WELCOMES YOU

TO THE EIGHTH ANNUAL

TEXAS STEM CONFERENCE

Science
Technology
Engineering
Mathematics

OCTOBER 24, 2020
Welcome to Lamar University’s 8th Annual Texas STEM conference. The event is organized by the Office of Undergraduate Research with the goal of inspiring graduate and undergraduate students from all majors to explore their field of interest and engage in research.

This year’s event brings twenty-seven oral presentations which is a record number. Among them fifteen are undergraduate presentations and six are graduate presentations by Lamar students. I congratulate our students for their desire to excel in their academic preparation for a successful personal and professional life. Kudos to both students and faculty for their efforts and results reported today.

For the first time Texas STEM conference welcomes a session of Lamar alumni who present their work as graduate students and postdocs at prestigious universities such as Auburn University, Texas A&M, University of Alabama at Tuscaloosa, and UT San Antonio. We are very proud of your accomplishments and we warmly welcome you back home.

I invite everyone to enjoy the presentations which reflect the intellectual curiosity of our students and the mentorship of our faculty. Enjoy the conference!

Dr. Brenda Nichols
Provost and VPAA at Lamar University
I’d like to welcome all students and faculty to the EIGHTH TEXAS STEM conference. It is a pleasure to be with you this morning. In academia we carry out research for a number of reasons. We begin by being driven by our intense interest in a topic. You may be researching a cure for a disease, while another is interested in resource allocation. We want to add to academic knowledge and to build upon the pool of literature and discoveries available in our field. We are interested in collaboration and we work with others in our field or we work interdisciplinarily. In the O.U.R. program, faculty mentors collaborate with students who are making the most out of their undergraduate experience. Most importantly, we find an innate satisfaction in learning. Lamar University is proud of the outstanding work that you are doing and we are confident in your success in your studies and your career!

Dr. Lynn M. Maurer  
Dean of Arts and Sciences
Dear Students, Colleagues, and Guests,

I welcome everyone to the Eighth Annual Texas STEM Conference. This event offers twenty-seven presentations, including ten graduate projects, fifteen undergraduate projects, one high-school project hosted by Lamar University, and one postdoc project, covering the whole STEM landscape from biology, chemistry, computer science, mathematics, physics and science education, to various engineering fields. Eight undergraduates will present their research done over summer as part of the Summer Undergraduate Research Fellowship (SURF) sponsored by the Office of Undergraduate Research. Five Lamar alumni will share their research efforts done in graduate schools such as Auburn University, Texas A&M, UT San Antonio, and University of Alabama-Tuscaloosa.

We are very proud to welcome our guest speaker, Dr. Benjamin Webb, a Lamar alumnus who graduated with a BS degree in Electrical Engineering in 2009 and received his PhD degree from University of Central Florida, College of Optics and Photonics (CREOL) in 2016. Dr. Webb is now a Laser Scientist in the Laboratory for Laser Energetics at the University of Rochester. His presentation will be about cutting-edge research in the field of high energy laser systems and is a celebration of laser-based technologies.

Daniel Quispe, a mechanical engineering major will give an invited talk about his summer research experience at the Northwestern University, IL, under a REU program, in the group of Professor Jian Cao from the Materials Research Science Center.

Dear Students, today we celebrate your scholarly accomplishments. I would like to thank all of you, students and faculty mentors for generously putting your time and effort in research and creative activities despite the current situation with the COVID-19 outbreak, and all the challenges and frustrations that came during this challenging year.

I want to thank heartily President Kenneth Evans and Provost Brenda Nichols for their continuous and generous support to the Office of Undergraduate Research for pursuing our mission. My special thanks go also to all academic Deans and Chairs for their encouragement to faculty and students to follow the pathway of research and creativity.

Cristian Bahrim, Acting Director of O.U.R.

Welcome to our first virtual Texas STEM conference at Lamar University

Message from O.U.R. Director

Organizing Committee:
Dr. Kendrick Aung
Dr. Robert Kelley Bradley
Dr. Xiangyang Sunny Lei

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Thank you to the OUR Advisory Board members for their contribution to the success of the O.U.R. programs.

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CONTACT US: CHEMISTRY BUILDING, ROOM 115A/B
P: 409-880-8290 Email: cristian.bahrim@lamar.edu
Interim Chair of the Phillip Drayer Department of Electrical Engineering:
“It was my distinct pleasure to see Dr. Webb again and learn about both his impressive career achievements and the cutting-edge research he is currently conducting. The knowledge that one of my best students is an active contributor to the exciting effort of developing the next generation of world’s most powerful lasers gives me the highest satisfaction that an educator can possibly enjoy. I am very proud of Ben’s accomplishments and wish him the best in this most challenging but highly rewarding field of Engineering that he has chosen.”

Benjamin Webb received his BS degree in Electrical Engineering from Lamar University in 2009. He then joined the Laser and Plasma Laboratory in the College of Optics and Photonics (CREOL) at the University of Central Florida, where he completed his MS and PhD in 2011 and 2016. He has since worked at the Laboratory for Laser Energetics (LLE) for 4 years as a research associate and scientist. Dr. Webb’s research has been focused on developing high-power femtosecond laser systems based on chirped-pulse amplification, coherent combination, and other novel techniques. Currently, Dr. Webb is leading a team to complete a 0.5 PW laser system that demonstrates scalable technologies for a proposed record-breaking multi-beam 25 PW laser system.
## SURF STEM Session

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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<tbody>
<tr>
<td>9:00 AM – 9:05 AM</td>
<td>Introduction of the 2020 Summer Undergraduate Research Fellowship</td>
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<td>STEM research: Four Engineering and four Basic Sciences SURF projects.</td>
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<tr>
<td>9:05 AM – 9:16 AM</td>
<td>Cindy Rodriguez – Major in Civil Engineering</td>
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<td>Mentor: Dr. Thinesh Selvaratnam</td>
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<td></td>
<td>Department of Civil Engineering and Environmental Sciences</td>
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<td>Project “Biological Treatment of Produced Water.”</td>
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<td>9:16 AM – 9:29 AM</td>
<td>Cleveland Elijah Keal – Major in Chemical Engineering</td>
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<td>Mentor: Dr. Clayton Jeffryes and Dr. James Henry</td>
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<td>Department Chemical Engineering</td>
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<td>Project “Effect of Copper Nanoparticles on the Digestive Tract.”</td>
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<td>9:29 AM – 9:40 AM</td>
<td>Cindy Rodriguez – Major in Civil Engineering</td>
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<td>Grafton Conger – Major in Mechanical Engineering</td>
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<td>Mentor: Dr. Cristian Bahrim</td>
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<td>Department of Physics</td>
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<td>Project “Evaporation Enhancement System Using Light.”</td>
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<td>9:40 AM – 9:53 AM</td>
<td>Mason Wyche – Major in Civil Engineering</td>
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<td>Mentor: Dr. Thinesh Selvaratnam</td>
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<td>Department of Civil Engineering and Environmental Sciences</td>
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<td>Project “Characterization of Algal-based Extracellular Polymeric Substances.”</td>
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<tr>
<td>9:53 AM – 10:04 AM</td>
<td>Menna Elsaka – Major in Chemistry and Biochemistry</td>
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<td>Mentor: Dr. Ashwini Kucknoor – Department of Biology</td>
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<td></td>
<td>Project “Akkermansia Muciniphila Correlation with Obesity and Metabolic Disorders.”</td>
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10:04 AM – 10:18 AM  
**Olivia Rigsby** – Major in Geology  
Mentor: Dr. Edgardo Pujols  
Department of Earth and Space Sciences  
Project “Onset of the Sevier Fold and Thrust Belt and Associated Foreland-Basin Sedimentation in Central Utah.”

10:18 AM – 10:30 AM  
**Ambriana Sykes** – Major in Chemistry  
Mentor: Dr. Ozge Gunaydin-Sen  
Department of Chemistry and Biochemistry  
Project “Studies of Ammonia Borane-Polyacrylic Acid Composites for Hydrogen Fuel Cells.”

10:30 AM – 10:44 AM  
**Talon Weaver** – Major in Physics and Civil Engineering  
Mentor: Dr. Evgeny Romashets and Dr. Cristian Bahrim  
Department of Physics  
Project “Studying the Dynamics of Interplanetary Magnetic Clouds using a Toroidal Coordinate System.”

### Keynote Speaker

10:45 AM – 10:50 AM  
Introduction of our Guest Speaker  
Dr. Cristian Bahrim, Acting Director of O.U.R.

10:50 AM – 11:40 AM  
**Reflections on Benjamin’s performance while student at Lamar, by the Chair of the Phillip Drayer Department of Electrical Engineering, Dr. Gleb Tcheslavski**  
Keynote speaker – **Dr. Benjamin Webb**  
Laser Scientist / Laboratory for Laser Energetics / University of Rochester / NY.  
Talk about the “Next generation Petawatt Laser Technology.”

**Abstract:** Petawatt lasers enable cutting-edge research in High-Energy Density (HED) science, quantum science with extreme fields, and the generation of relativistic particle beams. A new generation of petawatt lasers are required to reach the 100 PW level. The Laboratory for Laser Energetics (LLE) has developed a 0.5 PW laser system demonstrating key scalable technologies, supporting the amplification of sub-20 femtosecond pulses to kilojoule-level energies in a newly proposed system.

