normalized mutual information (NMI) to quantify the extent to which naïve T cells spatially associate with DCs, fibroblastic reticular cells (FRCs), and blood vessels in LNs. We measure spatial associations in physiologically relevant regions. We find that T cells are more spatially associated with FRCs than with their ultimate targets, DCs. We also investigated the role of a key motility chemokine receptor, CCR7, on T cell colocalization with DCs. We find that CCR7 deficiency does not decrease naïve T cell association with DCs, in fact, CCR7−/− T cells show slightly higher DC association compared with wild type T cells. By revealing these associations, we gain insights into factors that drive T cell localization, potentially affecting the timing of productive T:DC interactions and T cell activation.

Poster Session 1 – Fiesta

9:30 AM – 10:30 AM

Poster #	Name	Research Title	Department	Adviser
17	William Vining	How mobility helps distributed systems compute	Computer Science	Dr. Melanie Moses
18	Manish Bhattarai	End-to-End Deep Learning Systems for Scene Understanding, Path Planning and Navigation in Fire Fighter Teams	Electrical and Computer Engineering	Dr. Manel Martinez-Ramon
19	Pavlos Athanasios Apostolopoulos	Demand Response Management in Smart Grid Networks: a Two-Stage Game-Theoretic Learning-Based Approach	Electrical and Computer Engineering	Dr. Eirini-Eleni Tsiropoulou
20	Georgios Fragkos	ESCAPE: Evacuation Strategy through Clustering and Autonomous Operation in Public Safety Systems	Electrical and Computer Engineering	Dr. Eirini-Eleni Tsiropoulou
21	Wenjing Shi	Dynamic Group Interactions in Collaborative Learning Videos	Electrical and Computer Engineering	Dr. Marios Pattichis
22	Luis Sanchez Tapia	FIR Filter Design using Simulate Annealing Stochastic Optimization for fixed-point Implementation in FPGA	Electrical and Computer Engineering	Dr. Marios Pattichis

Oral Session 1 – Fiesta

10:30-10:50 Presentation by Abhinav Aggarwal

The Price of Ignorance: It's Always the Last Place You Look!
Computer Science, Adviser – Dr. Jared Saia

The need for robotic in-situ resource utilization solutions has renewed interest in central place foraging as a means to support habitation on other worlds. Practical algorithms that are provably scalable are needed. A key factor limiting the performance of foraging algorithms is the awareness of the bot(s) about the location of food items around the nest. From this perspective, we introduce Price of Ignorance as a measure of how much time an ignorant bot takes relative to an omniscient forager for complete collection of food items in the arena. This measure allows a comparative study of how close to perfect foraging can a realistic algorithm get. Based on the winning algorithms from NASA Swarmathon III held in 2018, we analyze two foraging algorithms: the the deterministic spiral search (DASA) and the randomized Ballistic search (BalCPFA). For mathematical simplicity, we do not model bot collisions and unexpected environmental effects.

Our theoretical analysis confirms the recent Gazebo simulation results by Lu et al. (ICRA'19) which indicate that a deterministic spiral search is expected to outperform a random walk based search. Our analysis also shows that even when the bots deploy perfect site fidelity, BalCPFA is unable to outperform DASA, in expectation. We further analyze the effect of depletion of food items from the arena on the foraging efficiency of BalCPFA and conclude that the uniformity of BalCPFA and hence, a higher expected overlap in the already foraged regions of the arena, is likely to be one of the key factors causing it to lag behind DASA. Additionally, we show that this behavior is consistent even when only the time to collect the first food item is considered (in contrast to complete collection), implying that BalCPFA inherently slows down foraging compared to DASA.

10:50-11:10 Presentation by Wayne Just

An Artificial Spiking Neural Network for Anytime Learning
Computer Science and Engineering, Adviser - Dr. Melanie E. Moses

The study of the animal brain has led to great advancements in the development of artificial neural networks (ANNs) which simulate the animal brain functions. However, ANNs significantly lag behind the ability of the animal brain in learning new things as the animal ages. ANNs are trained from the data set available at design but are typically very limited in learning anything new afterwards, they may even need to be completely retrained which is both costly and time consuming. This problem is associated with the stability-plasticity dilemma. The dilemma occurs because the neural synapses (connections between the neurons) need to be stable for correct output, but plastic to learn something new. Our research addresses this issue with a novel algorithm called the Neural Growth Algorithm (NGA). The NGA is a spiking neural network that applies a biologically plausible homeostasis model of the neuron. The NGA allows a neuron to form new connections with existing and new neurons, multiple connections between the same two neurons and the ability to break connections between neurons. Additionally, the NGA supports an age limiting function to both minimize breaking neural connections for established pathways and limiting synaptic changes. The combination allows the NGA to form new neural pathways, making the algorithm support plasticity and maintain existing pathways the NGA uses which brings stability to the network. This enables the NGA to learn at any time rather than within the limited window of its development making it both flexible and adaptable.

11:10-11:30 Presentation by Bradley Baker

Dynamic Network Connectivity in Deep Neural Networks
Computer Science, Adviser – Dr. Vince Calhoun

As artificial neural networks grow more complex, we require new analysis techniques to disentangle the exact character of the dynamics at work within them. Deep neural networks (DNNs) in particular suffer from interpretation issues due to the introduction of many non-linear interactions within the stacked layer structure. This gap in theoretical understanding has led to DNNs being characterized as “black-box models,” offering little clarity on how the model has learned to solve the problem, or represents data internally. In this paper, we take a step toward opening this black-box with a new quantitative analysis technique for analyzing the dynamics of internal activation. Our method, called dynamic network connectivity, is inspired by dynamic functional network connectivity (dFNC) analysis in neuroimaging, and characterizes a given network in terms of discrete connectivity states between layers or neurons entered during learning, or over a set of test inputs. We evaluate our method over a set of simple classification and regression problems, and introduce steps toward visualization for more complex learning tasks, such as image classification. Our method proves highly generalizable to a large class of problems and networks, and should inspire future theoretical and empirical investigations to help better understand the dynamics in complex neural networks.

Poster Session 1 – Santa Ana

9:30 AM – 10:30 AM

Poster #	Name	Research Title	Department	Adviser
29	Andrea Schmidt	Breaking the Universal Speed Limit: Faster-than-Light Polarization Currents and Their Applications	Electrical and Computer Engineering	Dr. Edl Schamiloglu
30	Stephen Sanders	Plasmon-enhanced quadrupolar transitions with nanostructured graphene	Physics and Astronomy	Dr. Alejandro Manjavacas
31	Paul Gieri	Plasmonic Resonances in Metallic Film-Nanorod Systems	Physics and Astronomy	Dr. Alejandro Manjavacas
32	Cayla Nelson	Mechanical Testing and Modeling of Silver/Carbon Nanotube Metal Matrix Composites to Increase Resilience of Contacts on Solar Cells	Nanoscience and Microsystem Engineering	Dr. Sang M. Han
33	Kasun Fernando	The physical origin of defect and transport for perovskite single crystals	Nanoscience and Microsystem Engineering	Dr. Wanyi Nie
34	Cameron Harjes	Insulator Technologies to Achieve Maximum Electric Field Holdoff	Electrical and Computer Engineering	Dr. Jane Lehr

Oral Session 1 – Santa Ana

10:30-10:50 Presentation by Lingyao Meng

Controlled Nanomorphology of Hybrid Organic/Inorganic Multi-Component Composites through Cooperative Non-Covalent Interactions

Nanoscience and Microsystem Engineering, Adviser – Dr. Yang Qin

Hybrid organic–inorganic nanocomposite polymers, with inorganic nanoparticles embedded in organic matrix have emerged as a special category of multifunctional materials. With rational materials design, these hybrids can show the synergistic effect of the properties from both phases. Homogenous dispersion and orderly arrangement of the organic and inorganic components are key in their functionalities. By controlling the interface and corresponding interfacial interactions between the organic and inorganic entities, we have developed a logical approach to form stable and controlled hybrid nanofiber structures. We demonstrate the formation of hybrid polymer/quantum dots (or iron oxide nanoparticles) nanocomposites through non-covalent interactions (hydrogen bonding, ionic interactions, etc.). We show that by synthesizing conjugated polymers with specific functionalities, capping nanoparticles with different ligands, we can specifically assemble them into a well-ordered core/shell structure. Besides possessing the excellent conducting properties of the polymer, the resulting nanocomposites also show some added value, such as broader light absorption range when combined with PbS quantum dots, magnetic properties when combined with iron oxide nanoparticles. Further characterization under solar cell and concentration cell operation conditions demonstrate their potential application for energy harvesting. We believe that this composite nanofiber strategy could be used to generate a wide variety of polymer/nanoparticle hybrid nanocomposites. Also, the achievement of homogeneous dispersion of inorganic species into a polymer matrix may offer opportunities to build a unified hybrid nanocomposite platform for different technical applications.

10:50-11:10 Presentation by Juan J Faria-Briceno

Optical Scatterometry for In-line Nano-Manufacturing

Electrical and Computer Engineering, Adviser - Dr. Steven R.J. Brueck

Optical scatterometry is a fast, non-contact, non-destructive nanoscale metrology tool that is widely used off-line in IC manufacturing process for quality control. This research focuses on an in-line metrological tool that can be used during roll-to-roll (R2R) manufacturing of nano-size structures. Both ellipsometric and angular scan scatterometry systems have been widely exploited for off-line metrology. We have previously reported on the wavelength dependence of angular scatterometry. Four different wavelength (244, 405, 633, 982 nm) were used to characterize wire-grid polarizer and photoresist gratings proving that angular scatterometry is capable for nano-metrology applications. It was demonstrated by simulation that using a 405 nm laser source, off-line angular scatterometry is capable of measuring down to 20 nm period for wire-grid polarizer and 24 nm periodic photoresist structures. Our in-line set up can scan the 0th order reflection as a function of incident angle by using a 2-kHz scanning galvanometer mirror and parabolic optics to handle the large angular range ($\Delta\theta$) of ~30^{o}. The angular range could be improved by using shorter focal length mirrors and variation of the off-axis-cut (45° vs. 90°) of the parabolas. Our current in-line scatterometry high-speed, non-contact, real-time, non-destructive tool can be integrated into both R2R manufacturing tools and wafer scale nanomanufacturing systems.

11:10-11:30 Presentation by Deepak Kunwar

Stabilizing High Metal Loadings of Thermally Stable Platinum Single Atoms on an Industrial Catalyst Support

Chemical and Biological Engineering, Adviser – Dr. Abhaya K. Datye

Single atom catalysts represent a new frontier in heterogeneous catalysis because of improved atom efficiency, higher reactivity and improved selectivity for a range of catalytic reactions. However, isolated atoms become mobile at elevated temperatures, causing agglomeration into nanoparticles. Hence, low surface concentrations are generally used since it is often energetically favorable to form dimers, trimers or larger clusters with increasing metal loading. It is desirable to make high concentration of single atom on support in order to make industrially relevant catalyst. However, a major challenge is to achieve high surface concentrations while preventing these atoms from agglomeration at elevated temperatures. Here we developed a synthesis method that allows us to form high concentration of Pt single atoms on an industrial catalyst support. Using a combination of surface sensitive techniques such as X-ray photoelectron spectroscopy (XPS) and Low energy Ion scattering (LEIS), X-ray absorption spectroscopy, electron microscopy, as well as density functional theory, we demonstrate that cerium oxide can support Pt single atoms at high metal loading (3 wt% Pt), without forming any clusters or 3D aggregates. The mechanism of stabilizing single atom Pt involves a reaction of the mobile platinum oxide (PtO2) with under-coordinated cerium cations present at Cerium dioxide (111) step edges, allowing Pt to achieve a stable square planar configuration. These findings provide insight into the capturing of mobile single atom species present during catalyst sintering and regeneration, helping explain the sinter-resistance of cerium dioxide supported metal catalysts.

Poster Session 2 – Acoma

12:30 PM – 1:30 PM

Poster #	Name	Research Title	Department	Adviser
8	Timothy Ohlert	Rainfall changes alter plant communities in Chihuahuan Desert grasslands	Biology	Dr. Scott L. Collins
9	Richard Ramirez	Seasonal and geographical variation in Cricetid thermoregulation of Southern California	Biology	Dr. Wolf Blair
10	Kimberly Wright	Overexpression of the native H+-pumping pyrophosphatase in the microalga Picochlorum soloecismus stimulates the accumulation of carbon storage molecules	Biology	Dr. David Hanson
11	Sudha Ananthakrishnan	Effect of surface tension on particle size and rheology of nanoemulsions of coenzyme Q10	Pharmaceutical Sciences	Dr. Jason. T. McConville
12	Christian T. Denny	Functionalized Oligo(Poly (Ethylene Glycol) Fumarate) to Examine the Effects of Charge on Valvular Interstitial Cells in 3D Culture	Biomedical Engineering	Dr. Elizabeth Dirk
13	Angelea Maestas-Olguin	The endocytotic fate of a mesoporous silica nanoparticle supported lipid bilayer CRISPR delivery vehicle	Chemical and Biological Engineering	Dr. C.J. Brinker, Dr. Achraf Nourredine

Oral Session 2 – Acoma

1:30-1:50 Presentation by Yazan K. Barqawi

Cost-effectiveness analysis of Enzalutamide, Abiraterone acetate plus prednisone, Cabazitaxel plus prednisone for the treatment of visceral metastatic Castration Resistant Prostate Cancer (mCRPC) after Docetaxel therapy
Pharmaceutical Sciences, Adviser – Dr. Matthew Borrego

Prostate cancer (PC) is the second leading cause of cancer death among men in the US. Approximately 165,000 men were diagnosed with new PC in the US in 2018. About 10-20 % will develop castration-resistant prostate cancer (CRPC) within 5 years of diagnosis; of these 70% will metastasize (mCRPC). Presence of visceral metastasis may affect survival. A cost-effectiveness analysis was conducted comparing enzalutamide (ENZ), abiraterone plus prednisone (ABI+PRD) and cabazitaxel plus prednisone (CAB+PRD) for visceral mCRPC post-docetaxel failure. Markov model with life-time horizon to estimate the incremental cost-effectiveness/utility ratios (ICER/ICUR) of direct medical costs per life-year (LY) and quality-adjusted life-year (QALY) gained from a US healthcare perspective (2018 US$; discount rate 3%/yr)). Inputs included drug and medical services costs, grade ≥3 adverse events with incidence >5%, physician follow up, blood and imaging tests. Kaplan-Meier curves from phase III trials were digitized and Weibull distributions were fitted to estimate overall (OS) and progression-free survival (PFS) transition probabilities. ICERs/ICURs were estimated in base case analyses, validated in probabilistic sensitivity analyses (PSA). Cost-effectiveness acceptability curves at various willingness-to-pay (WTP) thresholds were estimated.Models estimated mortality rates in 3 years' time of 98.7 % for ABI+PRD, 83.8 % for CAB+PRD, and 86.8 % for ENZ treated patients. In 1.5 years' time, estimated PFS rates were 14.47 % for ENZ, 0.27 % for CAB+PRD, and 0.51 % for ABI+PRD treated patients). LYs and QALYs gained were 1.58 and 0.79 respectively for ENZ, 1.20 and 0.58 for ABI+PRD, and 1.48 and 0.61 for CAB+PRD. At total costs of $157,830 for ENZ, $235,853 for ABI+PRD, and $496,756 for CAB+PRD, ENZ was cost-saving comparing to other therapies. All validated in PSAs.

1:50-2:10 Presentation by Phuong Anh Nguyen

Ex Vivo Human Chondrocyte Toxicity After Exposure to tranexamic acid, bacitracin, and other topical antiseptics and antibiotics
Biomedical Engineering, Adviser - Dr. Heather Canavan

Topical betadine, chlorohexidine, bacitracin, tranxenamic acid and vancomycin are commonly used antiseptic and antimicrobial agents utilized to reduce the risk of surgical site infections in numerous orthopaedic procedures. Tranexamic acid (TXA) is especially important as it is used to reduce blood loss by inhibiting plasminogen and preventing subsequent fibrinolysis, stabilizing fibrin clots. Human chondrocytes (knee cartilage cells) may potentially be exposed to these agents in vivo, and the impact of these topical agents on chondrocyte viability is unclear. We exposed chondrocytes to these reagents at different conditions to determine a potential safe dose. In the study, human osteochondral (OC) plugs were harvested from the knee joint of a human decedent within 48 hours of death. OC plugs underwent a 2x rinses with Dulbecco's Phosphate Buffered Saline (DPBS) and stored at room temperature. Individual OC plugs were exposed to NS (control) or a range of concentrations of betadine (0.25%, 0.5%, and 1%), chlorhexidine (0.01%, 0.5%), bacitracin (10K, 50K, and 100K) for a one minute lavage, as well as to vancomycin (0.16mg/mL, 0.4mg/mL, 1.0mg/mL) for 48hrs soak in vancomycin, and TXA 20mg/mL, 30mg/mL, 40mg/mL) mixed with nutrient media. Chondrocyte viability was evaluated with LIVE/DEAD assay at day 0, 2, 4, and 6. Day 0 begins immediately following exposure. Vancomycin, betadine and chlorhexidine, at commonly used topical concentrations, are toxic to human chondrocytes in an ex vivo setting as time progresses after exposure. Bacitracin showed concentration dependent chondrocyte toxicity. Initial exposure to TXA does show to cause some toxicity to human chondrocytes ex vivo at commonly used topical concentrations. We recommend further research prior to the use of intra-articular TXA in procedures with residual native cartilage while assessment of lower concentrations will determine a safe topical TXA concentration exists for human chondrocytes.

2:10-2:30 Presentation by Selina M. Garcia

Acid Sensing Ion Channel 1 Contributes to Angiotensin II-Induced Hypertension
Cell Biology and Physiology; Health Sciences Center, Adviser – Dr. Nikki L. Jernigan

The acid sensing ion channel 1 (ASIC1) is part of the amiloride-sensitive degenerin/epithelial sodium channel superfamily and conducts both Na+ and Ca2+. ASIC1 is expressed in the vascular smooth muscle cells and endothelial cells of various vascular beds. However, little is known about the role of these ASIC1 in the regulation of vascular resistance and mean arterial blood pressure (MABP). Based on preliminary experiments showing ASIC1 contributes to acetylcholine (Ach)-induced endothelial cell Ca2+ entry and vasodilation in small mesenteric arteries, we hypothesize that ASIC1 contributes to blood pressure homeostasis and that a loss of ASIC1 leads to increased MABP and exaggerated angiotensin II (Ang II)-induced hypertension. To test this hypothesis, aged (60 weeks) male wild type (+/+) and ASIC1 global knockout (-/-) mice were implanted with radiotelemeters to assess baseline MABP and responses to angiotensin II (600ng/kg/day for 28 days). Average 24-hr baseline MABP were slightly higher in aged ASIC1-/- mice (118 ± 1 mm Hg; n=6) compared to ASIC1+/+ (109 ± 6 mm Hg; n=7). In contrast to our hypothesis, Ang II (28 days following infusion) significantly increased MABP in ASIC1+/+ (change of 36 ± 9 mm Hg), but did not significantly increase MABP in ASIC1-/- mice (change of 6 ± 3 mm Hg), suggesting loss of ASIC1 is protective against Ang II-induced hypertension. Future studies will examine the mechanism by which ASIC1 contributes to Ang II-induced hypertension.

Poster Session 2 – Fiesta

12:30 PM – 1:30 PM

Poster #	Name	Research Title	Department	Adviser
23	Carly Anderson	The Implications of IOT	Anderson School of Business	Dr. Steven Walsh
24	Jon Golla	Natural Trace Metal Salinization of the Jemez River by Valles Caldera Geofluids	Earth & Planetary Science	Dr. Laura Crossey
25	Sean O'Neill	Albuquerque's Impacts on the Rio Grande	Civil Engineering	Dr. Becky Bixby
26	Erin D. Maestas	Using Computational Modeling for Dynamic Group & Subgroup Formation on Social Media	Anderson School of Business	Dr. Ranjit Bose
27	Torin Hovander	Authoritarianism 2.0	Global and National Security Policy Institute	Dr. Chris Lamb
28	Arnab Ghosh	Pore size and structure effects on Pt sintering at 800°C in air	Nanoscience and Microsystem Engineering	Dr. Abhaya K. Datye

Oral Session 2 – Fiesta

1:30-1:50 Presentation by Alesia Hallmark

The Dance of the Plants: Using Photography to Understand Branch Movements
Biology, Advisers – Dr. Scott Collins and Dr. Marcy Litvak

Movements of vegetative and reproductive plant parts are well-studied. Through the use of time-lapse photography, we were able to discover movements of woody branches in trees and shrubs around the world. In particular, we tracked the movements of creosote (Larrea tridentata) branches at a shrubland site in central New Mexico. Using a network of sensors, we were also able to record, at very high frequency, incoming radiation, wind speeds, temperature, humidity, soil water content, soil water potential, and stem water potential at this site. We found that woody branches displayed dramatic diurnal patterns of movement, with some branches displaying vertical movements of over 0.25mAfter testing several abiotic variables, we found that creosote branch movements were most correlated with changes in humidity and temperature. Although, live and dead branches moved in similar patterns, we found that these groups had distinct movement signatures, with dead branches moving passively and live branches actively controlling factors that lead to movements. These movements may result in plant-environmental feedbacks, altering rainfall interception and soil temperature. Challenging the assumption that tree and shrub architecture is static will change standard scientific methodologies and may lead to exciting technological advances. To our knowledge, this is the first study describing branch movements in creosote and is the most extensive dataset of observations of diurnal movements in any woody plant. It provides more knowledge about the biology of a desert shrub, but also offers novel methods for using repeat digital photography to gain inferences about plant form and function.

1:50-2:10 Presentation by Jason Silviria

Resolving the biogeography of North American mammals in the aftermath of the K/Pg mass extinction
Earth and Planetary Science, Adviser - Dr. Corinne Myers

The K/Pg mass extinction event (66 Ma) was typified by the extinction of the non-avian dinosaurs and the subsequent diversification of mammals, particularly the Eutheria. However, the spatiotemporal scale of mammal diversification in North America during this time remains the subject of debate. This study aimed to resolve the biogeography and biostratigraphy of eutherian faunas from the immediate aftermath of the K/Pg extinction, during the Puercan North American Land Mammal Age (earliest Paleocene, 66-65 Ma), using both genus-level and species-level raw abundance and presence/absence data. Occurrences at individual sites as well as basins were analyzed via non-linear multidimensional (NMDS) clustering of Kulczynski distances in R. Additionally, site-level and basin-level comparisons of taxic richness and Pielou's evenness were made in R using Shapiro and Kruskal-Wallis tests. The results generally indicated more pronounced divisions between northern and southern North American faunas in the late Puercan compared to the early Puercan, with basins and intervals, as well as taxic dietary niche, being the most important factors in ordination. Additionally, there were no universal statistically significant differences in richness and evenness between sites and basins due to time interval, lithology, or dominant collecting method. However, the lack of good radiometric age control for many sites inhibits robust reconstructions of Puercan eutherian biogeography.

2:10-2:30 Presentation by Preyom Dey

Optical Imaging Interferometric Microscopy
Electrical and Computer Engineering, Adviser - Dr. Steven R.J. Brueck

Microscopy is widely used for detecting small features that cannot be seen under normal observation. Despite of several groundbreaking improvements in microscopy techniques, optical microscopy still holds the predominant position in terms of expense and complexity. However, resolution limits in optical microscopy imposes a fundamental barrier for areas where feature size is extremely small and the viewer requires a large field of view and working distance. The lens of an optical microscope acts as a low pass filter and restricts frequency space coverage to $2NA/\lambda$ (λ is the wavelength of the light source and NA is the numerical aperture of the lens). According to Abbe criterion, for a 405 nm source and a 0.4 NA lens, maximum achievable resolution limit is around 500 nm ($0.5\ \lambda/NA$). To overcome this barrier of maximum frequency space coverage, we developed Imaging Interferometric Microscopy (IIM) technique which is a synthetic aperture approach that uses off axis illumination on a transparent solid substrate. Our technique can extend resolution limit to $0.5\lambda/(n+NA)$, where n is the refractive index of the substrate. So far by using a sapphire substrate (n=1.78) an extension of resolution limit to 100 nm has been achieved. Several mathematical and optical correction methods have been developed along with IIM to correct system aberrations and improve the image quality. Our goal is to extend resolution limit below 50 nm using a higher refractive index substrate (silicon, n=4.5). This technique will be useful for optical metrology systems and also for biological research and applications.