### Undergraduate Invited Talk

11:45 AM – 11:50 PM  
Introduction of our Invited Speaker – Dr. C. Bahrim

11:50 AM – 12:10 PM  
**Daniel Quispe** – Major in Mechanical Engineering  
Daniel will talk about his Research Experience for Undergraduates (R.E.U.) at the Northwestern University Chicago, IL in the area of Material Sciences.  
Mentor: Dr. Jian Cao / Northwestern University / Material Research Science Ctr.  
Title: “The Effects of Yarn Variations on Triaxial Braid Composites Fabrics.”
Breakout Sessions

**Session 1 – Lamar Alumni Graduate Research**

12:15 p.m. – 1:55 p.m.  
Moderators: Dr. Randall Terry / Department of Biology  
Dr. Cristian Bahrim / Department of Physics  
Dr. Chun-Wei Yao / Department of Mechanical Engineering

12:15 p.m. – 12:35 p.m.  
**Dr. Lauren Richardson** – Lamar alumnus in Biology  
Department of Electrical and Computer Engineering, Department of Biomedical Engineering, Texas A&M University, College Station, TX.  
Department of Obstetrics & Gynecology, Division of Maternal-Fetal Medicine & Perinatal Research, The University of Texas Medical Branch at Galveston, TX  
**Title:** *Modeling Ascending Infection with a Feto-Maternal Interface Organ-On-Chip*

12:35 p.m. – 12:55 p.m.  
**Carlo Vanz** – Lamar alumnus in Biology  
Ph.D. candidate in Molecular Immunology & Microbiology Genetics, UT Health San Antonio, TX.  
**Mentor:** Dr. Elizabeth Leadbetter  
**Title:** *T-bet+ B cells exacerbate chronic inflammation and metabolic disorder during obesity*

12:55 p.m. – 1:15 p.m.  
**Azam Nurul** – Lamar alumnus in Electrical Engineering  
Ph.D. candidate in Electrical Engineering and Computer Sciences, Auburn University, AL  
**Mentor:** Dr. Masoud Mahjouri-Samani  
**Title:** *Laser-Assisted Accelerated Synthesis of 2D Quantum Materials.*

1:15 p.m. – 1:35 p.m.  
**Russel Rowe** – Lamar alumnus in Mechanical Engineering  
Graduate student in the Department of Mechanical Engineering, The University of Alabama, Tuscaloosa, AL  
**Mentor:** Dr. Keivan Davami  
**Title:** *Dynamic strain rate comparison of additively and traditionally manufactured nickel-based superalloys*  
**Co-authors:** Michael Munther and Noah Holtham  
Department of Mechanical Engineering, The University of Alabama, Tuscaloosa

1:35 p.m. – 1:55 p.m.  
**Noah Holtham** – Lamar alumnus in Mechanical Engineering  
Graduate student in the Department of Mechanical Engineering, The University of Alabama, Tuscaloosa, AL  
**Mentor:** Dr. Keivan Davami  
**Title:** *Investigating the Strengthening Effects of Laser Peening on Nickel-based Superalloys*  
**Co-authors:** Michael Munther and Russel Rowe
<table>
<thead>
<tr>
<th>Time</th>
<th>Presentation</th>
</tr>
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| 2:00 p.m. – 2:15 p.m. | Study of the Mechanical Properties, Wettability, and Corrosion Resistance of a Superhydrophobic Nanocomposite Coating.  
Divine Sebastian  
Mentor: Dr. Chun-Wei Yao  
Department of Mechanical Engineering / LU |
| 2:15 p.m. – 2:30 p.m. | Produced water: A potential resource for algae cultivation.  
Dr. Ashiqur Rahman¹ / Center of Midstream Management and Science / LU  
Co-authors: Saumya Agrawal ², Tabish Nawaz ², and Shanglei Pan ³  
Mentor: Dr. Thinesh Selvaratnam ¹,²,³  
¹Environmental Science and Engineering Department, Indian Institute of Technology Bombay, Powai, Mumbai 400076, Maharashtra, India;  
²Email: saumyaagrawal99@gmail.com (S.A.); tnawaz@iitb.ac.in (T.N.)  
³Email: span@lamar.edu (S.P.) |
| 2:30 p.m. – 2:45 p.m. | Detecting Defects of Railway Tracks by Using Computer Vision Methodology.  
Premkumar Ravishankar¹  
Co-Authors: Xulong Zhang², Dr. Hwang³, and Dr. Zhang²  
Mentor: Dr. Berna Eren-Tokgoz¹  
¹Department of Industrial and Systems Engineering, LU  
²Department of Computer Science / LU  
³Construction Management Program / LU |
| 2:45 p.m. – 3:00 p.m. | Toward an Effective Resource Allocation by Using Non-emergency Requests.  
Nader Madkour  
Mentor: Dr. Berna Eren-Tokgoz  
Department of Industrial and Systems Engineering / LU |
| 3:00 p.m. – 3:15 p.m. | Evaluation of Dietarily-Sourced Compounds as Potential Inhibitors of Alzheimer's Disease Progression.  
Hy Lai¹ / Ph.D. Candidate in Chemical Engineering  
Co-Authors: Kelsey Tran², Paityn Warwick², Rose Alincastre¹, Maryam Vasefi²  
Mentor: Dr. James Henry¹  
¹Department of Chemical Engineering / LU  
²Department of Biology / LU |
| 3:15 p.m. – 3:30 p.m. | Classification of Heart Diseases using a Stethoscope-based Heart Sound Method.  
Sayeda Farzana Aktar  
Mentor: Dr. Stefan Andrei  
Department of Computer Science / LU |
### Session 3 - Undergraduate Research at Lamar University (LU)

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Presenter</th>
<th>Department</th>
<th>Mentor</th>
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</thead>
<tbody>
<tr>
<td>3:30 p.m. – 3:43 p.m.</td>
<td>Current Methods of Sintering and Sintering Modeling</td>
<td>Kalen Baker</td>
<td>Major in Mechanical Engineering and Mathematics / LU</td>
<td>Dr. Ping He</td>
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<td>Department of Mechanical Engineering / LU</td>
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<td>3:43 p.m. – 3:56 p.m.</td>
<td>Effects of Entry-level chemistry courses in STEM majors</td>
<td>Emily Ingram</td>
<td>Major in Chemistry and Biochemistry / LU</td>
<td>Dr. Ozge Gunaydin-Sen</td>
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<td>Department of Chemistry and Biochemistry / LU</td>
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<td>3:56 p.m. – 4:09 p.m.</td>
<td>Introducing STEM to 7th Grade Females using SeaPerch and Scratch</td>
<td>Rachel M. van Sciver</td>
<td>Major in Computer Science / LU</td>
<td>Dr. Stefan Andrei and Dr. Sujing Wang</td>
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<td>Department of Computer Science / LU</td>
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<td>4:09 p.m. – 4:22 p.m.</td>
<td>Some Considerations on the Characteristics Polynomial of Two Square non-Commutative Matrices</td>
<td>Cristian Andrei</td>
<td>Major in Applied Mathematics Computational Emphasis / LU</td>
<td>Dr. Ted Mahavier</td>
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<td>Texas A&amp;M University / LU</td>
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<td>4:22 p.m. – 4:35 p.m.</td>
<td>A Structured Intervention for Cognitive Decline</td>
<td>Hannah Thompson</td>
<td>Major in Biology</td>
<td>Dr. Maryam Vasefi</td>
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<td>Department of Biology / LU</td>
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### Session 4 – High-school Research at Lamar University (LU)

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<th>Time</th>
<th>Title</th>
<th>Presenter</th>
<th>School</th>
<th>Mentor</th>
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<tr>
<td>4:35 p.m. – 4:37 p.m.</td>
<td>Synthesis, Characterization, and Photophysical Properties of a Benzobis(imidazole)-Based Chemosensor</td>
<td>Kent Liu</td>
<td>West Brook Senior High School</td>
<td>Dr. Xiangyang (Sunny) Lei</td>
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<td>4:37 p.m. – 4:50 p.m.</td>
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<td>Associate Dean of the College of Arts &amp; Sciences</td>
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Investigations of Autocatalytic Phenomena using a Continuously Stirred Tank Reactor and Python Simulations
Caitlyn Clark¹ and Emily Ingram¹,²
Mentors: Dr. Ozge Gunaydin-Sen¹ and Dr. Cengiz Sen³
¹Department of Chemistry and Biochemistry / LU
²Department of Chemical Engineering / LU
³Department of Physics Lamar University / LU

A BIG THANK YOU TO JUDGES WHO SCORED THE PRESENTATIONS AND ALLOWED US TO OFFER TODAY’S AWARDS

Dr. Stefan Andrei
Dr. Kendrick Aung
Dr. Robert Kelley Bradley (Chair)
Dr. Bianca Easterly
Dr. Ping He
Dr. Xiangyang Sunny Lei
Dr. Thinesh Selvaratman

Dr. Mamta Singh
Dr. Dorothy Sisk
Dr. Berna Eren-Tokgoz
Dr. Maryam Vasefi
Dr. Sujing Wang
Dr. Chun-Wei Yao
Dr. Jenny Zhou

THANK YOU ALL FOR YOUR PARTICIPATION IN THE EIGHT EDITION OF THE TEXAS STEM CONFERENCE

PLAN TO JOIN US FOR THE NEXT TEXAS STEM CONFERENCE IN OCTOBER 2021
Biological Treatment of Produced Water

Produced water (PW) is a byproduct laden with chemical contaminants that reach the earth’s surface during the oil and gas extraction process. There are several existing methods to treat/recycle this wastewater, one which includes physiochemically removing the harmful contaminants. However, this costly method carries more flaws in that it does not completely remove heavy metals; instead, significant amounts of chemicals are added. Another method consists of deep-well reinjections of the wastewater, which potentially results in disastrous harm to the environment as there is limited control over underground activities. This STEM SURF project assists in developing a biological system using algae species, *Galdieria sulphuraria*, to remove/recover contaminants, including nutrients, total dissolved solids, heavy metals, and salts offering an ecologically safer, more economical, and efficient alternative to treat produced water.