Poster Session 2 – Santa Ana

12:30 PM – 1:30 PM

Poster #	Name	Research Title	Department	Adviser
35	Brian Douglas Rummel	Characterization and Imaging of Surface Acoustic Waves on GaAs with Raman Spectroscopy	Nanoscience and Microsystem Engineering	Dr. Sang M. Han
36	Christopher Buksa	Mechanical Characterization of Polycaprolactone (PCL)/Polypropylene Fumarate (PPF) Composite Scaffolds for Bone-Ligament Enthesis Tissue Engineering	Mechanical Engineering	Dr. Christina Salas
37	Christian A. Pattyn	Shape Memory Effect (SME) in Epoxy-Based Polymers; Synthesis and Dynamic Mechanical Analysis	Biomedical Engineering	Dr. Marek Urban
38	Bokyung Park	Examination of light scattering properties on the bio-inspired polyethylene fibrous film	Nanoscience and Microsystem Engineering	Dr. Sang Eon Han, Dr. Sang M. Han
39	Adan Myers y Gutierrez	Continuous Chemical Kinetic Reaction Model for DNA Strand Displacement and DNAzyme Assay	Nanoscience and Microsystem Engineering	Dr. Steven Graves, Dr. Darko Stefanovic, Dr. Matthew Lakin
40	Madalyn Wilson-Fetrow	Functional Supported Diblock Copolymer Microspheres for Use in Flow Cytometry	Nanoscience and Microsystem Engineering	Dr. Steven Graves

Oral Session 2 – Santa Ana

1:30-1:50 Presentation by Diksha Gupta

Puzzling Sybil into Bankruptcy: An asymmetric Sybil Defense
Computer Science, Adviser – Dr. Jared Saia

A common tool to defend against Sybil attacks is proof-of-work, whereby computational puzzles are used to limit the number of Sybil participants. Unfortunately, current Sybil defenses require significant computational effort to offset an attack. In particular, good participants must spend computationally at a rate that is proportional to the spending rate of an attacker. In this paper, we present the first Sybil defense algorithm which is asymmetric in the sense that good participants spend at a rate that is asymptotically less than an attacker. In particular, if T is the rate of the attacker's spending, and J is the rate of joining good participants, then our algorithm spends at a rate of $O(\sqrt{(T J)} + J)$.

We provide empirical evidence that our algorithm can be significantly more efficient than previous defenses under various attack scenarios. Additionally, we prove a lower bound showing that our algorithm's spending rate is asymptotically optimal among a large family of algorithms.

1:50-2:10 Presentation by Lauren Zundel

Edge Effects on Arrays of Plasmonic Nanostructures
Physics and Astronomy, Adviser - Dr. Alejandro Manjavacas

The ability of metallic nanostructures to support surface plasmons, the collective oscillations of conduction electrons, makes them an ideal tool for realizing a wide range of technologies related to optical sensing, energy harvesting, and nanoscale color production, to name a few. An arrangement for these nanostructures that is of particular interest for these purposes is periodic arrays, which not only have a stronger overall response than single nanostructures, but can also give rise to collective effects that result from the interactions between the individual constituents. Although actual implementations of these arrays must be finite, with a size limited by the fabrication method, it is typical to model these systems as perfectly periodic, and therefore infinite. This approximation is much less computationally demanding than modeling finite systems containing a large number of elements, but it neglects the possible impact of edges on the overall response of the array. Here, we investigate the role played by finite-size on the optical response of arrays of plasmonic nanostructures. The results of our work serve to inform the design and modeling of devices seeking to take advantage of the extraordinary properties of finite arrays of nanostructures.

2:10-2:30 Presentation by Robert Malakhov

Mechanics of the Low-Flow Limit in Slot-Die Coating with no Vacuum
Nanoscience and Microsystem Engineering, Adviser - Dr. P. Randall Schunk

Slot-die coating is a pre-metered, film-deposition process compatible with a wide range of materials. Of topical interest to precision electronics applications is the deposition of high-cost nano-material dispersions over moderately sized (>10 cm^2) areas with sub-micron wet film thickness. In this work, a two-dimensional model has been developed to understand the limits of the process and to predict the thinnest possible film achievable. Coined the low-flow limit, this parametric operating boundary presents the minimum uniform, defect-free film achievable at a given set of liquid properties and die/substrate geometry. We investigate the low-flow limit with a model that allows menisci to locate anywhere on the die lands, faces, and substrates with prescribed contact angles, thereby minimizing the assumptions on the bead configuration. The model is validated via comparison of its low-flow limit predictions to published experimental data. Analysis yields insights into the mechanics of coating bead breakdown at the low-flow limit.

Poster Session 3 – Acoma

3:15 PM – 3:45 PM

Poster #	Name	Research Title	Department	Adviser
14	Shiva Sharma	Depressive Symptoms among Elderly Rural New Mexico Uranium Workers	School of Medicine	Dr. Akshay Sood
15	Ray deKay	Improving Hospital Satisfaction: An Integrative Approach	Neurosciences	Dr. Atif Zafar
16	Ben Matheson	Pretty Gross: Beauty Tools Aren't Only Biocompatible for the Human Face	BME	Dr. Heather Canavan

Poster Session 3 – Santa Ana

3:15 PM – 3:45 PM

Poster #	Name	Research Title	Department	Adviser
41	O. Liota Weinbaum	Dismantling dogma by modeling mastitis: Assessing the impact of asymptomatic infections	Biology	Dr. Helen J. Wearing
42	Darnell Cuylear	Design and Characterization of "Smart" Hydrogels for Colonoscopy Preparation	BME	Dr. Heather Canavan
43	Reza Pirayeshshirazinezhad	A novel approach toward controlling optimally the attitude of a Two-CubeSat Virtual Telescope	Computer Science, Mechanical Engineering	Dr. Manel Martinez-Ramon

Oral Session 3 – Acoma

3:45-4:05 Presentation by Tye D. Martin

Computational Investigation of Phenylene-ethynylene based Sensors for Amyloid-β Aggregates
Biomedical Engineering, Advisers – Dr. Eva Y. Chi and Dr. Deborah G. Evans

Alzheimer's Disease (AD) detection and treatment continues to be a critical research area as an estimated 6 million cases of the disease were reported in 2018. Small, bioactive molecules have shown promise as sensors for protein aggregates observed in two pathological hallmarks found in AD: intraneuronal neurofibrillary tangles (NFTs) and extracellular amyloid-beta (Aβ) plaques. Along with insoluble Aβ fibrils are heterogeneous pre-fibrillar species which are known to be more toxic and cause disruption of neuronal communication. A number of current sensors, such as Thioflavin T, are unable to pinpoint these smaller aggregates prompting the search for novel compounds with improved detection. A class of conjugated oligomeric p-phenylene ethynylenes (OPEs) have shown potential for signaling presence of pre-fibrillar Aβ and also the ability to detect tau aggregates which form NFTs. In this study, we are looking to explore the nature of the binding mechanism of OPEs to Aβ using classical all-atom molecular dynamics (MD) simulations. Our simulations have revealed a number of OPE binding sites featuring hydrophobic and charged amino acid residues on the surface of small Aβ oligomers. Binding energy calculations have shown favorable energetic interactions for both anionic and cationic OPEs. We have also observed self-assembly of OPEs during the simulated binding process which could be one reason that OPEs displayed measurable fluorescence enhancement in previous experimental studies.

4:05-4:25 Presentation by Nicole Maphis

pT181-Qß vaccine reduces pathological Tau and rescues cognitive deficits in a mouse model of tauopathy
Molecular Genetics and Microbiology, Adviser – Dr. Kiran Bhaskar

Alzheimer's disease (AD) is a progressive neurodegenerative disease clinically characterized by cognitive decline and likely mediated by the aggregation of hyperphosphorylated, pathological tau (pTau) as neurofibrillary tangles (NFTs) inside neurons. There is no FDA-approved treatment that cures, slows or prevents AD. Current immunotherapy strategies targeting pTau have generated encouraging data but may pose concerns about scalability, affordability, and efficacy. Here, we engineered a virus-like particle (VLP)-based vaccine in which tau peptide, phosphorylated at threonine 181, was linked at high valency to Qß bacteriophage VLPs (pT181-Qß). We demonstrate that vaccination with pT181-Qß is sufficient to induce a robust and long-lived anti-pT181 antibody response in the sera and the brains of both Non-Tg and rTg4510 mice. Sera from pT181-Qß vaccinated mice are reactive to classical somato-dendritic pTau on human tauopathy brain sections. Finally, we demonstrate that pT181-Qß vaccination reduces both soluble and insoluble species of pTau in the hippocampus, avoids a Th1-mediated pro-inflammatory cell response, prevents hippocampal and corpus callosum atrophy and rescues cognitive dysfunction in a 4-month-old rTg4510 mouse model of tauopathy. These studies provide a valid scientific premise for the development of a VLP-based immunotherapy to target pTau and potentially prevent Alzheimer's and other tauopathy-mediated diseases.

4:25-4:45 Presentation by Stephen Amoah

Psychosis and inflammation induced astrocytic microRNA downregulates neuronal gene expression via exosomes
Neurosciences, Adviser - Dr. Nikolaos Mellios

Secretory microvesicles known as exosomes in glia and neurons influence various aspects of brain development and function through intercellular communication. The central dogma of biology posits that DNA is transcribed into RNA, which is translated into protein; but only 1.5% of the human DNA code for proteins. Yet, 76% of the human DNA is actively transcribed into various non-protein coding RNAs (ncRNAs), such as microRNAs (miRNAs) that are highly expressed and regulate various aspects of brain function. There is paucity of research on the impact of exosomal miRNAs in psychiatric disorders. Here, we used miRNA profiling and qRT-PCR in postmortem brain samples from the orbitofrontal cortex (OFC) of patients with schizophrenia (SCZ) and bipolar disorder (BD), and examined the expression of miRNAs in neuronal and glial cultures, as well as their capacity to be secreted via exosomes. We found that miR-223, an inflammation-related miRNA, secreted in exosomes, was increased in SCZ and in BD patients with psychosis. miR-223 expression in the OFC positively correlated with inflammatory and glial gene expression, but was inversely associated with miR-223 validated targets: Glutamate ionotropic receptor AMPA type subunit 2 (GRIA2) and glutamate ionotropic receptor NMDA type subunit 2B (GRIN2B). Analysis in cell cultures revealed that miR-223 is produced by astrocytes and is transferred to neurons via exosomes, where it downregulates GRIA2 and GRIN2B. Finally, miR-223 expression and exosomal secretion was affected by antipsychotics. Our results demonstrate that an inflammation-induced, glial-produced miRNA, modified in psychiatric disorders, can regulate disease-related neuronal gene expression via exosome secretion.

Oral Session 3 – Fiesta

3:45-4:05 Presentation by Dustin Perriguey

Initial Environmental Conditions and their Influence on Phanerozoic Mass Extinctions
Earth and Planetary Sciences, Adviser – Dr. Corinne Myers

Biologic extinctions have been occurring throughout Earth's history with an extensive scientific focus on those that occurred during the Phanerozoic (~540 Ma to Present). Phanerozoic extinction science has focused heavily on extinction events themselves, leaving little explained about the influence of initial conditions on extinction events. We want to determine the relationships between initial abiotic environmental parameters and periods of elevated extinction. More specifically, we want to determine what environmental conditions prior to marine mass extinctions make those mass extinctions more likely to occur. This requires the compilation of ~540 Myr worth of environmental proxies and diversity data from the geologic record to calculate extinction percentages. We have compiled several databases of Phanerozoic environmental isotopic and sedimentary rock data, along with some of their latitudinal variation including δ18O (temperature), δ13C (carbon cycling), 87Sr/86Sr (continental weathering rates), eustatic sea level, and carbonate continental shelf area. We will test the hypothesis that a strong relationship exists between initial environmental conditions and subsequent major and minor Phanerozoic extinctions. With these results, we will be able to determine if there are combinations of environmental factors that increase or reduce extinction severity. If a relationship is determined, it will enhance our ability to evaluate our current biodiversity crisis in light of modern climate and environmental changes and their long term projections.

4:05-4:25 Presentation by Jamal Mamkhezri

Consumer Preferences for Solar Energy: A Choice Experiment Study
Economics, Adviser – Dr. Janie Chermak

Electricity generation in the United States is rapidly moving towards integrating more renewables into the system. This is due to several factors including cost competitiveness, consumer preferences, and state and federal policies, such as federal tax incentives, renewable portfolio standards (RPSs), and state level subsidies for solar energy. While these policies have been researched extensively, in this paper we investigate consumer preference and willingness to pay toward renewable energy. Consumer preferences may impact the type of renewable energy utilized, as well as state-determined RPS requirements. We implement a choice experiment survey to gain understanding of consumer preferences and their preference heterogeneity. We conduct the survey in New Mexico, a state with RPS and great potential for renewables, particularly in solar where it ranks third in the U.S. for that potential. Focusing on the consumers of the state's major utility, our choice experiment considers an increase in renewable energy and preference for different types of solar energy. We control for location heterogeneity (i.e., rural vs. urban), as well as exposure to solar installations. Utilizing multinomial logit and random parameter logit our results suggest respondents support an increased RPS solar requirement and they have a positive marginal willingness to pay (MWTP) for rooftop solar and smart meter installation. These values are impacted by several factors, including location and exposure to solar. We also observe a distance decay effect on respondents' MWTP for different solar plans. For regulators considering additional RPS levels, or utilities considering solar installations, the results provide improved information on consumer preferences, heterogeneity of response, and MWTP for solar energy.

4:25-4:45 Presentation by David James Walwark

Modeling the fluorescence response of organic solar cell efficiency-doubling molecules
Nanoscience and Microsystems Engineering, Adviser - Dr. John K. Grey

When solar cells absorb light, energy is often lost as heat unless the just-excited electrons jazz up a sleepy friend before they cool off. This is a rough description of the process of 'singlet fission', a physical phenomenon that could double the efficiency of organic solar cells. The excited electrons in a solar cell must journey far in a confusing landscape, so longer-lasting species are more important to study than their short-lived relatives. We study these longer-lived excited states with a sensitive fluorescence microscope; we observe single molecules to clarify the relationship between shape and excited electronic spin states, and because single molecules are the easiest to understand. To better interpret and explain experimental data we built a computer model of the absorption and emission of an optoelectronic molecule, with each photon accounted for. This Monte Carlo simulation of a fluorescent molecule provides powerful insight into the dynamics of electronic spin states in emissive materials. It also strongly suggests the elusive singlet fission phenomenon is occurring in specially folded single-chains of a well-studied conjugated polymer.

Oral Session 3 – Santa Ana

3:45-4:05 Presentation by Nekoda van de Werken

Improving Mechanical Properties of Additively Manufactured Continuous Carbon Fiber Composites Using Hot Isostatic Pressing

Mechanical Engineering, Adviser – Dr. Mehran Tehrani

Additive manufacturing has recently begun to explore its role in the composites industry, bringing the capability of engineered fiber orientation and placement, complex part geometry, and tailored internal structure to the traditionally high strength, high stiffness, and low-density material class. Nowhere is this more true than for additively manufactured continuous fiber composites, where material properties can begin to approach those of conventionally manufactured composites. Like their conventionally manufactured counterparts, however, additively manufactured composites suffer from poor out-of-plane and off-axis properties, where transverse and shear stresses are often the limiting design consideration. This study investigates the use of hot isostatic pressing (HIP) to post-process 3D printed composites to improve the flexural, interlaminar shear, and axial and transverse tensile properties. Isostatic pressure and elevated temperatures are used in combination to compress internal voids in the composite parts, which act as defects and contribute significantly to the onset of failure, as well as allow for the diffusion of molecular chains across printed layers to improve interlayer bond strength. This treatment method can be applied to parts with complex geometries and in general is not limited by part size. The strength, stiffness, and shear properties of the composites were all found to increase by 20-30% following a 1 hour treatment, accompanied by a corresponding reduction in void volume fraction. This method demonstrates a fast and robust method to post-process continuous carbon fiber reinforced 3D printed parts, resulting in a significant improvement in mechanical performance.

4:05-4:25 Presentation by Madelaine Chavez

Hybrid Molecular-Enzymatic Cascades on Carbonaceous Scaffolds

Chemical and Biological Engineering, Adviser – Dr. Plamen Atanassov

Glycerol, or glycerin, is a major byproduct of the biodiesel manufacturing process. In general, for every 100 pounds of biodiesel produced, approximately 10 pounds of crude glycerol are created. As the biodiesel industry expands. the amount of glycerol expands, which is hazardous. Nature has already developed a way to breakdown this compound in complex pathways called metabolons. A metabolon is a temporary structural-functional complex formed between sequential enzymes of a metabolic pathway. However, humanity does not know how to mimic this behavior. The fundamental understanding of the ways molecular and/or inorganic catalysts can be incorporated with enzymes to enhance the efficiency of multi-step reactions can lead to knowledge crucial for any further improvements in the development of multi-component multi-step catalytic cascades. The goal of this project is to develop the beginning fundamental understanding of metabolons by developing strategies to spatially organize three different catalysts, biological, molecular, and inorganic, using 3D-Graphene nanosheets as a scaffold and apply it to efficiently catalyze multi-step oxidation of glycerol [1,2]. In this work, we first studied the immobilization of oxalate decarboxylase (OxDC), from Bacillus subtilis, through physical absorption and tethering using 1-pyrenebutyric acid N-hydroxysuccinimide ester on conductive carbonaceous supports. Furthermore, strategies to incorporate both the molecular and enzymatic catalysts system that will enable them to efficiently perform two-step catalytic cascade - the last two steps in the glycerol oxidation mechanism. Results of electrochemical studies show that OxDC and pyrene-TEMPO were successfully immobilized on the carbonaceous scaffold and the hybrid catalyst can catalyze two different reactions sequentially.

4:25-4:45 Presentation by Sarun Atiganyanun

Disordered Microsphere-Based Coatings for Effective Daytime Radiative Cooling

Nanoscience and Microsystems Engineering, Advisers - Dr. Sang M Han and Dr. Sang Eon Han

Radiative cooling is a process where a material loses heat due to strong photon emission in the mid-infrared spectrum and enhanced light scattering in the solar region. This process would allow cooling below the ambient temperature under the sun without the use of electricity and therefore would reduce energy consumption. We have demonstrated passive radiative cooling of disordered microsphere coatings below the ambient temperature while exposed to direct sunlight. To fabricate the coatings, silica microspheres are deposited by colloidal sedimentation method and spray coating method. Scanning electron microscopy show that the structures are disordered without short- or long-range order. Optical measurements indicate that the coatings have a short transport photon mean free path of 4-8 μm in the solar region. These coatings also exhibit high emissivity above 95% in the atmospheric transparency window. These results suggest that the films would enable effective radiative cooling. To test this, we apply this film on a black substrate and expose the material to direct sunlight during the summer in New Mexico. Temperature measurement of the samples shows that our coating reduces the substrate temperature below that of the ambient air by as much as 12 °C. Similar testing with a commercial solar-rejection paint indicates that the silica coating performs better than the commercial paint by 4.7 °C. Additionally, the similar technique is used to fabricate disordered coatings made of polystyrene-polymethyl methacrylate microspheres. Outdoor experiments have shown that such polymer coatings perform better than the commercial paint by 5.5 °C.

Poster Abstracts

Poster 1, Acoma Session 1, Chanju Fritch

C1 Decompression in Therapy of Pseudotumor Cerebri

Idiopathic intracranial hypertension, also known as pseudotumor cerebri, often presents with severe headache and associated vision loss. Venous outflow obstruction has been noted as a prominent etiologic factor in many cases, and previous anatomic study has shown that the internal jugular vein at the skull base can be prone to compression by the neighboring bony structures. We present a case of 13-year-old male with a multifactorial intracranial hypertension including compression of the internal jugular vein by the lateral mass of C1. CT angiographic imaging revealed bilateral stenosis of the internal jugular veins by the lateral masses of C1. Medical management, shunt, and stenting were all attempted prior to partial C1 lateral mass resection without relief of the patient's intracranial hypertension. This case saw final resolution of the patient's symptoms only after a portion of the lateral mass of C1 was removed.Contribution of C1 compression to this patient's intracranial hypertension suggests that evaluation for internal jugular compression below the skull base may be needed to identify the underlying cause of intracranial hypertension in certain patients. Furthermore, surgical decompression of the internal jugular vein may be required as part of the treatment strategy; if venous stenting is being considered, this decompressive step must be taken before stenting is performed. We offer this case as evidence that decompression of the internal jugular vein by C1 lateral mass resection can be an effective and novel technique in the repertoire of neurosurgical management of intracranial hypertension.

Poster 2, Acoma Session 1, Henning De May

Biomineralized cancer cells as a therapeutic vaccine for ovarian cancer

The merger of materials-science and immunotherapy has led to the development of a novel anti-cancer vaccine created through ex vivo tumor cell silicification and surface decoration with pathogen-associated molecular patterns (PAMPs). This technology transforms cancer cells into bacterial-pathogen mimics, thereby overcoming self-tolerance. PAMPs stimulate antigen-presenting cells (APCs) through pattern recognition receptors (PRR) such as Toll-like receptors (TLRs), resulting in antigen uptake, processing, and presentation. Recent reports suggest combining TLR-4 and TLR-9 agonists induces synergistic immune activation. Here we tested the therapeutic benefit of coating silicified BR5-Akt (BRCA1(-) ovarian cells) with TLR-4 and TLR-9 agonists. Monophosphoryl lipid-A (MPL) is a nontoxic derivative of the gram-negative bacterial antigen lipopolysaccharide (LPS). It binds TLR-4 thereby promoting an APC mediated T-helper-1 (Th1) immune response. Unmethylated CpG oligonucleotide (ODN) binds TLR-9, triggering an APC mediated proinflammatory response. Here we test the benefit of treating tumor-bearing mice with silicified BR5-Akt cells coated with MPL with/without CpG. Four days after intraperitoneal (IP) tumor challenge (BR5-Akt-luciferase2+ cells), BALB/c mice were vaccinated with silicified BR5-Akt cells coated with MPL or MPL/CpG (four treatments on five-day intervals). Using tumor bioluminescence, we found that combining vaccination with MPL and CpG resulted in a reduction of IP tumor burden compared to both the MPL/vaccine only group and the untreated control group. We have shown that combined CpG/MPL coating of the tumor vaccine results in an anti-tumor response strong enough to overcome self-tolerance in an established ovarian cancer model. These findings have significant implications for the future development of ovarian cancer vaccines.

Poster 3, Acoma Session 1, Sajjad Ahmad Khan

Lipid-coated Mesoporous Silica Nanoparticles for siRNA delivery

Prostate cancer is the second highest cancer-related cause of death in men, accounting for 8% of deaths due to metastatic disease. Androgen deprivation therapy is commonly the initial treatment, resulting in initial response rates of 80-90%. Unfortunately, most men develop castrate-resistant prostate cancer. Resistance to last line chemotherapeutics, such as enzalutamide (ENZ) signals disease progression with no defined standard of care. Here, we propose to develop a new treatment involving delivery of siRNA targeting the PCA3 oncogene, packaged and protected within porous nanoparticles (NP) guided to the tumor by novel anti-GRP78 antibodies that will selectively bind to unique molecular signatures present within prostate tumors. The goal of our research is to demonstrate in vivo therapeutic efficacy by inhibiting ENZ- resistant (ENZR) LNCaP tumor growth in mice. To accomplish this, we will develop biocompatible monosized lipid-coated mesoporous silica nanoparticles (LC-MSNs) for PCA3 siRNA delivery. In our preliminary studies, the synthesis of MSNs was carried out through the sol-gel process that yielded spherical MSNs of 130 nm size with stellate structure and conical pores of 12 nm diameter. The cargo-free LC-MSNs exhibited a positive zeta potential of ξ= 15 mV and decreased to ξ= +3 mV and ξ= -1.31 mV upon loading with nucleic acid and protein components respectively. The decrease in surface potential is consistent with electrostatically-mediated cargo loading. Due to less cationic surface charges following cargo loading, cellular uptake was reduced in cancer cells but still robust. Furthermore, in preliminary studies, loaded and unloaded LC-MSN reduced proliferation indicating that the high positive charge was slightly cytotoxic. For siRNA loading, our goal is to further optimize the surface properties to maintain good loading but reduced toxicity. The results obtained thus far indicate that we have a versatile and chemically fertile platform.

Poster Abstracts

Poster 4, Acoma Session 1, Murali Manohar Duggina

Engineering Immunogenic Nanoparticles for cancer therapy

Ovarian cancer accounts for around 3 percent of cancers in women in the US killing almost 14,195 who received a diagnosis among 21,161 in 2018 . Treatment methods like surgery, , and radiation therapy may be palliative aimed at alleviating symptoms rather than being curative and leads to many negative side effects. It is the goal of the National Cancer Institute and researchers to eliminate cancer cells throughout the body in all patients. Here we propose a novel method of augmenting chemotherapy-induced immunogenic cell death. This project benefits from a) immunogenic presentation of antigen arising from doxorubicin (DOX)- induced apoptosis, b) stimulation of dual TLR signaling pathways in phagocytic antigen presenting cells (APC) and c) inhibition of checkpoint regulators that would otherwise silence the immune response. The goal of our research is to engineer immunogenic nanoparticles in order to create more effective cancer treatments by measuring the dose response of DOX with and without nanoparticles, release kinetics of ATP and ICD include 3 hallmarks: release of ATP, translocation of calreticulin (CRT), HMGB1 binding with TRL4 on dendritic cells (DCs). For this, mesoporous silica nanoparticles are synthesized and loaded with DOX before being coated by a lipid-bilayer (LC-MSNs). It is observed that the positive charge absorbs more drug at the same time being more positive implies more toxicity. One of the challenges is to find the right balance between the charge and the toxicity for a better therapeutic efficacy. For toxicological assessment of NPs in immune competent mice in vivo acute toxicity over a range of doses, repeat dose toxicity studies are performed to evaluate the maximum tolerated dose (MTD) of DOX-loaded and control NPs in immune competent BALB/c mice to guide dosing in efficacy studies.. Future works include optimization of drug loading capacity along with the layered presentation of components will enable production of environmentally-sensitive drug carriers in vivo for more effective cancer treatment.