**Objectives:** In aims to provide beneficial information for the on-site treatment, this research focused on the collection of preliminary data on the proposed algal system (Fig. 1), the growth performance of *Galdieria sulphuraria*; the evaluation of the optimum dilution of PW; and the evaluation of nutrient, TDS, and salt removal. The composition of PW in different geographical regions was also studied for the production of synthetic PW to use in larger-scale experimentation. The optimization experiments of different dilutions (0%, 5%, 10%, 20%, 40%, 60%, 80%, 100%) of PW- using Cyanidium medium (CM) as a control and deionized water as a dilutant- were conducted in 6 mL (culture volume(photobioreactors with cultivated algae (Fig. 2).The same Design of Experiment (DOE) approach was used to investigate how macronutrients, ammonia-
nitrogen, and phosphate-phosphorus, impact algal growth. The data was recorded in terms of the biomass density, biomass growth rate, and levels of primary treatment (nutrient removal rates). Specifically, a measured relationship of optical density with ‘ash-free dry weight’ (AFDW) was used.

**Results:** The growth profiles of *G. sulphuraria* in the different dilutions of PW demonstrate significant results for the standard media, 0% PW, and 5% PW experiments over 7 days (Fig. 3). After day 3, the growth rate in 5% PW clearly exceeds that of any other dilution, including the standard media. In addition, the 5% PW reaches a peak biomass production on day 6, with a 20.4% increase from that of CM for the same day. The removal of ammonium-nitrogen and phosphate-phosphorus takes place in all the dilutions of PW, except in 80% PW, with a 9.2% increase of NH$_4$-N. More importantly, the 5% PW decreased 99.4% in NH$_4$-N and 31.1% in PO$_4$-P. The 5% dilution had the greatest nitrogen percentage decrease while the 20% dilution followed behind with a 68.4% and 67.7% decrease, respectively. The standard media removed the most phosphate by 35.3%. However, the 5% PW follows shortly behind. These results show an impressive removal efficiency as well as a significant biomass production from the 5% PW dilution.

**Lessons Learned**

Overall, this research revolves around developing a sustainable wastewater treatment alternative by using an algal-based bioremediation system to remove contaminated and produce biomass, which can be used as biofuels. The experiments have allowed me to learn technical skills and knowledge while exploring topics regarding cell culturing and UV-vis spectrophotometry. More importantly, working on this topic has exploited the real-world endeavor for sustainability that will most definitely resurface in engineering instruction and practices. As a result, the SURF experience has provided an opportunity for academic development and enrichment.
Cleveland Elijah Keal  
Major in Chemical Engineering  
Mentor: Dr. Clayton Jeffryes and Dr. James Henry  
Research in Chemical Engineering  
Department Chemical Engineering

**Effect of Copper Nanoparticles on the Digestive Tract**

My SURF research project involves testing the effect of copper oxide nanoparticles on intestinal nerve cells. There have been studies on how to cheaply and easily synthesize copper oxide nanoparticles by microwave heating a solution of copper chloride, starch, and glucose. There have been many studies on the possible benefits of nanoparticles, however, there have been few studies on the effect nanoparticles have on the body.

The parts that needed to be bought with the SURF budget were the nerve cells [Figure 1], ethanol, hydrochloric acid, gastric acid, T-flasks [Figure 2], and filtered injector syringes. It all equaled about $850. The nanoparticles [Figure 3] have been successfully synthesized using a microwave reactor and one of the many solutions synthesized has been diluted to 500μg/mL. The same has been done for a solution of copper chloride, glucose, starch and 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) to act as controls for testing the viability of the cells exposed to the nanoparticles. The initial cluster of cells were plated in the T-flask and grown for about a month and a half [Figure 4] and split into 3 other cell colonies in separate flasks [Figure 5] and 2 emergency vials to be saved if the other cells died. By the time the final experiment was meant to occur, we had 3 T-flasks full of cell colonies. Unfortunately, for unknown reasons, the splitting process for our cells were highly inefficient. The cells would not properly detach from the flask and we would not be able to do the final test. Also, every time a splitting attempt was made after the first one, the flask was contaminated. This contaminant grew faster than the nerve cells and would quickly fill up the flask [Figure 6], which forced us to dispose of them. After multiple failed attempts to split the cells, we were forced to use one of the emergency vials to continue our research. Unfortunately, this means that a new colony must be grown from scratch and another month is needed to have a cell colony big enough to run the final test. Also, more research must be done to ensure that the cells are split as efficiently as possible without any contaminants getting in.

When the cell colony [Figure 7] is big enough, we will separate the cell colony from the flask and place them in a 96 well cell assay. Once the cells have attached to the wells in the assay, about 24 hours after being placed in the wells, certain wells will be exposed to the nanoparticles, copper chloride, glucose and starch in concentrations of 500, 400, 300, 200, 100, and 0μg/mL and the MTT at 0, 125, 300, 425, and 500 μg/mL [configuration shown in Figure 8] After 24 hours of exposure, all cells would be dyed with MTT, broken open, and analyzed. The MTT turns purple in correlation to the health of the mitochondria of the cell its in. Therefore, testing the health and survivability of a cell can be determined by measuring the absorbance of light using a spectrometer.

My hypothesis for the results of the final test is that due to the small size of the nanoparticles, they will bypass all of the cells’ defenses, and when the starch coating breaks down the cell will be poisoned from a copper ion being inside it.
Figure 1: Purchased vial of cryopreserved nerve cells

Figure 2: 550mL T-flask used to house cells

Figure 3: diluted and filtered copper oxide nanoparticles

Figure 4: T-flask full of the first grown colony of nerve cells

Figure 8: newest cell colony being grown to date
Figure 5: 3 cell colonies made from the 1st one shown in Figure 4

Figure 6: unknown containment after spreading thought the flask

Figure 7: Configuration of 2 96 well cell assay plates
Evaporation Enhancement System Using Light

**Hypothesis:** Our initial hypothesis was to investigate whether we could create an efficient evaporation system using technologies based on the conversion of sunlight into heat. Convex lenses were used to concentrate the light onto the water’s surface to increase the efficiency of the evaporation. However, while testing, we noticed that suspensions in water can increase the heat transfer from sunlight to water and lengthen the steam production. This observation led us to test different additives dissolved in water that would create more reflectivity for the incoming light thus producing more heat.

**Experimental Setup:** Our indoor setup shown in figure 1 includes a small ceramic bowl with 100 mL for boiling water, a 38mm diameter convex lens, a hotplate, and a 140 V heat lamp as artificial light source for replacing the sunlight. This setup would give more consistent results than an outdoor setup because significant variables could be controlled. The hotplate was used to ignite the boiling process while the lens and heat lamp functioned to sustain the evaporation process for a longer time. To obtain the optimal illumination on the surface of the water, the alignment of lenses was considered. The minimal distance between lenses and the surface of water is four times the focal distance of the lens. This gives us the maximum illumination of the water surface.

**Figure 1.** The experimental setup.

**Figure 2.** Preparing the water bowl.
Our outdoor setup contains an array of convex lenses (Figure 3) held by rotating rod. An aluminum base was included to increase the reflectivity while the system of rotating rods facilitated the production of optimal focal images onto the base. Tests for this system outdoors lacked consistency in results due to uncontrolled outside variables, such as sunlight availability and wind speeds.

Figure 3. The array of convex lenses.

Figure 4. The evaporation system for outdoors measurements.

Experimentation: The evaporation rates were investigated with the indoor setup where the lens located below the heating lamp focuses the light on the water or solution while a hot plate heats the bowl initially. The time it takes from the start of the boiling process to its peak temperature is recorded. At the peak temperature, the hot plate is turned off and the time of a 3°C Celsius drop is measured; the times are then added together. Next, the amount of water evaporated is subtracted from the original amount and divided by the sum of the times to find the evaporation rates.

Mixing Carbon Nanoparticles in Water for increasing water’s reflectivity

When investigating different additives, the results of our research showed that carbon nanoparticles are the most efficient in increasing the evaporation process in our system. The rough version of these particles had a 15.5% increase in evaporation rate as compared to water. Refined carbon nanoparticles were then made and retrieved with adequate instrumentation in the laboratory and tested to compare with those of the ‘homemade’ carbon nanoparticles, which we refer to as ‘rough carbon nanoparticles’. These refined particles were made mixing 20 g of 100% raw honey and 20 g of molasses. The mixture was then put in a microwave for approximately 10 minutes to undergo plasma radiation which was noticeable through sparks and flames initiated. After cooking the mixture, a bluish tint from the combustion was visible, the microwaved mixture was then crushed into a powder. Approximately 1g of this powder was added to 10mL of distilled water per tube for eight tubes and centrifuged for 10-15 minutes. The supernatant was then collected, which contained the prominent carbon nanoparticles. When using the refined nanoparticles in our setup we were unable to achieve a measurable effect in the evaporation rate as compared to the rough nanoparticles. However, when we added a much higher concentration of refined nanoparticles to the water we were able to obtain a noticeable effect of 20.9% increase in the evaporation rate. The refined nanoparticles seem to be a more reflective as...
compared to the rough nanoparticle while keeping its capability producing a visible focal image.

Carbon nanoparticles are potentially reusable as they remain at the bottom of the pan after evaporation has been completed. These nanoparticles can also create heat through photo-excitation followed by collisional de-excitation which spreads their energy out around them. They also have a larger volume than other additives and therefore have a larger buoyant force acting on them so they stay closer to the surface and reflect more light back to the surface.

**Conclusion:** A higher concentration of nanoparticles is needed to test whether they could increase the volume of water evaporated for a shorter time interval. The full solution, consisting of the higher concentration of nanoparticles, was added to about 20mL of water to obtain a total volume of 100mL. The carbon nanoparticle solutions of higher concentrations have a greater density resulting in a 7% increase of amount of water evaporated when compared to that of water; this concludes to a higher rate of evaporation for the ‘full solution carbon nanoparticles’. The evaporation rates can be found in Table 1 and have a 20.9% increase. Though the amount of time for evaporation was greater with higher densities of additives, such as the full solution carbon nanoparticles, more water was evaporated over time. The full solution of nanoparticles was also highly reflective as noticed by image location closer to the top of the water. This trait was only noticed on the rough nanoparticles. By including the full solution of refined nanoparticles in the water, the light can sustain the boiling process after turning off the hotplate below the system.

**RESULTS:**

<table>
<thead>
<tr>
<th></th>
<th>Trial 1 Avg Evaporation Rate</th>
<th>Trial 2 Avg Evaporation Rate (2x concentration)</th>
<th>Trial 3 Full Carbon Nanoparticle Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>0.087 ± 0.011</td>
<td>0.087 ± 0.011</td>
<td>0.087 ± 0.011</td>
</tr>
<tr>
<td>Rough Carbon Nanoparticles</td>
<td>0.089 ± 0.006</td>
<td>0.103 ± 0.023</td>
<td>———</td>
</tr>
<tr>
<td>Filtered Carbon Nanoparticles</td>
<td>0.083 ± 0.008</td>
<td>0.081 ± 0.004</td>
<td>0.11 ± 0.01</td>
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<tr>
<td>Light Brown Sugar</td>
<td>0.082 ± 0.005</td>
<td>0.089 ± 0.002</td>
<td>———</td>
</tr>
<tr>
<td>Sea Salt</td>
<td>0.082 ± 0.005</td>
<td>0.083 ± 0.008</td>
<td>———</td>
</tr>
</tbody>
</table>

*Studies of the effect of several dissolvent in water over the evaporation rate.*
Mason Wyche  
Major in Civil Engineering  
Mentor: Dr. Thinesh Selvaratnam  
Research in Civil Engineering  
Department Civil Engineering and Environmental Sciences

Characterization of Algal-based Extracellular Polymeric Substances

Algal biomass has garnered increasing attention due to its useful properties across a wide variety of sectors, ranging from fuel to water filtration. Algal biomass is most useful after being extracted and refined several times. The refined components of this algal biomass are known as extracellular polymeric substances (EPS). Our research is concerned with EPS from *Galdieria sulphuraria* since it has a mild pH of 4-5, and because it can withstand temperatures (thermophilic) of up to 56°C.

Our main objectives were to extract the EPS from the *G. sulphuraria*, and once extracted, we wanted to find potential uses for it. Once we had grown the necessary amount of *G. sulphuraria*, we then extracted approximately 600 mL of algae and split the amount across 40, 15 mL centrifuge tubes, and began the centrifugation process (Fig. 1), which ended taking 25 minutes to complete. Now that the heavier algal particles were separated from, the lighter EPS, we then emptied the EPS from each tube into a 1000 mL beaker. The collected EPS was approximately 600 mL, which we then divided into 100 mL samples. These smaller samples were then poured into a flask that was attached to a rotary evaporator, or rotovap for short. We only rotovaped 100 mL of the solution at a time to ensure that it would not overload the machine. For dialysis, we cut a length of tubing, roughly the diameter of the beaker the tubing would be inside of, let it soak so it would be easier to handle, and then clamped off one end. The other end, we filled with approximately 100 mL of EPS, then we clamped the end off, completely sealing the tube.
We then placed the filled tube inside a beaker of deionized water and allowed the entire filled tube to soak. Once approximately 22 hours have passed, the batch of deionized water was changed, and the EPS was allowed to soak for another 22 hours. To prove that the dialysis was an effective process, the electrical conductivity (EC), was taken before and after the dialysis of both the deionized water, and the EPS. Before the experiment began, the EPS had an EC reading of 5.52 (mS/cm), and the deionized water had an EC reading of 4.13 (µS/cm). Once 22 hours had passed, the first batch of deionized water had a reading of 424.0 (µS/cm), and the EPS had a reading of 0.0681 (mS/cm)(Fig.3). Essentially, the dialysis had effectively removed a majority of the conductive salts inside the earlier sample earlier, leaving behind an incredibly pure sample of EPS that could be used for experimentation.

We want to see how this EPS, harvested from *G. sulphuraria*, can perform when used as a bioflocculant, and more specifically, we want to see how it works in wastewater treatment. The goal for these future experiments is to eventually come up with a formula that can effectively filter wastewater, without producing harmful byproducts that could severely damage the environment. Alum is a popular chemical compound used in wastewater treatment due to its effectiveness and relatively cheap coast to use. However, once used, the byproduct produced is extremely toxic to the environment. With more research and development, we can potentially formulate a bioflocculant that is environmentally friendly, relatively cheap, and highly effective. After the experimentation, I have found that *G. sulphuraria* produces vast amounts of EPS. In addition, I have found that the process necessary for extraction, albeit, is incredibly efficient. I have learned that there are multiple pieces of specialized equipment that are necessary for the extraction of EPS from *G. sulphuraria*. The need for this equipment, along with the vast amounts of time necessary for extraction, could be major reasons as to why algal biomass has not been used more now than it has been. The refinement techniques, if scaled up to commercial production, would take vast amounts of space and an incredibly long time. More research and development are necessary for this area. Once all the data had been gathered, I was able to take a moment to reflect on my experience, and I must say that I am incredibly blessed and honored to have been chosen to take part in an incredible research opportunity such as this one. Through this experience, I have gained a more robust understanding of what it takes to become an expert researcher.
Menna Elsaka
Major in Chemistry and Biochemistry
Mentor: Dr. Ashwini Kucknoor
Research in Biology
Department of Biology / Science and Technology Building

Akkermansia Muciniphila Correlation with Obesity and Metabolic Disorders.

The aim of this project is to determine the influence of *Akkermansia muciniphila*, both individually, and in association with other common gut residents such as *Escherichia coli* and *Enterobacter aerogenes* on enterocytes’ ability to secrete proinflammatory cytokines. The results from this study suggested that a combination of *Akkermansia muciniphila* along with other gut bacteria might promote gut health while any one bacteria alone in increased numbers might promote inflammation and tissue injury in the gut. *Akkermansia muciniphila* is a mucin-degrading Gram-negative anaerobic bacterium of the phylum verrucomicrobia. It resides in the gastrointestinal tracts of humans and animals. In recent studies, *Akkermansia muciniphila* has been linked to improving metabolic status in type 2 diabetic subjects and intestinal health.
The first part of the project was to grow Caco-2 cells from a frozen stock. Caco-2 cells will simulate the enterocytes lining the small intestines when cultured. This step took 3-4 days, during this time we grew *Akkermansia muciniphila* on blood-heart infusion agar plates with 5% sheep’s blood in an anaerobic jar. We also grew *E.coli* and *E. aerogenes* on nutrient agar plates aerobically. Next, we used a hemocytometer, which is a cell counting grid. This step is necessary to ensure that we will have the adequate amounts of bacteria to interact with Caco-2 cells based on how much Caco-2 has been grown.

Two sets of interactions took place next, one set aerobically and the other in the anaerobic jar. The incubation was set for one hour. After the interaction between Caco-2 cells and the respective bacteria, Caco-2 cells were harvested and RNA was isolated using standard protocol. Using a NanoDrop, RNA was quantified to ensure that we are starting with the same amount of RNA for each experiment. The next step was to set up for Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) and then PCR was next. PCR is a technique used to make copies of DNA regions. We used eight primers that correspond to pro-inflammatory cytokine genes related to gut inflammation. The cytokines were IL-4, IL-6, IL-10, IL-18, IL-1α, TNF-α, TGF-β, and hBD1. This accounts for eight PCRs per interaction.

After the PCR, samples were loaded on to a gel. Gel electrophoresis is a method to separate and analyze DNA based on its size. After analyzing the results from the gels, IL-6 which is expressed in the presence of *Akkermansia muciniphila* promotes wound healing and prevents tissue injury. TGF-β behaves similarly in curtailing inflammation. IL-4, a pro-inflammatory cytokine gene was reduced in expression when *Akkermansia muciniphila* was present along with other gut bacteria, when compared to one individual bacteria, suggesting that the combination of bacteria will promote gut health. IL-10 and IL-1α also behaved the same way. In conclusion, the cytokines that were down regulated in the presence of Akkermansia muciniphila individually and among other gut bacteria are the same cytokines that are up regulated in metabolic disorders such as diabetes. This suggests that maintaining Akkermansia muciniphila in balance with other gut bacteria is an important factor that will influence the metabolic disorders and can promote gut health.
Onset of the Sevier Fold and Thrust Belt and Associated Foreland-Basin Sedimentation in Central Utah

**Purpose:** The Sevier fold-and-thrust belt (SFTB) and its foreland basin have served to formulate fundamental concepts on the dynamic interplay between thrusting, flexural subsidence, and eustasy during foreland basin evolution. However, the onset of crustal deformation in western USA, and its kinematic history during the Jurassic through Early Cretaceous time has been a source of considerable debate over decades. This is in part due a lack of evidence for deformation and age control in proximal strata during the Jurassic and Early Cretaceous times. This research used detrital zircon U-Pb geochronology on major thrust faults and proximal strata in central Utah, to determine the onset of frontal thrust-belt deformation and connect sediment dispersion with deformation by means of isotopic provenance analysis. The results in this study give us a better understanding of the rate of geologic processes, especially mountain building events, as well as clues on volcanic and earthquake cyclicity in the long-term, and oil and gas maturation, and trap formation.