Poster 5, Acoma Session 1, Lien Tang

Nanoparticle Immunotherapy: Towards a Cancer-Curative Vaccine

Cancer immunotherapy is an important alternative or addition to traditional treatments such as chemotherapy and radiation, with the potential to reduce toxicity and negative side effects. Although immunosuppressive changes in the tumor microenvironment impair normal immune surveillance against cancer in the body, effective immunotherapy has the ability to reactivate immune defense mechanisms. Success in loading protein and nucleic acids in lipid-coated mesoporous silica nanoparticles has encouraged us to create immunogenic nanoparticles that target, activate and deliver antigens to dendritic cells (DC). We have optimized both the mesoporous silica core and the lipid coat for co-delivery of the model antigen ovalbumin (ova) and the Toll-like receptor 4 (TLR4) ligand monophosphoryl lipid-A (MPL-A). Engagement of TLR4 on DC stimulates signaling pathways leading to upregulation of co-stimulatory molecules and cell activation essential for antigen presentation and stimulation of effector functions. Flow cytometry and confocal microscopy were used to show selective uptake of our immunogenic nanoparticles by immune cells, with low uptake by cancer and stromal cells. Ongoing preclinical studies using immune competent female C57BL/6 mice challenged with ID8-ova epithelial ovarian cancer cells are designed to test the efficacy of our nanoparticle vaccine. Following intraperitoneal injection of ID8-ova cells, mice develop malignant ascites and tumor implants in the omentum and along peritoneal surfaces, mimicking the typical clinical presentation in patients. By expressing targetable tumor antigens, this model permits direct analysis of tumor-specific lymphocyte function.

Poster 6, Acoma Session 1, Gabriela Perales

MicroRNA-150-5p exerts antiangiogenic activity in brain microvascular endothelial cells during prenatal alcohol exposure

Fetal alcohol spectrum disorders (FASD) occur in children whose mothers consumed alcohol during pregnancy and manifest in a wide range of deficits. These deficits can be caused by alterations in gene expression that are regulated by microRNAs (miRNAs). miRNAs are small non-protein-coding RNA molecules that silence gene expression by binding to the 3'UTRs of target mRNAs and prevent translation. In an established mouse model of moderate prenatal alcohol exposure (PAE), we found that cortices from alcohol-exposed pups at embryonic day 18 (E18) had higher levels of miR-150-5p compared to saccharin-exposed controls. We have identified a novel angiogenic target of miR-150-5p, vascular endothelial zinc finger 1 (Vezf1), which is an endothelial-specific transcription factor which was found to be reduced in the E18 PAE cortices compared to controls. In brain microvascular endothelial cells (BMVECs), transfection of miR-150-5p mimics decreased Vezf1 expression, while miR-150-5p inhibitors increased its expression. To demonstrate direct binding, a WT or mutated Vezf1 3'UTR was cloned into a firefly luciferase reporter. In the presence of the miR-150 mimic, a reduced luciferase activity for the WT Vezf1 3'UTR reporter was observed but no change for the mutated reporter. In addition, intrauterine injection of miR-150-5p inhibitors into pup ventricles at E16 increased cortical Vezf1 expression at E18. To investigate the effect of miR-150-5p on angiogenesis, we examined BMVECs following transfection with miR-150-5p mimics and inhibitors and found that miR-150-5p attenuated cell migration and tube formation. Our research suggests that miR-150-5p inhibition of Vezf1 may adversely alter the cortical microvasculature during PAE.

Poster Abstracts

Poster 7, Acoma Session 1, Zinia Pervin

Invasive hemodynamic measurement in large animal model of combined traumatic brain injury plus hemorrhagic shock in the consideration of care management.

Traumatic brain injury (TBI) and hemorrhagic blood loss usually occurs simultaneously, resulting in worse outcome compared with each of this insult alone that is the major cause of mortality and morbidity in both the civilians and military settings. The management of combined traumatic brain injury and hypovolemic shock that occurs after poly trauma poses a remarkable challenge due to possible conflicting outcome. Several treatment modalities have been proposed but the specific objective and optimal resuscitation goal have not yet been clearly exemplified. In this study, we investigate the hemodynamic status in Swine model to observe the physiological and neurological consequence after this combined effect because of large animal models of poly-neuro trauma are closely mimic with human physiology. This study was carried out on Yucatan swine, by placing two catheters into both femoral arteries where one for invasive blood pressure monitoring and the other for controlled blood loss. Continuous invasive monitoring sensors were calibrated by using a mercurial sphygmomanometer to measure the Mean arterial blood pressure (MAP) and A closed head traumatic brain injury was inflicted by a pneumatic device (HYGE, Inc., PA, USA) that can converts the linear force to an angular motion to develop the similar type of injury like TBI. Results: The remarkable changes of MAP indicates enormous disturbance in autoregulation of constant cerebral blood flow (CBF) and represents a severe neuropathological response following TBI which warrants further investigation to evaluate the association of functional deficits and neuronal death after this combined effect.

Poster 8, Acoma Session 2, Timothy Ohlert

Rainfall changes alter plant communities in Chihuahuan Desert grasslands

Variations in New Mexico's climate have been detected over the past century and are expected to continue into the future. Some of these climatic changes result in more frequent instances of extreme drought events and alterations of monsoon seasonality, with monsoons being pushed later into the fall. Such changes could make our Chihuahuan Desert plant communities less productive, shift the abundance of the plant species, or have other destabilizing impacts. Our experiment manipulated precipitation in two desert grassland communities at the Sevilleta National Wildlife Refuge near Socorro, NM. Some plots were subjected to an extreme drought event, receiving only 33% of annual precipitation for five years, and others were subjected to a change in the timing of monsoon precipitation, delaying rainfall to September and October. We found that not only did plant production decrease but plant community assembly also changed in response to these treatments. The greatest production loss was in the extreme drought manipulation which also experienced a change in species diversity, an immediate diversity decrease that eventually recovered to levels above its initial condition. Plant diversity in the delayed monsoon treatments initially increased and eventually settled to near ambient levels, probably due to an initial propagation of bet-hedging species that had been accumulating in the seed bank. In both grasslands, the two treatments caused the dominate grasses to become subordinate which likely drove the lowered productivity and greater evenness of the plant abundances within communities of both treatments.

Poster 9, Acoma Session 2, Richard Ramirez

Seasonal and geographical variation in Cricetid thermoregulation of Southern California

Many climate models predict higher average global temperatures as well as increased magnitude and frequency of extreme heat events. Nocturnal rodents will increasingly be subject to warmer conditions which will directly impact activity periods and ability to balance water and energy budgets. To examine to thermoregulatory capacity of species exposed to extreme temperature variation, we measured the thermoregulatory function of four Cricetid species (N. albigula, N. lepida, P. eremicus, P, crintus) at three sites in the Mojave Desert; Cottonwood Springs in Joshua Tree National Park and Zzyzx and Midhills sites in the Mojave National Preserve. Additionally, we conducted winter versus summer measurements for two of the sites (Cottonwood Springs and Zzyzx). We used flow-through respirometry to measure resting metabolic rate (CO_2 production), evaporative water loss and body temperature. We continuously measured these parameters through temperature treatments from 15 degrees Celsius to 43 degrees Celsius. We compared performance as a function of body size, site and season to examine the potential effects of warming and extreme events on relative animal function. Results demonstrate little difference in the upper and lower critical limits of the thermal neutral zone of each species independent of site or season. However, resting metabolic rates do show an increase in the winter. Additionally, onset of increased evaporative water loss initiates at lower ambient temperatures in the winter which may explain an increase in the maximum temperature tolerated during the winter. These desert species are under some of the most extreme climate pressures. Their distribution largely depends on physiological tolerance to extreme temperature variations and limited water availability. Understanding physiological performance under these pressures will be a good predictor of species distribution under increasing climate variability.

Poster Abstracts

Poster 10, Acoma Session 2, Kimberly Wright

Overexpression of the native H+-pumping pyrophosphatase in the microalga Picochlorum soloecismus stimulates the accumulation of carbon storage molecules

Picochlorum soloecismus (hereafter Picochlorum) is a green halotolerant microalga with fast growth rates, moderate starch/lipid accumulation, and is amenable to genetic engineering. We set out to increase carbon storage in Picochlorum by overexpressing its native vacuolar proton-pumping pyrophosphatase, AVP1, which has been shown to increase biomass in plants. We hypothesized that by overproducing AVP1 in microalgae, the consequent increase in the vacuolar proton gradient, and the decrease in inhibitory pyrophosphate, would increase ATP levels and photosynthetic efficiency. Ultimately, this results in an increase in carbon storage molecules. The expression of AVP1 and Sh-ble was driven by native RbcS and TELF promoters/terminators, respectively, and were inserted into the genome via electroporation. Gene integration and expression were confirmed by PCR, sequencing, and RT-PCR. AVP1 overexpression lines were compared to wildtype by growth, light and electron microscopy, biochemical composition, and oxygen evolution. Although we continue to characterize these strains, our preliminary data shows that AVP1 mutants accumulate more carbon storage molecules (carbohydrates and lipids) than the wild type, without significantly affecting growth. These results suggest that AVP1 overexpression can benefit algal biofuel production strains by increasing the overall carbon storage of P. soloecismus.

Poster 11, Acoma Session 2, Sudha Ananthakrishnan

Effect of surface tension on particle size and rheology of nanoemulsions of coenzyme Q10

Coenzyme Q10, also known as CoQ10, ubiquinone or ubidecarenone, is a vitamin-like compound that is a poorly-water soluble compound and is being widely investigated for cancer therapeutics.This anti-cancer agent is naturally present in most eukaryotic cells, predominantly aids in electron transport and proton transfer in mitochondrial respiration. In this work, aqueous submicron emulsions of CoQ10 for pulmonary delivery, were formulated using appropriate non-ionic stabilizer (Tween 80 : Capryol 90) and co-solvent (Triglyceride of coconut oil) followed by high-shear homogenization and studied the effects of particle size (Z-average) ,viscosity on drug concentration. It was observed that, by varying the concentration of surfactant, the interfacial tension between the oil and water varied. Lesser concentrations of surfactant resulted in unstable emulsions and phase separation was seen. These water in oil emulsions were prepared using drug concentrations 0.1%, 0.3%, 0.5% and 95% water. The Z-average values of these emulsions were observed to be ~ 186nm, 293.5nm and 330nm respectively. The viscosity measurements were performed on Discovery Hybrid Rheometer (TA instruments) equipped with cone and plate geometry. The magnitude of shear stress is inversely related to the particle size. The shear stress versus shear rate was estimated to study the rheological behavior of the emulsions. It was noted that the emulsions with lower drug concentrations and increasing concentration of surfactant, the shear rate increased thereby reducing the viscosity of the emulsions. The average viscosity of the emulsions range from ~ 3.5cP to 6.8cP. Hence, in conclusion the particle size reduction was attributed to the resultant surface tension and the shear stress caused upon varying surfactant concentration .

Poster 12, Acoma Session 2, Christian T. Denny

Functionalized Oligo(Poly (Ethylene Glycol) Fumarate) toExamine the Effects of Charge on Valvular Interstitial Cells in 3D Culture

Heart disease accounts for 1 in 7 deaths in the U.S. Aortic stenosis, a type of heart disease, is characterized by calcification of valvular leaflets, leading to increased stiffness and decreased blood flow. The mechanical properties of the aortic valve leaflets are maintained by valvular interstitial cells (VICs) a type of myofibroblast. VICs are crucial to maintaining the extracellular matrix (ECM). VICs are non-fully differentiated cells, and the environmental cues that induce phenotypic changes are not fully understood. Researchers are particularly interested in what signals cause VICs to become osteoblastic-like and produce the calcified nodules that lead to stenosis. We have shown that positive charged 2-D surfaces cause VICs to become osteoblastic-like without the addition of any additional induction factors. We are currently exploring oligo(poly(ethylene glycol) fumarate) (OPF) hydrogels as a model to examine how charge influences VIC phenotype in a 3-D environment. OPF is linear polyester with multiple unsaturated double bonds available for functionalization or covalent crosslinking. Our OPF hydrogels are functionalized with cell adhesive peptides (CGRGDS) and charged functional groups (NH 3 + , COO -) through thiol click chemistry. It was hypothesized that a negatively charge end group would cause encapsulated VICs to become osteoblastic-like and form calcified tissue. Our model is the first to describe how charge affects VICs in a 3D environment. Our work should lead to a disease model for future research applications and provide a more comprehensive understanding of how and why VICs produce calcified tissue in vivo.