**Method:** Detrital zircon (DZ) U-Pb in-situ dating combined with sediment compositional analysis has been widely employed in provenance studies to help reconstruct the deformational history, unroofing events, paleo-drainages, and paleogeographic evolution in orogenic systems. Eight sedimentary samples were collected in the proximal and distal portion of central Utah foreland basin and were analyzed using DZ U-Pb geochronology and sediment composition.

**Results and Conclusions:** The youngest zircon mode for each population was analyzed to provide maximum depositional ages and improved stratigraphic age control. In ascending stratigraphic order, we have the Morrison Formation youngest mode at 155 ± 2 Ma, the Lower Cedar Mountain Formation at 133 ± 2 Ma, the Upper Cedar Mountain Formation at 116 ± 1 Ma, and the Lower San Pitch Formation at 97± 1 Ma. The statistical (K-S test) multi-sample comparison show that the late Jurassic Morrison formation is statistically indistinguishable from Mississippian strata in the SFTB indicating that the onset of thrusting occurred rapidly slightly prior to 155 Ma, and synchronous with magmatism and subduction in western USA. The DZ U-Pb ages in the basin recorded
multiple episodes of deformation and the eastward migration of thrusting from the Jurassic to the Cretaceous. This is as well recorded in the sediment compositional analysis where the older samples contained more quartz (~95%) than the younger samples showing a gradual increase in lithic (%) fragments up stratigraphy. The DZ percentages of cratonic source per samples shows that the major contributors of zircons have a long recycling history and a genesis in the Precambrian- billions of years ago. To conclude this study shows some of the first evidence for Late Jurassic deformation in central Utah and helped us reconstruct the chronology of major depositional events and sediment derivation as a function of thrust belt deformation (source-to-sink model).

**Figure 1 (left).** Multidimensional Scaling plot (MDS) detailing the correlation between the basin and thrust belt samples. **Figure 2 (right).** The source-to-sink model describes the thrust belt, unroofing and depositional history of central Utah in the Late Jurassic-Early Cretaceous.
Studies of Ammonia Borane-Polyacrylic Acid Composites for Hydrogen Fuel Cells

co-authors: Emily Ingram and Haley Snyder

The main goal of this grant was to prepare a novel bulk composite with polyacrylic acid (PAA) and ammonia borane with different proportions to get hydrogen release at lower temperatures with faster rate in order to be used as an alternative fuel source. Additionally, we aim to analyze the composites by using differential scanning calorimetry (DSC) and Fourier-Transform infrared spectroscopy (FT-IR) to understand dehydrogenation properties, i.e. kinetics. Ammonia borane (AB) has proven to be a sufficient compound for hydrogen release due to its vast hydrogen content at 19.6 wt. % [1]. AB also has some drawbacks such as slow kinetics, high hydrogen release temperature, and release of unwanted gases and byproducts, such as ammonia and borazine. Various studies have shown that modifying AB results in improving the hydrogen release properties [2-3].

A 1:1 (mass ratio) ABPAA composite was prepared and the samples were analyzed using DSC and FT-IR. The DSC results show the peak of hydrogen release for AB to be 118.8 °C, while the peak for PAA was at 121.9°C. More samples would need to be analyzed in order to come to an accurate conclusion; however, this sample shows that the temperature stayed within a similar range. The IR data of ABPAA shows intermolecular bond changes in AB with the addition of PAA, conforming that there is a possible interaction which could be the reason decreasing the release of unwanted gases and byproducts. A broadening of IR nodes signifies a weakening of bonds which could, in turn, correlate to increased hydrogen release.

The project also involved theoretical computational studies as well. The goal consisted of using Spartan Student molecular modeling software to understand the thermodynamics properties of ammonia borane on a molecular level and to compare the results with experimental values. This computational study allowed for the analysis of the internal rotation in AB, apply the Density Functional Theory, and understand AB kinetics. It was discovered that the barrier to rotation, staggered↔eclipsed, is only 1.5129 kcal/mol, which agrees quite well with a previous study value of 1.93 kcal/mol and 2.07 kcal/mol [4]. When going from staggered to eclipsed a stretch of the B-N bond was observed of 0.003 Å, however in previous studies the stretch was more notable. The Density
Functional Theory is based on electron density of a molecule, which gives the ability to investigate the electronic structure of the system. Further, calculations of total energies and forces under general conditions gives broader understanding of the thermodynamics and kinetics of AB.

The above spectrums show ammonia borane’s IR spectroscopy. Figure a. shows the calculated IR using MP2/6-311+G**. Figure b. shows the experimental IR as determined in lab by Emily Ingram. Pristine AB was made into a pellet using KCl and tested with the FTIR. While Spartan reports the IR in Transmittance vs. Wavenumber and the experimental value was found in Absorbance vs. Wavenumber, the vibrational modes should still be very similar. Luckily, there are similarities between the two spectrums. There are similar peaks between 1000 and 1750 cm⁻¹, indicating similar fingerprints in both spectrums. There is a small peak in Figure a. around 750 cm⁻¹, however, in figure b., there is a splitting of peaks in this region. Another difference is the peaks in the 2000 to 2500 cm⁻¹ range of Figure b. are shifted downfield. The last peak, which should signify amines, (N-H groups) shows only one peak for figure a., and multiple splitting for figure b. Amines have noticeable splitting in this region, and since Figure a. does not have this characteristic, there may be something off in the calculations.

Future experimental goals include preparing 1:2 and 1:3 AB:PAA composites with polymer and catalyst, MgCl₂ and CaCl₂, to compare to 1:1 composites and pure AB, performing FT-IR experiments of all composites to see how the bonds and functional groups have changed with the addition of the polymer and catalysts. Additionally, run DSC ramps 1,3,10 and 15 °C in order to obtain a line of best fit of each exothermic peak and find the activation energy. Future theoretical goals include investigating rotational barrier with the addition of PAA to AB and investigating thermal properties after H₂ is released also with the addition of PAA.

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**Studying the Dynamics of Interplanetary Magnetic Clouds using a toroidal coordinate system**

This project uses a dynamics model, initially proposed by Romashet *et al.* (2007), that indicates the geometric and structural properties of the magnetic clouds as they move from the Sun’s surface toward the Earth’s orbit. Our model uses a large database which gives the boundary conditions for solar activities responsible for the formation of magnetic clouds through the release of very energetic coronal mass ejections (CMEs). This model includes information about the geomagnetic activity, average speed of the solar wind and density of protons in the solar wind before the magnetic cloud arrives. The model can predict the time for a magnetic cloud to reach the Earth’s orbit. We can determine from this model the average and maximum speed of the magnetic cloud. Our analytic model uses adjustable parameters for finding a conclusion about tracking the cloud as it approaches the Earth’s orbit. We incorporate data provided by the Wilcox Solar Observatory (WSO) and World Data Center A on solar wind conditions. Magnetic clouds can exceed peak speeds of 2,000 km/sec near the Sun’s surface. Figure 1 shows the speeds of the magnetic cloud and the solar wind as the cloud travels from Sun’s surface to Earth. Also, our study indicates an average solar wind speed near Earth of about 350 to 500 km/sec.

![Figure 1. The speed of the magnetic cloud (blue curve) when it leaves the sun and the speed of the solar wind (red curve) near Earth.](image)

Our analysis starts with reading the magnetic field components in toroidal coordinates and the density of particles (mainly protons) in the magnetic clouds. We surveyed graphs which give the $A_p$ and $D_{st}$ indices. The
model includes data such as the aspect ratio (the major to minor radii) of the toroid and the drag coefficient produced by the dynamic pressure of the solar wind on the protons in the cloud. These variables can impact the magnitude of the major forces involved in the kinematic equation for the magnetic cloud (such as diamagnetic, drag, and gravitation forces). Adjustable parameters serve to fine-tune the dynamics of the cloud observed near Earth’s orbit for finding a reasonable agreement between the experimental value of the magnetic cloud as detected by Wind and ACE spacecrafts with respect to our model’s output.

**Figure 2:** The chart contains the density of protons in the solar wind near Earth’s orbit. An average value was obtained from this chart for use in our dynamics model. The red and green lines indicate the locations where an average value was taken before and during the event.

**Figure 3:** The chart gives the solar wind speed near the Earth’s orbit as measured by the ACE and Wind spacecrafts. The red and green lines indicate the locations where average values are taken before and during the event, consistent with the similar regions indicated in Figure 2.

Preliminary data analysis shows there is a strong correlation between the magnitude of solar magnetic field at the origin of the cloud and its maximum speed close to the Sun’s surface. This speed is always radial. We noticed that a higher value of the maximum speed leads to a greater asymptotic threshold speed of the cloud near Earth’s orbit. Having patterns to reference new similar events provide excellent insight for predicting their motion, density, and strength of the clouds. With the data from various geomagnetic events, we could analyze the general
characteristics of the clouds and develop new theories and patterns for forecasting interplanetary magnetic clouds. This final goal is our work in progress.

**Results and Observations:** We noticed a linear correlation between the major and minor radii of the toroid for the fourteen events we have studied. Our observations can more accurately relate the density of protons, the strength of magnetic clouds ejected from the Sun to the speed of the cloud near the Earth and create more accurate forecasting tools. The knowledge provided by this data gives us insight into the unknown features of interplanetary magnetic clouds.

The linear pattern shown in Figure 3 was generated from comparing the maximum speed of the magnetic cloud with the strength of the initial magnetic field (labelled B00) near the Sun’s surface. The $A_p$ index of each cloud determines the maximum speed, the strength of the magnetic field, and the average number density of protons. We were focusing on events with daily average $A_p$ index of 100 or greater. The simple linear trend shown in Figure 3 can possibly allow us to create a recipe for predicting the impact of the magnetic clouds on Earth.