Poster Abstracts

Poster 13, Acoma Session 2, Angelea Maestas-Olguin

The endocytotic fate of a mesoporous silica nanoparticle supported lipid bilayer CRISPR delivery vehicle

CRISPR gene editing technology is strategically foreseen to control diseases by correcting underlying aberrant genetic sequences. In order to overcome drawbacks associated with AAV-CRISPR, the establishment of an effective non-viral CRISPR delivery vehicle has become a primary goal for nanomaterial scientists. Herein, we introduce the first monosized lipid-coated mesoporous silica nanoparticle (LC-MSN) delivery vehicle that enables loading of CRISPR components (11% wt RNP) with efficient release within cancer cells (~70%). With a low toxicity and a clathrin-mediated endocytotic internalization pathway, the gene editing efficiency in a reporter cell line was up to 10% using ribonucleoprotein (RNP) complex (Cas9/gRNA) and a CRISPR plasmid. The structural and chemical versatility of the silica core and the lipid coat along with their biocompatibility make the LC-MSN a promising vector towards safe CRISPR components delivery and enhanced gene editing.

Poster 14, Acoma Session 3, Shiva Sharma

Depressive Symptoms among Elderly Rural New Mexico Uranium Workers

Introduction: Due to occupational exposures, rural communities of uranium workers (miners, millers, and ore-transporters) are at risk of developing cardiopulmonary disease. Dawson & Madsen found uranium workers of Navajo descent were at risk for depression. This study seeks to evaluate the association between host characteristics and depressive symptoms (anhedonia and depressed mood) among current and former uranium workers screened by the New Mexico Radiation Exposure Screening & Education Program (RESEP) from 1998 to 2017.
Methods: In this cross-sectional study, uranium workers with valid spirometry results, race/ethnicity and gender data at baseline evaluation were identified in the RESEP database. Anhedonia and depressed mood was assessed via administration of the modified Patient Health Questionnaire-2 (PHQ-2). Wilcoxon Rank-Sum and Kruskal-Wallis tests were used to evaluate the association between depressive symptoms and indices of pulmonary function. Chi-Square and Fisher's Exact tests were used to evaluate the association between demographic variables and depressive symptoms. Frequencies, percentages, means, and standard deviations in a univariate analysis are reported.
Results: Of the 554 uranium workers, 529 (95.5%) were men, 201 (36.3%) were American Indian, 181 (32.7%) were non-Hispanic White, and 169 (30.5%) were Hispanic, with mean age of 68.5 ± 8.1 years; and mean BMI of 29.4 ± 5.5 kg/m2. 7.2% of workers reported depressed mood and 3.7% reported anhedonia. 13.0% of Hispanics endorsed depressed mood, which was significantly higher than that reported by American Indians (6.5%) or non-Hispanic Whites (3.3%; overall p=0.002). There was no association between race/ethnicity and anhedonia. Percent predicted forced vital capacity (FVC) was significantly lower among workers reporting anhedonia (81.3 ± 17.9 %) than those who did not (90.4 ± 18.6%, P = 0.04). Percent predicted FVC was not associated with depressed mood. No significant associations were noted between depressive symptoms and age, BMI, percent predicted forced expiratory volume (FEV1), or absolute values for FEV1, FVC, or FEV1/FVC ratio.

Poster 15, Acoma Session 3, Ray deKay

Improving Hospital Satisfaction: An Integrative Approach

Introduction: Managing hospital noise is a nationwide challenge. Historically, noise has been the number one patient complaint according to Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) surveys. UNMH scores have an overall average rating of 48% satisfaction (from a 0-10 scale) compared to the nationwide average rating of 62%. Patients suffer from poor sleep due to shared rooms, loud machines, and busy hallways. Using an integrative team approach, this quality improvement project aims to improve patient satisfaction through a protocol that: (1) provides patients with comfort packages including, but not limited to, eye shades, earplugs, and magazines; (2) encourages staff to lower voices; (3) implements checklists reminding providers to review orders for unnecessary night-time interruptions; and (4) when feasible, move patients to an area of the floor that is known to be quieter. Progress was monitored through short surveys, inspired by Press Ganey, that were administered prior to discharge.
Methods: A team-based protocol was implemented using the Plan-Do-Study-Act (PDSA) method which was composed of the following PDSA cycles: PDSA #1: Provided each patient with earplugs, an eye mask, and a variety of other comfort items including magazines and an extra blanket. PDSA #2: When feasible, transitioned patients to the south end of the floor, which is typically quieter by ten-to-fifteen decibels. PDSA #3: Posted reminders on lowering voices along with a noise monitoring sign at the nursing station as an intervention for behavior change. PDSA #4: Implemented provider checklists to safeguard against unnecessary routine morning labs and excessive overnight vitals checks. PDSA #5: Posted provider work-room reminders to consider providing PRN pain and cough medications while routinely asking the patient about his/her needs.

Poster Abstracts

Poster 16, Acoma Session 3, Ben Matheson

Pretty Gross: Beauty Tools Aren't Only Biocompatible for the Human Face

The cosmetics industry consists of a multitude of products developed and sold as a way to enhance the appearance or odor of the human body. Among these products, Beauty Blender™ and similar sponges have quickly become the go-to tool designed to apply cosmetics onto the face in a way that evenly distributes the perfect amount into the skin. In 2017, sales of these sponges in the USA alone equated to $445B USD, and sales are expected to rise to $605B/year by 2023. Manufacturers recommend that these sponges be cleaned prior to each use and be replaced every 1-3 months. However, many users are relatively reluctant to do so, due to their high cost ($20/sponge). Such practices will impact the hygiene of the sponge, and, potentially, the user. In this work, we evaluate how the surface properties of various makeup blending sponges correlate with their utility and propensity to harbor unwanted bacteria and other microbes. Using a variety of surface analysis tools including X-ray photoelectron spectroscopy (XPS) and scanning electron microscopy (SEM), the surface chemistry and porosity of different commercially available sponges were evaluated. In addition, the relative hospitality of the sponges to harbor and grow bacteria such as Escherichia coli was evaluated through bacterial culturing and Gram-staining techniques. Preliminary results indicate that these sponges, which are primarily poly(urethane)-based, support the invasion and growth of bacteria, as well as other microbes such as fungi, within days of environmental exposure. These results are the first to attempt to quantify the extent of the issues surrounding inadequate sponge hygiene, and the benefits of developing antimicrobial implements for these sponges.

Poster 17, Fiesta Session 1, William Vining

How mobility helps distributed systems compute

Brains are composed of connected neurons that compute by transmitting signals. The neurons are generally fixed in space, but the communication patterns that enable information processing change rapidly. In contrast, other biological systems, such as ant colonies, bacterial colonies, slime molds and immune systems, process information using agents that communicate locally while moving through physical space. We refer to systems in which agents are strongly connected and immobile as solid, and to systems in which agents are not hardwired to each other and can move freely as liquid. We ask how collective computation depends on agent movement. A liquid cellular automaton (LCA) demonstrates the effect of movement and communication locality on consensus problems. While solid brains allow complex network structures to move information over long distances, mobility provides an alternative way for agents to transport information when long-range connectivity is expensive or infeasible. Our results show how simple mobile agents solve global information processing tasks more effectively than similar systems that are stationary.

Poster 18, Fiesta Session 1, Manish Bhattarai

End-to-End Deep Learning Systems for Scene Understanding, Path Planning and Navigation in Fire Fighter Teams

Firefighting is a dynamic activity with many operations occurring simultaneously. Maintaining situational awareness, defined as knowledge of current conditions and activities at the scene, are critical to accurate decision making. Firefighters often carry various sensors in their personal equipment, namely thermal cameras, gas sensors, and microphones. Improved data processing techniques can mine this data more effectively and be used to improve situational awareness at all times thereby improving real-time decision making and minimizing errors in judgment induced by environmental conditions and anxiety levels. This objective of this research employs state of the art Machine Learning (ML) techniques to create an automated system that is capable of real-time object detection and recognition utilizing currently gathered data to achieve improved situational awareness of firefighters on the scene. The algorithms authored effectively exploit the information gathered from the infrared camera by using a trained deep Convolutional Neural Network (CNN) system to identify, classify and track objects of interest. Crucial information is identified and relayed back to firefighters to assist their decision making processes and aid in safely navigating the environment. The ANN-based algorithm we are authoring is sufficient to infer human recognition and posture detection to deduce a victim's health level to assist in prioritizing victims by need and guide firefighters accordingly. We also employ deep-learning based systems path planning and navigation, path reconstruction, scene segmentation, estimation of firefighter condition, Natural Language Processing for informing firefighter about the scene. We will integrate our search and rescue system with the image recognition system to produce a new search and rescue method that adapts to the changing environment by using Deep Q-learning.

Poster Abstracts

Poster 19, Fiesta Session 1, Pavlos Athanasios Apostolopoulos

Demand Response Management in Smart Grid Networks: a Two-Stage Game-Theoretic Learning-Based Approach

In this paper, the combined problem of power company selection and demand response management (DRM) in a smart grid network consisting of multiple power companies and multiple customers is studied via adopting a reinforcement learning and game-theoretic technique. Each power company is characterized by its reputation and competitiveness. The customers, acting as learning automata select the most appropriate power company to be served, in terms of price and electricity needs' fulfillment, via a reinforcement learning based mechanism. Given customers' power company selection, the DRM problem is formulated as a two-stage game theoretic optimization framework. At the first stage the optimal customers' electricity consumption is determined and at the second stage, the optimal power companies' pricing is obtained. The output of the DRM problem feeds the learning system to build knowledge and to conclude to the optimal power company selection. To realize the aforementioned framework a two-stage Power Company learning selection and Demand Response Management (PC-DRM) iterative algorithm is introduced. The performance evaluation of the proposed approach is achieved via modeling and simulation and its superiority against other approaches is illustrated.

Poster 20, Fiesta Session 1, Georgios Fragkos

ESCAPE: Evacuation Strategy through Clustering and Autonomous Operation in Public Safety Systems

Natural disasters and terrorist attacks pose a significant threat to human society, and have stressed an urgent need for the development of comprehensive and efficient evacuation strategies. In this paper, a novel evacuation-planning mechanism is introduced to support the distributed and autonomous evacuation process within the operation of a public safety system, where the evacuees exploit the capabilities of the proposed ESCAPE service, towards making the most beneficial actions for themselves. The ESCAPE service was developed based on the principles of reinforcement learning and game theory, and is executed at two decision-making layers. Initially, evacuees are modeled as stochastic learning automata that select an evacuation route that they want to go based on its physical characteristics and past decisions during the current evacuation. Consequently, a cluster of evacuees is created per evacuation route, and the evacuees decide if they will finally evacuate through the specific evacuation route at the current time slot or not. The evacuees' competitive behavior is modeled as a non-co-operative minority game per each specific evacuation route. A distributed and low-complexity evacuation-planning algorithm (i.e., ESCAPE) is introduced to implement both the aforementioned evacuee decision-making layers. Finally, the proposed framework is evaluated through modeling and simulation under several scenarios, and its superiority and benefits are revealed and demonstrated.

Poster 21, Fiesta Session 1, Wenjing Shi

Dynamic Group Interactions in Collaborative Learning Videos

We introduce a new method to detect student group interactions in collaborative learning videos. We consider the following video activities: (i) human to human, (ii) human to others, and (iii) lack of any interaction. The system uses multidimensional AM-FM methods to detect student faces, hair, and then use the results to detect possible interactions. We use dynamic graphs to represent group interactions within each video.We tested our methods with 15 videos and achieved an 84% accuracy for students facing the camera and 76% for students facing both towards and away from the camera.

Poster 22, Fiesta Session 1, Luis Sanchez Tapia

FIR Filter Design using Simulate Annealing Stochastic Optimization for fixed-point Implementation in FPGA

The current paper explore stochastic methods from optimization theory to enhance the process of designing a complex band-pass filter. Simulate Annealing allow a versatile procedure to modify the coefficients of the filter to better suit the constraints of a fixed-point implementation in reconfigurable hardware. This objective of reducing the number of bits required to represent coefficients and outputs would lead to decrease hardware requirements at the stages of pre-processing inside larger architectures.

Poster Abstracts

Poster 23, Fiesta Session 2, Carly Anderson

The Implications of IOT

The Internet of Things, what is it and how does it work? The Internet of Things is simply, “the interconnection via the Internet of computing devices embedded in everyday objects enabling them to send and receive data.” As a fairly new concept, coined by Kevin Ashton in 1999 during a presentation to Proctor & Gamble, the Internet of Things could very well be the next step in our growth as a society. Further development has the potential to lead to successful implementation within smart city technology, renewable resources, robotic technology, and accessibility regarding daily conveniences. However, as with every new innovative development, we must also consider the potential consequences. Could this new innovation pose a potential national security threat? How would the government regulate something still so unfamiliar? And what about the promise of personal privacy? What is the ratio of privacy to convenience? Through the process of creative innovation and the sudden acceleration of technological advancement, we suddenly find ourselves facing a future where our daily lives depend on the use and implementation of technology linked by the Internet. Over the past few decades, we have grown as a society by embracing positive and innovative developments. The Internet of Things is the next exciting step in our evolution towards establishing the basis of our future relationship with advances in technology and what that means for our way of life.

Poster 24, Fiesta Session 2, Jon Golla

Natural Trace Metal Salinization of the Jemez River by Valles Caldera Geofluids

The Jemez River (JR), a tributary of the Rio Grande, is in north-central New Mexico within the Jemez Mountains, which houses the active, high-temperature (≤ 300 deg. C), liquid-dominated Valles Caldera geothermal system (VC). This work focuses on the northern portion of the JR, spanning a reach from the East Fork JR to the town of San Ysidro. Previous decadal work during low-flow or baseflow conditions (~10-20 cfs) has identified and characterized significant major-solute contributions from two outflow expressions of the VC, Soda Dam Springs and Jemez Hot Springs, and two major tributaries, Rio San Antonio and Rio Guadalupe. There is generally a net ~500-ppm increase from below Soda Dam to the end of the 50-km study segment. Among twenty-four trace metals measured via ICP-MS, ~60% show behavior similar to that of major solutes, which is defined by an increase in concentrations at each inflow with the greatest contribution (as much as an order of magnitude) at Soda Dam. The rest of the suite is characterized by more complex patterns that may be a result of non-conservative processes, such as precipitation/dissolution and complexation. We attempt to resolve these potential in-stream processes with geochemical speciation modelling and high-resolution (regular 1-km spacing with interspersed 50-m intervals around sites with complete chemistry) spatial surveys of temperature, dissolved oxygen, pH, oxidation-reduction potential, and turbidity.

Poster 25, Fiesta Session 2, Sean O'Neill

Albuquerque’s Impacts on the Rio Grande

Water from the Rio Grande supports hundreds of miles of riparian forest, abundant and diverse fauna, and thousands of individuals throughout the watershed. Anthropogenic influences can lead to highly impacted river systems, particularly through dense urban areas. For this study, students from four different high schools participated in water quality data collection (over 360hours of field time) with the Bosque Ecosystem Monitoring Program to examine how the river changes as it flows downstream through Albuquerque. The Bosque Ecosystem Monitoring Program (BEMP) is a long term ecological research organization involving K-12 students, their teachers, and University students as citizen scientists monitoring key indicators of the local bosque ecosystem along the Rio Grande. With the support of the Middle Rio Grande Storm water Quality Team, BEMP and participating students sampled the Rio Grande at five locations every month from January 2017through September 2018 (sampling is ongoing). Additional sampling during three qualifying storm events was also incorporated into this study in order to capture the influence of the North Diversion Channel, which drains runoff from east Albuquerque. Parameters tested were pH, dissolved oxygen, turbidity, conductivity, and E.coli. In February2018, additional samples were taken for analysis of pharmaceuticals and personal care products (PPCPs) both above and below the outflow of the Southside Water Reclamation Plant(SWRP). More compounds were detected below the SWRP than during previous years with a77% increase in total detections. Levels of E.coli tend to increase as the river flows through Albuquerque. Runoff from the three storm events had a (significant) impact on the water quality immediately south of the North Diversion Channel outflow.

Poster Abstracts

Poster 26, Fiesta Session 2, Erin D. Maestas

Using Computational Modeling for Dynamic Group & Subgroup Formation on Social Media

The technical work completed was to process theories of how groups form dynamically on social media in response to news events. I combine social networking analysis with information systems analysis, text mining analytics, and conceptual blending analysis to model: (a) the subgroups that form based on recurring events on social media; (b) the information shared between subgroups; (c) the cognitive residue of this information sharing; and (d) how this cognitive residue affects the formation of future groups and subgroups. I performed an analytic ethnography of a case where groups formed on social media in response to incomplete news of an incident. The groups framed the incident in terms of existing narratives and called for action against those actors they perceived as the aggressors. Later, footage showed this framing to be inaccurate. Based on the analytic ethnography, I pro-pose a computational model of how groups form in response to incomplete or inaccurate reports on social media. This work differs from traditional social network analysis (SNA) applied to social media, which is content agnostic and focuses mainly on actors and direction of communication. This research will contribute to our understanding of how event, social, and cognitive factors from past group formation affects future group formation.

Poster 27, Fiesta Session 2, Torin Hovander

Authoritarianism 2.0

ABSTRACT

China's current intranet structure with a focus on the Great Firewall.
Project the implications of China's developing Social Credit System.
Project the export of these technologies to other authoritarian regimes.

INTRODUCTION

The People's Republic of China is investing heavily in technology that ensures state security. These technologies are designed to censor information, monitor and quantify the loyalty of citizens, and commit espionage abroad. China has expressed interest in exporting these technologies to other authoritarian regimes. The People's Republic of China is developing technology that will fundamentally enhance the capability of authoritarian regime to control information and assess the loyalty of citizens through social credit scores.

Main Points

- China's regime stability and the role of technology in state security.
- Continued decline in global internet freedom
- Strengthened authoritarian regimes

Poster 28, Fiesta Session 2, Arnab Ghosh

Pore size and structure effects on Pt sintering at 800° C in air

Metal nanoparticle growth is one of the main causes for catalyst deactivation. The USDRIVE Low Temperature Oxidation Catalyst Test Protocol recommends an accelerated aging temperature of 800^{o}C for Diesel Oxidation Catalysts (DOCs). At 800^{o}C in the presence of oxygen platinum forms volatile Platinum oxide (PtO_2) with significant vapor pressure, which is responsible for vapor phase ripening. Previous studies by Carrillo et. al [3] showed that adding Palladium (Pd) improves the durability of DOCs, also work done by Plessow et. al showed that silica has negligible binding to PtO_2 so it is a good candidate to study vapor phase transport processes.

In this work, we studied three different supports, Davisil silica (open pore structure, 15 nm average pore diameter), MCM-41 (Mobil Composition of Matter No. 41) and SBA-15 (Santa Barbara Amorphous-15) (one dimensional pore structure, 3 nm and 6 nm pore diameter). Our goal was to understand the differences between an open pore structure and a well-ordered network of pores, on the emission of PtO_2 vapor and the final particle size in a catalyst. By aging each powder sample at 800^{o}C for 5 hrs, we were able to investigate the role of pore structure on the rate of emission of PtO_2 as well as the performance of these Pt catalysts in probe reactions such as CO oxidation.

Poster Abstracts

Poster 29, Santa Ana Session 1, Andrea Schmidt

Breaking the Universal Speed Limit: Faster-than-Light Polarization Currents and Their Applications

A source that moves through a homogeneous medium emits focused waves if its speed exceeds that of the induced waves themselves. Hence, a ship that glides across the sea faster than the wave propagation speed gives rise to directed surface waves. Similarly, an aircraft in supersonic flight sends a “boom” to the ground, a powerful pulse created by the merging of pressure waves. These phenomena have been studied extensively in hydrodynamics and acoustics; yet, the same cannot be said for electrodynamics, where the publication of Einstein’s special theory of relativity and the inception of c – the speed of light in vacuo – as "universal speed limit" put an abrupt end to early research. However, while massive particles are precluded from surpassing c, patterns of electric charges and currents may travel arbitrarily fast and break the “light barrier” with ease. Recent experiments have shown that polarization currents, accelerated to superluminal speeds within a dielectric, emit tightly focused packets of electromagnetic radiation similar in nature to their hydro- and aerodynamic counterparts. Prototype antennas that employ extended distributions of polarization currents moving faster than light have already demonstrated advantages over conventional technologies in communications and radar technologies. The present talk will focus on two novel applications: a secure communications scheme in which the signal is only comprehensible at a certain point (“spatial encryption”) and superluminal Very Low Frequency (VLF) antennas, where radio waves circumnavigate the globe due to reflection from the ionosphere and penetrate salt water to considerable depth in order to reach submarines.

Poster 30, Santa Ana Session 1, Stephen Sanders

Plasmon-enhanced quadrupolar transitions with nanostructured graphene

Many important molecules have quadrupolar excitations which occur at much slower rates than the competing dipolar transitions and hence are termed forbidden. In this work, we propose a new approach to enhance quadrupolar transitions using graphene nanostructures. We provide a detailed investigation of the enhanced transition rate in the vicinity of graphene nanoislands and use rigorous computational methods to analyze how this quantity changes with the geometrical and material parameters of the nanoisland. To support these calculations we also provide a semi-analytic approach. Finally, we investigate the performance of arrays of graphene nanoribbons, which constitutes a suitable platform for the experimental verification of our predictions. This work opens new possibilities for the enhancement and control of quadrupolar transitions of molecules and can find application in the detection of relevant chemical species.

Poster 31, Santa Ana Session 1, Paul Gieri

Plasmonic Resonances in Metallic Film-Nanorod Systems

Understanding how the plasmonic response of metallic nanoparticles is modified by the interaction with metallic substrates is of paramount importance, due to the large potential of these systems for applications in biosensing, solar energy harvesting, and photochemistry. Here, we investigate the optical response of gold nanorods both in direct contact and dielectrically separated from a metallic substrate. We show that, for direct contact the response is dominated by a charge transfer resonance, while for small separations gap modes dominate the optical response of the system. The properties of these modes are largely dependent on the morphology of the contact area/gap, making these modes far less sensitive to the nanoparticle size and aspect ratio than the typical dipolar plasmon modes.

Poster 32, Santa Ana Session 1, Cayla Nelson

Mechanical Testing and Modeling of Silver/Carbon Nanotube Metal Matrix Composites to Increase Resilience of Contacts on Solar Cells

We are investigating the use of carbon nanotubes as a reinforcement in metal matrix composites (MMC) to enhance the mechanical resilience of photovoltaic cells. Finite element modeling is used to relate the microstructure of a silver/CNT thin film matrix to its mechanical properties. The FEM models are compared to mechanical data taken by dynamic mechanical analysis (DMA). The composites are fabricated in a layer-by-layer structure: the silver layer is evaporated followed by spray coating of carbon nanotubes in a dog bone structure that can be removed from the substrate as a free-standing film for testing. Fitting the model to DMA data gives qualitative trends of how mechanical properties of the MMC change with CNT volume fraction. Combining mechanical modeling with experimental results, allows for a broad evaluation of CNT reinforced metal matrix composites.

Poster Abstracts

Poster 33, Santa Ana Session 1, Kasun Fernando

The physical origin of defect and transport for perovskite single crystals

Current day in the fields of national security and medical imaging and treatment, radiation detectors with high sensitivity become a “must-have” equipment's. Solid state radiation detector utilizes semiconducting material to convert radiation signal directly into electrical signal offers various advantages in sensitivity, energy and spatial resolution that greatly reduces the radiation dosage level needed for high quality signals. It thus resolves the issue raise by the concerns of health side effect introduced by high dosage of radiation exposure during the treatment. However, the high cost associated to the fabrication and operation still greatly limit their wide use. Hybrid perovskite materials are single crystalline semiconductor produced from solution, which has overtaken most of classical semiconductor technologies existed in the field of opto-electronics by showing high photo conversion efficiencies and stabilities. This is attributed to their superior transport properties. Additionally, containing a heavy compound such as Pb in side the crystal made such crystal to become a good candidate in detecting X rays and Gamma rays.

In my project, I aim to find out how to characterize their electronic properties such as charge transport and trapping process, to guide the material and device design for detector with high sensitivity and energy resolutions. I examined the charge transport and trapper mechanisms on hybrid perovskite single crystals by dark and photo-conductivity characteristics. I therefore fabricated as a gamma ray detector with perovskite crystals incorporated with various dopants. Also comparing the dark current and under illumination that would give a better idea about the possible defects and ways to overcome them.