**Conclusion:** This research is the first of its kind and is being used to enrich the original model proposed by Romashets *et al.* 2007 for forecasting magnetic clouds and predicting geomagnetic storms. These geomagnetic storms can damage sensitive electronics and guidance packages inside spacecrafts and aircrafts. Having the ability to accurately state when a disturbance arrives on the Earth’s orbit can significantly reduce the negative impact of these devastating storms on human activities.
Lauren Richardson, Ph.D., is a Lamar alumnus with a BS degree in Biology and a McNair Scholar mentored by Dr. Ian Lian. Dr. Richardson obtained her Ph.D. in Cell Biology, with an emphasis in Reproductive Biology, from the University of Texas Medical Branch in Galveston (UTMB). While receiving training from the Environmental Toxicology T32 at UTMB, her research focused on the mechanistic processes of fetal membrane cellular and collagen remodeling (i.e., Epithelial-to-Mesenchymal Transition [EMT] and MET) throughout gestation and its dysregulation at term. She is currently a T32 Post-Doctoral Fellow and previously funded Kempner Scholar in the Department of Electrical and Computer Engineering at Texas A&M University. Her research is currently focused on fabricating, developing, and validating primary cell-derived pregnancy-related organ-on-chip devices (i.e., placenta, fetal membranes, and cervix) to study the effect of maternal and fetal risk factors (i.e., Oxidative stress, toxicants, infection) on the induction of preterm labor pathways. Dr. Richardson has served as the LSSOT postdoctoral representative, the Department of Cell Biology graduate school representative, the student representative for the Department of Cell Biology curriculum committee and has helped organize international and national preterm birth related conferences. She additionally is a patient and research advocate by collaborating with the Galveston Pregnancy Help Center to educate women on fetal development and preterm birth phenotypes and by helping establish the Fetal Membrane Society where she is the Secretary General. She is currently a peer reviewer for multiple Journals and has published over 30 peer-reviewed research articles, reviews, and book chapters in the field of fetal membrane biology over her five years in the field.

Carlo Vanz graduated from Lamar University with a BS in Biology and an MBA in Financial Management. Carlo is now a second year PhD student in Molecular Immunology & Microbiology at UT Health San Antonio. His work is focused on the field of immunometabolism to study how the immune system affects the body’s metabolic state and vice versa. Carlo’s project utilizes a mouse model of obesity to characterize the roles and effects of immune populations such as B lymphocytes and iNKT cells in the adipose tissue. During his time at Lamar University, Carlo worked in Dr. Ashwini Kucknoor’s research lab where he studied Leishmania parasites and he received a SURF fellowship to support his research.
Nurul Azam is a Lamar Alumnus with an MES Degree in Electrical Engineering. He is now a Ph.D. candidate in the Electrical and Computer Engineering department at Auburn University. Mr. Azam is currently working for the development of next-generation electronics. In this process, he published a high impact journal article on the laser-assisted accelerated synthesis of 2d quantum materials, which is a new approach to synthesize atomically thick two-dimensional materials. During the stay at Lamar University, he completed his thesis work under Prof. Cristian Bahrim and was involved in numerous outreach activities as the student leader of the STAIRSTEP (an NSF sponsored grant) physics team to promote STEM education in southeast Texas.

Russell Rowe graduated from Lamar University with a BS in mechanical engineering in December 2019. He is currently a first year PhD student in mechanical engineering at the University of Alabama in Tuscaloosa. His work focuses on additively manufactured nickel-based superalloys and their performance at high strain rates. Russell uses a Split Hopkinson Pressure Bar to test uniaxial compression samples at strain rates between 500 1/s and 3000 1/s. While attending Lamar University, Russell was involved on campus as a SCOPE scholar and member of the local ASME chapter.

Noah Holtham graduated from Lamar University in May 2020 with a BS in Mechanical Engineering. Noah is now a first-year PhD student in Mechanical Engineering at the University of Alabama. His research is primarily centered around laser peening of single-crystal Nickel-based superalloys. These alloys are of particular interest to groups such as Rolls-Royce and the Department of Energy who are seeking to push the boundaries of efficiency and sustainability in gas turbine engines. While attending Lamar University, Noah took interest in the work of Dr. Keivan Davami whom is now his research advisor at the University of Alabama.
Modeling Ascending Infection with a Feto-Maternal Interface Organ-On-Chip

Lauren Richardson, PhD\textsuperscript{1,2}

Co-authors: Sungjin Kim, MS\textsuperscript{2}; Arum Han, PhD\textsuperscript{2}; and Ramkumar Menon, PhD\textsuperscript{1}

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Maternal infection and the resulting host inflammatory response are risk factors associated with preterm birth (PTB), a major pregnancy complication. However, the path of infection and its propagation from the maternal side to the fetal side is difficult to study due to lack of appropriate models. A better understanding of the propagation kinetics of infectious agents and development of the host inflammatory response at the feto-maternal interface (FMi) is critical in curtailing host inflammatory responses that can lead to PTB. To model ascending infection, we developed a microfluidic organ-on-chip (OOC) device containing primary cells from the FMi (decidua and amniochorionic membrane) and collagen matrix harvested from tissue. The FMi-OOC is composed of four concentric circular cell/collagen chambers designed to mimic the thickness and cell density of the FMi \textit{in vivo}. Each layer is connected by arrays of microchannels filled with type-IV collagen to recreate the basement membrane of the amniochorion. Cellular characteristics (viability, morphology, production of collagen, cellular transitions, and migration) in the FMi-OOC were similar to those seen \textit{in utero}, validating the physiological relevance and utility of the developed device. The ascending infection model of the FMi-OOC, triggered by exposing the maternal-decidua side of the OOC to lipopolysaccharide (LPS), shows that LPS propagated through the chorion, amnion mesenchyme, and reached the fetal amnion within 72 h. LPS induced time-dependent and cell-type-specific pro-inflammatory cytokine production. Collectively, this OOC model and study successfully modeled ascending infection, its propagation, and distinct inflammatory response at the FMi indicative of pathologic pathways of PTB.
T-bet+ B cells exacerbate chronic inflammation and metabolic disorder during obesity

Carlo Vanz

Co-authors: Thomas Hägglöf, Elizabeth Dudley, and Elizabeth Leadbetter

Department of Microbiology, Immunology & Molecular Genetics, UT Health San Antonio

Immunometabolism is a rapidly growing research field that connects both Immunology and Metabolism. It was only recently appreciated how much these two systems are interconnected in both health and disease. Today, many scientists are trying to understand how exactly the immune system affects human metabolism and vice versa, especially in the context of metabolic disorders. Obesity is currently one of the biggest health problems worldwide, affecting a large part of the global population and representing a major risk factor for many other diseases. In addition to enlarged adipocytes, one of the hallmarks of obesity is the presence of low grade chronic inflammation. This inflammation is caused by a dysregulation of the immune system and it affects many vital organs, further exacerbating metabolic disorders. To find potential therapeutic targets to reduce this inflammation, we study a population of immune cells that accumulate during obesity in the adipose tissue and the spleen. These cells are B lymphocytes characterized by their expression of the transcription factor T-bet and their production of IgG2c/a antibodies. They contribute to adipose tissue inflammation in part through production of cytokines and antibodies. Understanding how exactly these cells promote chronic inflammation, and how they accumulate during obesity may reveal new immune targets or approaches to improve the health of obese patients.
Laser-Assisted Accelerated Synthesis of 2D Quantum Materials

Nurul Azam

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Two-dimensional (2D) layered materials including transition metal dichalcogenides (TMDCs), exposed numerous bizarre properties that have been recently at the center of the quantum materials and information sciences research. In pursuit of the accelerated growth and discovery of 2D materials, many efforts have concentrated on developing new approaches, including physical and chemical vapor deposition techniques. However, complex, uncontrolled gas-phase reactions and flow dynamics have made the synthesis of these multi-component 2D crystals exceedingly challenging. This work demonstrates a novel laser-assisted synthesis technique (LAST), which significantly reduces the existing growth complexities and remarkably accelerates 2D materials' growth. The uniqueness of this approach arises from the uses of laser for direct vaporization of stoichiometric powder. We show that this laser heating permits pressure independent decoupling of the growth and evaporation kinetics, enabling the use of stoichiometric powder as precursors for the growth of various high-quality 2D materials including MoS2, MoSe2, WSe2, and WS2.
Dynamic strain rate comparison of additively and traditionally manufactured nickel-based superalloys

Russell A Rowe

Co-authors: Michael Munther, Noah Holtham, and Keivan Davami

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Nickel based superalloys are often used in the aerospace, automotive and energy sectors due to their high corrosion resistance and desirable material properties that will be retained even at elevated temperatures. Turbine blades in both jet engines and car engines are often made from nickel-based superalloys due to the desirable properties previously mentioned. Manufacturing turbine blades using additive manufacturing will reduce material waste and allow for the fabrication of more efficient blade designs. Direct metal laser sintering (DMLS) and selective laser melting (SLM) are two commonly used additive manufacturing methods that are used to print various superalloys. The quasi-static material properties of DMLS and SLM components are not significantly different from those manufactured using traditional processes. However, properties such as fatigue life, ultimate yield strength and fracture toughness is affected my additive manufacturing, so it is important to determine the response of nickel based superalloys at dynamic strain rates. Therefore, a comparison of dynamic mechanical properties between traditionally and additively manufactured components made from nickel-based superalloys is needed to ensure the reliability of additively manufactured components. This research compares the high strain rate response of additively and traditionally manufactured nickel-based superalloys components. A split Hopkinson Pressure Bar is used the perform tests at high strain rates.
Investigating the Strengthening Effects of Laser Peening on nickel-based superalloys

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Laser Peening (LP) is a surface enhancement technique used widely in aerospace, automotive, and power generation industries to improve the lifespan of critical service components under severe loading conditions. The primary function of LP is to induce beneficial compressive residual stresses within the surface and near-surface regions of a material and thereby provide strength against surface-related failure mechanisms induced by fatigue loading, corrosion-fatigue, stress corrosion cracking, and general wear. In this research, the effects of laser peening on Nickel-based superalloys are investigated and discussed. Several Inconel specimens of additively and traditionally manufactured origin were peened without a protective overlay and tested extensively. Hardness and elastic modulus were mapped at depth from the peened surface by means of indentation to shed light on mechanical changes resulting from the intense plastic deformation. X-ray diffraction was employed to determine the resultant stress state following LP and these findings were correlated with microstructural changes observed by electron microscopy. Results show that over a broad range of manufacturing and processing conditions, LP greatly increases the magnitude of beneficial compressive residual stresses and hardness up to a depth of around 2mm. Additionally, these enhancements were largely retained after high temperature exposure, showing a high degree of thermal stability.
1. Study of the Mechanical Properties, Wettability, and Corrosion Resistance of a Superhydrophobic Nanocomposite Coating

Divine Sebastian

Mentor: Dr. Chu-Wei Yao
Mechanical Engineering, Lamar University

In this work, a nanocomposite coating solution constituted by nanoparticles and PDMS is optimized by studying the variation in mechanical properties, surface wettability, and surface morphology of the coating. The developed coating's hardness and elastic modulus were studied in detail. A clear change in the mechanical properties was observed with respect to the change in the proportion of PDMS binder. Also, the average surface roughness, skewness, and kurtosis values show the influence of the amount of PDMS on the surface roughness characteristics of the coating. Furthermore, the amount of PDMS was selected so that maximum super hydrophobicity was attained with commendable mechanical properties. The corrosion resistance of the developed coating was analyzed using electrochemical technique and in situ atomic force microscopy technique. The results from potentiodynamic polarization technique showed that the coating has high polarization resistance and a low corrosion rate. Furthermore, a micro/nanoscale investigation using the in situ atomic force microscope technique in which the change in surface topography was monitored showed that the coating has excellent corrosion resistance.
2.

Produced water: A potential resource for algae cultivation

Ashiqur Rahman ¹

Co-authors: Saumya Agrawal ², Tabish Nawaz ², and Shanglei Pan ³

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Produced water (PW), the largest waste stream generated in oil and gas industries, has the potential to be a harmless product rather than being a waste. Biological processes using microorganisms have proven useful to remediate PW contaminated by petroleum hydrocarbons, complex organic chemicals, and solvents. In particular, the bioremediation of PW using algae is an eco-friendly and low-cost approach due to algae’s ability to utilize certain pollutants as nutrient sources. Therefore, the utilization of PW as an algal growth medium has a great potential to eliminate chemicals from the PW and minimize the large volumes of freshwater needed for cultivation. Therefore, the current research is dedicated to filling this gap by portraying the many different facets of the algae cultivation in PW. Several algal species that are known to thrive in a wide range of salinity and the critical steps for their cultivation in hypersaline PW have been identified. Overall, the current work highlights the PW bioremediation using algae and brings attention to utilizing PW to grow biomass that can be processed to generate biofuels and useful bioproducts.
3.

Evaluation of Dietarily-Sourced Compounds as Potential Inhibitors of Alzheimer's Disease Progression

Hy Lai#

_Co-authors:_ Kelsey Tran§, Paityn Warwick§, Rose Alincastre##, and Maryam Vasefi§

_Mentor:_ Dr. James Henry#

#Chemical Engineering, Lamar University

§Department of Biology, Lamar University

Alzheimer’s disease (AD) was the sixth leading cause of death among people of all ages and the fifth leading cause among people aged 65 and over in 2017. Moreover, AD is the most common cause of dementia and not accounted when coexisting with other dementia diseases. AD is an irreversible and progressive brain disease that cause decline in cognitive, behavior, functional status and self-care. The underlying cause of AD is the aggregation of beta amyloids to form amyloid plaques and the deposition of the amyloid plaques causing neurons to die. As the population ages and mortality due to other chronic diseases decline, a larger population survives to ages where the risk for dementia is higher. Late term therapeuetic development presents significant challenges associated with irreversible neural degradation and location delivery. Therefore, it is necessary to identify lifestyle preventative measurements such as dietary and nutraceutical solutions. In this work, we utilize SH-SY5YS as the cell model, react various compounds with 1-42 beta-amyloid and perform different in vitro configurations to study toxicity, protection and anti-aggregation effects. We examine the cell viability with CyQuant/Vybrant MTT cell proliferation procedure, correlate absorption spectral readings to percentage of cell survived and generate percentages of cell survived versus concentrations of the potential compound relationship to evaluate long-term commercialization and effectiveness.
4.
Detecting Defects of Railway Tracks by Using Computer Vision Methodology

Premkumar Ravishankar¹

Co-authors: Xulong Zhang² · Dr. Hwang³ · Dr. Zhang²

Mentor: Dr. Berna Eren-Tokgoz¹

¹Department of Industrial and Systems Engineering, Lamar University
²Department of Computer Science, Lamar University
³Construction Management Program, Lamar University, Beaumont

Maintaining railway tracks in healthy conditions is critical to ensuring the safe operation of railroad transportation. According to the Federal Railroad Administration, nearly 23% of train accidents occurred between 2015 to 2020 were due to the defects of the tracks. In an effort to prevent such accidents, railway companies regularly inspect tracks to detect and fix defects of track systems. This research proposes an innovative method for conducting railroad track inspection to enhance the maintenance operation. The proposed approach aims to overcome the existing inspection practice based on the human observation that is costly, time-consuming, and error-prone. To this end, the proposed method utilizes computer vision methodologies to achieve high-level automation and accuracy of defect detection through the analysis of digital images. The outcome of this study is envisioned to help railway companies perform predictive maintenance more effectively and, thereby, reduce the risk of train accidents and increase the resiliency of their assets.
5. Towards an Effective Resource Allocation by Using Non-Emergency Requests

Nader Madkour

Mentor: Dr. Berna Eren-Tokgoz
Department of Industrial and Systems Engineering, Lamar University

It has become a great challenge for any city officials nowadays to be able to allocate their resources efficiently for public responses towards any complaints regarding the city. Natural disasters that occur in the United States (US) on average 100 times per year from earthquakes, floods, severe thunderstorms to tropical cyclones. One of the keys to evaluate a city’s performance is its response times for their residents’ complaints regarding the city’s properties or services which might malfunction after natural disasters. 311 non-emergency services are established to respond to these complaints in more than 100 cities among the US including Houston, TX. Predicting the future 311 non-emergency services calls will help the city’s officials to respond faster and effectively for a less recovery time. In this research, the city of Houston in Texas was selected. 311 Houston service helpline was introduced in 2001, which was designed to response towards city residents’ requests towards non-emergency services. In this study, a time series prediction model was carried out to generate a forecast for future number of requests. By knowing the future number of requests, the city can be prepared for an increase in calls during the next few years by making sure there are enough resources capable of responding rapidly especially during natural disasters. The time series model revealed a forecasted region of number of requests for the upcoming years for the departments with high number of requests.
6. Classification of Heart Diseases using a Stethoscope-based Heart Sound Method

Sayed Farzana Aktar

*Mentor*: Dr. Stefan Andrei
Department of Computer Science, Lamar University

In this era of advanced technology, detecting heart diseases has been a research of interest in health care. In our paper, we propose a new method to classify heart diseases by analyzing heart sounds. Our goal is to help the medical doctor to identify the type of heart disease a patient has. In general, doctors use acoustic stethoscope to detect abnormalities in the heart sound. There are different types of heart sounds indicating distinct categories of heart diseases. Hence, doctors are facing difficulties while detecting the cardiac sound and its abnormalities being very hard to precisely predict the exact disease type. They must suggest more diagnosis to identify the type of heart disease the patient has, which is costly and time consuming. We developed and applied a novel data analysis to detect heart problems. Our method uses deep architecture features for analyzing heart diseases. We consider the heart sound as our raw data. This approach uses electronic stethoscope (i.e., e-stethoscope), to collect heart sounds and deep learning approach to identify the type of heart disease. From our previous research we have a result confirming if the heart has a disease or not. It is aimed to design a software known as a heartbeat audio classifier. This software should be able to differentiate normal heartbeats and types of murmurs which would assist the doctors to analyze a heart sound and detect the type of diseases of the heart. Our approach could lead to better results in comparison with other similar methods.
Sintering is the process of fusing a compacted finely powder into a single object at temperatures just below the melting point. The sintering process itself is accomplished by many different means of which Hot Isostatic Press, Hot Hydrothermal Press, Current-Assisted, and microwave sintering are just a few of. Because of the value of a low waste and potentially low energy consumption production of materials extensive modeling efforts have been performed with different schemes at all scales. Modeling efforts are Molecular Dynamics, Discrete Element Analysis, Finite Element Analysis, Monte Carlo methods. The goal of this presentation is to provide an overview of these methods.
8. Effects of Entry-level chemistry courses in stem majors

Emily Ingram¹
Major in Chemistry and Biochemistry

Co-authors: Berna Eren-Tokgoz², Ashikur Rahman Abid², Morshedul Alam², Mamta Singh³

Mentor: Dr. Ozge Gunaydin-Sen¹

¹Department of Chemistry and Biochemistry, Lamar University
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³Department of Teacher Education, Lamar University