Poster 34, Santa Ana Session 1, Cameron Harjes

Insulator Technologies to Achieve Maximum Electric Field Holdoff

In large machines, such as accelerators and high power microwave systems, it is common to implement pulsed power technology. Pulsed power attempts to deliver large amounts of power in a short amount of time. This is done by generating high voltage and delivering that energy to the desired load quickly through switches. To ensure that the energy is delivered to the desired load it is necessary to use insulators to separate high voltage from ground. The insulators function is crucial in the success or failure of the system and because of this, much research has been done in the materials, geometries, and sizes of insulators. A common mean of failure for these insulators is surface flashover. Surface flashover occurs when the electric field becomes strong enough to accelerate electrons along the surface of the insulator to a point where an arc is created between high voltage and ground. The machine is therefore limited to the amount of voltage it can produce and the amount of power it can deliver. By making modifications to the insulator, improvements in electric field holdoff has been documented. This paper attempts to analyze the different methods used to increase the electric field holdoff to improve the function of the system.

Poster 35, Santa Ana Session 2, Brian Douglas Rummel

Characterization and Imaging of Surface Acoustic Waves on GaAs with Raman Spectroscopy

Surface acoustic wave (SAW) devices are commonly found in sensors, resonators, and RF filters, and utilizing a facile technique to image the transmitted signal would prove useful in characterizing device operation and optimization. We show how Raman spectroscopy can offer analytical insight into the mechanical strain imposed by SAWs traveling along the surface of various III-V substrates. SAWs are generated using a single port interdigital transducer (IDT) design, modified to produce free surface standing waves. These standing waves provide a means to differentiate between nodes and antinodes of the acoustic wave. The temporal period of the SAWs does not easily allow in-situ, real-time measurement of the waves; however, a broadening of the Raman peaks corresponds to an averaging of the peak shifts over the integration time of the spectrometer. An analytical fitting model has been derived to effectively calculate the maximum strain induced by the acoustic waves, thus allowing one to characterize the SAWs. IDTs were deposited onto a GaAs (110) substrate to study the potential of Raman analysis for SAW devices. Wavelengths ranging from 3.2 µm to 10 µm were used to study insertion loss, attenuation, diffraction parameters, and the mechanical coupling coefficient. Future applications of this technique to probe growth defects in ScAlN/Si substrates will also be discussed.

Poster Abstracts

Poster 36, Santa Ana Session 2, Christopher Buksa

Mechanical Characterization of Polycaprolactone (PCL)/Polypropylene Fumarate (PPF) Composite Scaffolds for Bone-Ligament Enthesis Tissue Engineering

Scapholunate ligament injury is one of the most common wrist injuries resulting from falling on an outstretched hand. In the case of complete rupture, treatment techniques requiring an autograft often fail to integrate and result in donor site morbidity. 3D bioprinting is a viable additive manufacturing technique for patient specific, tissue reconstruction. However, current biomaterials do not possess the mechanical properties necessary for fabrication of interfacial tissues with distinct mechanical properties. Near-field electrospinning (NFE), a modification to standard electrospinning, allows for fiber alignment that has been shown to resist higher tensile loads. This technique paired with current liquid extrusion-based bioprinting, has allowed us to create composite scaffolds to mimic the native tissue of choice. Using a hybrid system consisting of both liquid extrusion-based bioprinting along with NFE, we have fabricated composite scaffolds with an alternating pattern to mimic the graded enthesis region. We are extruding polypropylene fumarate (PPF) for the bone phase and NFE polycaprolactone (PCL) ligament-like fibers. Mechanical characterization showed an average tensile yield strength of 8.33 +/- 3.45 MPa for the composite, which is close to the reported 8.2 MPa bulk PCL strength (1). Failure consisted of rupture in the ligament region with necking present at the PCL-PPF interface, indicating sufficient fiber integration with the bone phase. Mechanical testing has validated the sufficiency of the PPF/PCL interface, but suggests the need to introduce material modifications to the PCL to further increase the resistance to tensile loads as the native scapholunate tendon has a tensile strength of 25 Mpa.

Poster 37, Santa Ana Session 2, Christian A. Pattyn

Shape Memory Effect (SME) in Epoxy-Based Polymers; Synthesis and Dynamic Mechanical Analysis

This project represents a part of the recent major efforts to correlate the shape memory effects (SME) in polymers. Specifically, the relationships between the glass transition temperature, the storage modulus in the glassy and rubbery states, as well as the tangent delta values are critical in further advancing the role of SMEs in self-healing. Although these quantities are known to be pertinent to shape memory performance, it is critical to gain fundamental understanding how the maximum strain, stress and entropic energy can be utilized in predicting SMEs and correlate to self-healing properties.

Poster 38, Santa Ana Session 2, Bokyung Park

Examination of light scattering properties on the bio-inspired polyethylene fibrous film

The structure that is inspired by nature, such as white beetle scales, shows outstanding light scattering properties from fiber-like random biopolymer network. Although significant advances have been made in understanding of light scattering in random media, it still has limitations for perfectly mimicking nature's performance. However, simply replicating the real-space geometry of the nature which is complicatedly random is difficult. Therefore, we will approach differently not just to imitate their random structure but to imitate different biomimicking properties. When the bio-inspired structure has a similar factor with biological structure, bio-inspired structures that are different from the nature can exhibit similar light scattering properties. Surpassing the light-scattering limit of the biological structures would be a definitive possibility. In this study, we fabricate random electrospun fibrous film with polyethylene(PE) that reproduces the nature's optical properties. Our tests will examine the photon transport mean fee path and the relationship between the structure and light scattering properties in the electrospun PE film.

Poster Abstracts

Poster 39, Santa Ana Session 2, Adan Myers y Gutierrez

Continuous Chemical Kinetic Reaction Model for DNA Strand Displacement and DNAzyme Assay

Toehold-mediated strand displacement (TMSD) and catalytic DNA (DNAzymes) are DNA nanotechnology techniques that show promise in molecular computation, molecular assays, theranostics, and a myriad of other potential applications. Implementations of these applications use systems of reactions based on DNAzymes and TMSD. These reaction systems, sometimes known as cascades or circuits, are aqueous solution-based interactions of few or many oligonucleotide molecules. Systems tend to have an input and an output which can be used for sensing and report in an assay system. While there have been many implementations of systems based on TMSD and DNAzymes, there has only been limited characterization of the kinetics of the systems. This work seeks to build a fuller kinetic model for a particular assay implementation, the unified sensor architecture used in a Dengue detection assay implementation. Using KinTek Global Kinetic Explorer (KinTek Corporation, Snoe Shoe, PA) for modelling, we have formulated a multistep reaction model that incorporates 11 reaction steps (reversible and irreversible) and 15 reactant species. The model contains molecules that interact through TMSD and catalytic reactions between enzyme and substrate. Global fitting of multiple concentrations of enzyme-substrate reaction show derived rate constants commensurate with existing literature. Full reaction model incorporates the enzyme-substrate reaction model and through global fitting and constraint analysis a model that is reasonable and consistent has been developed. Kinetic rate constants are consistent with literature where available. The development of this model has provided a tool that can be used for development of future DNA reaction systems for assays.

Poster 40, Santa Ana Session 2, Madalyn Wilson-Fetrow

Functional Supported Diblock Copolymer Microspheres for Use in Flow Cytometry

Biologically-inspired microsphere-based systems are commonly used as platforms to study processes of interest through flow cytometry. Supported lipid bilayers are the most widespread of these systems. However, supported lipid bilayers have several limitations. Here we present supported diblock-copolymer layers (SDC) on solid silica microspheres which show increased versatility, stability, and adaptability over lipid systems. Solid 10µm silica microspheres form the base for the system. The polymer used, methoxy poly(ethylene glycol)-b-poly(caprolactone) (mPEG-PCL), was be driven into bilayers centered on solid silica microspheres through the hydrophobic effect of the poly(caprolactone) block, much like the self-assembly of lipid bilayers. Microspheres were visualized through flow cytometry and fluorescence microscopy. Coverage of solid silica microspheres by diblock-copolymer layers was shown through confocal microscopy and demonstrated to be stable over time through flow cytometry monitoring of a hydrophobic dye in the layer. We will show successful incorporation of Cholesterol-functionalized and fluorescently-tagged DNA and increased stability over time. Strand-displacement reactions between solution-phase DNA and DNA confined to the surface demonstrates the continued functionality of the Cholesterol- DNA after incorporation into the SDC. We will also show the incorporation of a biotinalated custom-molecule allowing for molecular attachments using the streptavidin-biotin bond. Here we report a diblock-copolymer-based alternative to supported lipid bilayers for assays which require stable and fluid layers. This system shows promising solutions to some of the shortcomings of supported lipid membranes. This system can be adapted to a wide range of molecules of interest and hydrophilic support surfaces for a greater range of reaction possibilities.

Poster 41, Santa Ana Session 3, O. Liota Weinbaum

Dismantling dogma by modeling mastitis: Assessing the impact of asymptomatic infections

Despite widespread compliance with control recommendations, chronic infectious disease remains problematic in animal agriculture. Efforts to disrupt transmission target individuals with symptomatic infections, but disease continues to persist at the population level. Staphylococcus aureus mastitis in dairy cows is a painful inflammation of the udder that reduces milk volume and quality. The only currently accepted transmission mechanism is contact between the milk of symptomatic cows and the udders of unexposed cows via milking equipment. Could a practice of milking visibly inflamed cows last, known as the Milk Last Intervention (MLI), delay or reduce the epidemic peak significantly compared to an unordered herd milking sequence? What role could asymptomatic infectious cows play in maintaining the disease in a herd? We developed a mathematical model parameterized from the literature as well as from USDA industry surveys. To model transmission at the herd level, we used a compartmental framework that classifies cows according to infection status. The model is implemented in a stochastic framework with discrete time steps. Our simulation suggests that MLI is not effective because infectious asymptomatic cows are milked in any order in regards to susceptible cows. This study addresses how chronic infectious disease persists in herds by assessing the contribution of a previously unconsidered transmission mechanism. This broader understanding of S. aureus infection is urgently needed to inspire new non-pharmaceutical interventions, as antibiotic resistant strains like MRSA begin to confound our traditional attempts at control.

Poster Abstracts

Poster 42, Santa Ana Session 3, Darnell Cuylear

Design and Characterization of “Smart” Hydrogels for Colonoscopy Preparation

Colorectal cancer (CRC) is the second leading cause of cancer-related deaths in the United States. The most reliable screening method of CRC is a colonoscopy, which requires a 4-liter poly(ethylene glycol)-electrolyte lavage solution (PEG-ELS) for preparation. ~34% of all patients who obtain the procedure reported moderate to significant discomfort in association to the preparation. A small percentage of patients (particularly women) experience more severe side effects: including dehydration and reversible kidney failure. PEG has been recognized as a biocompatible polymer since 1950s, but no studies have fully examined the short-term and long-term effects of low and high concentrations of PEG in vitro. In this work, we examined the cytotoxicity of this PEG formulation toward cells within the human gastrointestinal tract in vitro. Using cell morphology, LIVE/Dead and XTT assays, we found that cell viability is altered with direct exposure to PEG at current dosage with increasing cytotoxic effects at higher dosages. Therefore, to prevent over-dosage of PEG, and to improve its palatability for patients, we developed a novel hydrogel system to form a stable hydrogel from the PEG-3350. Using 1H NMR, we confirmed that while the PEG complex is stable at the pH of most liquids, it rapidly releases its cargo at stomach pH=1-3. In addition, the PEG complex can release its contents into simulation fasted gastric fluid. These preliminary results show great promise for the creation of a new, more form of colonoscopy prep that could increase the numbers of people undergoing this life-saving screening method.

Poster 43, Santa Ana Session 3, Reza Pirayeshshirazinezhad

A novel approach toward controlling optimally the attitude of a Two-CubeSat Virtual Telescope

"The Virtual Telescope for X-ray Observations mission, VTXO, uses an innovative design based on diffractive optics with a Phased Fresnel Lens (PFL). The telescope elements (lens and camera) will be separately located on two small satellites, flying in precision formation, to accommodate the required focal length (100 m) of the system. High resolutions of the images require the satellites to be in sub-arc second angular precision formation for the period they observe the Crab Nebula, i.e., 1 hour. In this paper, attitude control is exploited based on the quaternion model including all the noises in the system. Unknown initial conditions and noise in the dynamical system lead to different errors and energy consumption values assuming the same controller parameters. This is not acceptable since the spacecraft are power limited, and the goal of the mission is to obtain the least error. As a result, there are two objective functions to minimize, i.e., the energy consumption and the error. A heuristic optimization method, simulated annealing optimization algorithm, is used to find the controllers’ optimal parameters in the development phase, and multi-objective genetic algorithm in used in the scientific phase. The initial conditions are not known in the development phase. Similarly, different RMS errors to total energy consumption are desired for each mission. Consequently, the authors used a neural network to estimate the optimal controllers’ parameters based on the initial quaternion, initial velocity, different RMS errors, and energy consumption."

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