The following study evaluates student performances in General Chemistry I & II courses at Lamar University in Southeast Texas, United States and how it correlates to the retention of STEM students. Current studies show that successful performance of students in gatekeeper courses, such as Calculus I & II, General Chemistry I & II and Physics I, can help predict the students who stay in STEM related fields. In this study, the correlation between success in General Chemistry I & II courses with the math skill of students was investigated, along with how students’ study habits determine success in chemistry courses. A twenty-eight-question survey was administered at the end of the spring semesters of 2015-2019 by the authors. These questions included student success rate, current majors, previously taken math courses, interest in chemistry and math, as well as study habits to assess the effect of gatekeeper chemistry courses on the continuation of STEM related fields. The 2018 and 2019 surveys were improved from previous years to allow for the tracking of students using unique codes to maintain student privacy and anonymity. Tracking STEM students from General Chemistry I through their college careers allows for the investigation into whether the students improved in STEM courses and if they maintained a STEM degree. The results of this study included 535 students whose survey answers were recorded in Excel, individually, and will help both instructors and students to understand the rationale of student failure and what can be improved to increase future student success.
9. Introducing STEM to 7th Grade Females using SeaPerch and Scratch

Rachel M. van Sciver¹
Major in Computer Science

Co-authors: Otilia Urbina² and Dorothy Sisk²

Mentor: Dr. Sujing Wang¹ and Dr. Andrei Stefan¹

¹Department of Computer Science, Lamar University
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This Innovative Practice Full Paper discusses a one-week summer camp that used the SeaPerch and Scratch game programming as engaging hands-on approaches to teach 7th-grade (the second grade in secondary education in the USA) females programming concepts, engineering skills, and scientific principles to increase their knowledge and interest in science, technology, engineering, and mathematics (STEM). Adding diversity to the STEM workforce and increasing enrollment in STEM degrees is critical for fulfilling the needs of our modern economy. Today, many organizations are preparing future workers for the modern workforce by implementing academies/camps that attempt to engage students in STEM disciplines at a young age by exposing them to the critical thinking and reasoning skills that are intrinsic to STEM disciplines to combat the decline of students in STEM careers and pique female interest. We have developed a programming and robotics academy to demonstrate STEM concepts to 7th grade females. Our STEM academy differs from others in several ways: First, it was for 7th-grade girls only, creating a non-competitive social learning opportunity, in order to improve female participation. Second, we hired female instructors and invited female professionals from local industries to assist the academy by serving as mentors. Third, it introduced STEM concepts to the females. Fourth, it adopted social learning, e.g., buddy system. A formal assessment of the 2018 academy found that the academy’s female participants experienced a significant increase in knowledge and interest in STEM. This paper describes the organization, coordination, content, and assessment of the STEM academy. It describes how the academy was organized and taught, which includes a brief description of the instructional materials, the concepts taught in each hands-on session, how the academy was assessed and the assessment results, and the first-year experience of conducting the STEM academy, and lessons learned. The intent of this paper is to provide all the information needed for others to host similar academies and further prompt the effort to increase female participation in STEM careers.
10.
Some Considerations on the Characteristic Polynomial of Two Square non-Commutative Matrices

Cristian Andrei
Major in Applied Mathematics Computational Emphasis

Mentor: Dr. Ted Mahavier

1Department of Electrical Engineering and Computer Sciences, Texas A&M, College Station, TX
2Department of Mathematics, Lamar University

Applications of the characteristic polynomial of matrices have been studied for centuries now by many researchers, in areas such as astronomy, mechanics, geometry, complex analysis, arithmetic, and more. The main result of our paper proves that the matrices $\lambda I_n-(A^pB^m)^k$ and $\lambda I_n-(B^mA^p)^k$ have the same characteristic polynomial.
11. A Structured Intervention for Cognitive Decline

Hannah Thompson
Major in Biology

Mentor: Dr. Maryam Vasefi
Department of Biology, Lamar University

Cognitive decline, largely represented as dementia, impacts an estimated 16 million Americans, while Alzheimer’s disease affects more than 5.8 million Americans. Many risk factors make an individual more likely to develop dementia and cognitive decline. These risk factors vary widely and include being genetically predisposed to Alzheimer’s disease and dementia and also practicing lifestyle habits that are believed to contribute to a person’s neurological health. We have examined and considered many of these factors and collected data from scientific papers. Using this data, we composed graphs, specific to each risk factor, to determine the percent risk which each risk factor presents to patients as a whole. Odds ratio comparison of several risk factors were obtained through database analysis, including ApoE e4, Hypertension (HTN), Diabetes mellitus (DM), Cholesterol, and 5 years or less education. We found that ApoE e4 (odds ratio 2.52) and limited education (odds ratio 2.32) show the greatest significance. Incredibly, limited education seems to show nearly as much significance as the genetic risk factor which is strongly associated with the development of AD. At the conclusion of this project, our goal is to combine all of the data gathered from literature analysis and to determine the overlapping risk for each risk factor and how it might increase one’s chances of developing cognitive decline or dementia. This research provides information on how to prevent or delay the progression of Alzheimer’s disease through lifestyle.

Kent Liu

West Brook Senior High-School, Beaumont, TX

Mentor: Xiangyang Lei*

*Department of Chemistry & Biochemistry, Lamar University

In recent years, the development of fluorescent chemosensors for the detection of metal ions, particularly toxic heavy metal ions such as mercury (II) in biological and environmental samples, have been an important research topic. In this study, a highly conjugated benzobis(imidazole) molecule was synthesized. Its structure was characterized by $^1$H and $^{13}$C NMR. The investigation of its photophysical properties indicates that it is a good chemo sensor for the mercury (II) ion.
Daniel Quispe

Research Experience for Undergraduates (REU)
Mentor: Dr. Jian Cao from Northwestern University,
Material Research Science and Engineering Center
Research in Material Sciences
Department of Mechanical Engineering

My undergraduate research journey began in my first semester of university when my older brother and I received an Office of Undergraduate research grant to conduct solar cell research. This introductory research experience cemented my determination to contribute to the effort made towards solving our world’s energy reliance on fossil fuels. Since then, my interest has matured as I continued working on this research project and applying to opportunities to help fund it. Thanks to the support from the McNair Scholar Program, I was able to continue the solar cell research throughout the summer of 2019. My curiosity in observing how weather conditions can affect the efficiency of solar cells led me to construct various indoor setups to evaluate the photo-power production efficiency of solar cells when under lab simulated weather conditions.

Thanks to my efforts and guidance from my mentor Dr. Cristian Bahrim, I was able to present the results at several professional gatherings. These gatherings consisted of Texas Undergraduate Research Day at the Capitol, the Undergraduate Research Conference hosted by the Ronald E. McNair Scholars Program (Buffalo, NY), and the Gulf Coast Undergraduate Research Symposium hosted by Rice University. These experiences have served to open up many pathways that will help to further my knowledge of solar cell research and ultimately prepare me for graduate school. From these experiences, I determined that the next steppingstone in my goal in preparing for graduate school was to participate in a Research Experience for Undergraduates (REU). I knew that by participating in this competitive nationwide opportunity, it would provide me an irreplaceable opportunity that would allow me to transition from my current undergraduate level of research towards experiencing research at a world-class level. In the summer of 2020, I was selected to participate in an REU with Northwestern University's Materials Research Science and Engineering Center. I worked under the guidance of Dr. Jian Cao, and my project looked to the mesoscopic characterization of triaxial braid composite fabrics with yarn angle variations. In working on this project and attending faculty talks throughout the summer, I was able to broaden and enrich my knowledge of professional research.
The effects of yarn variations on triaxial braid composites fabrics

Quispe, Daniel¹, Sikander, Qasim², Bisram, Marisa³, Dr. Cao, Jian⁴

1. Department of Mechanical Engineering, Lamar University, Beaumont, TX
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In the automobile industry, one of the most impactful improvements to a vehicle's fuel efficiency is the reduction of its weight. A recent research publication links 75% of fuel consumption directly to the weight of the automobile. Composites contain reinforced fibers made of either synthetic or natural materials, which makes them an excellent alternative to solitary metals and alloys without compromising structural properties. Composites such as carbon fiber reinforced polymers (CRFPs) weigh close to a fifth of steel and achieve a high power-to-weight ratio. Because of the lightweight properties of CRFPs and correlation to fuel efficiency, we look to altering the parameters of the composite to explore the full structural range of this composite material.

We do this by conducting a mesoscopic analysis to determine the capabilities of various representative volume elements of triaxial braid fabrics with different braid angles. Characteristics such as stiffness and fiber architecture alter when using different braid angles, which are used for failure analysis. We focus our project on the use of triaxial braided fabric due to its quasi-isotropic properties providing a stable homogenous behavior as compared to bi-axial woven fabrics. The dimensions of the two samples presented have a braid architecture of 0°/+30°/-30° and 0°/+45°/-45°. To predict the braided properties of our braided samples several simulations are conducted. The initial penetration free models are controlled by python scripting, where we can modify the yarn thickness and braid angle, and displayed using TexGen. With this model, we assign orthotropic material properties for the coefficient of thermal expansion and conductivity to prepare the sample for thermal expansion. By using an implicit simulation in Abaqus, the software can recognize the contact definitions of the yarns and prevent penetration when expanding. After reaching the desired yarn thickness, a mechanical simulation compresses the braid to the desired ply thickness. The finalized expanded and compressed yarn geometry is merged with a matrix and meshed with reduced order voxel elements to create a representative volume element (RVE) of the braided CRFP. In doing so, mass analysis, performed by using the volume of the axial, angled yarns, and matrix, allows us to solve for the model's fiber-volume-fraction (FVF). A linear elastic mesoscopic finite element (FE) simulation is then used to extract the orthotropic elastic constants from the RVE.

The elastic constants are collected to generate a library of RVEs of triaxial braid fabrics. The purpose of this library is to compare how these orthotropic materials' properties will change based on the braid angle. The library of results will continue to expand with each trial to eventually create a database for the use of a neural network to determine the required braid angle to achieve desired structural properties.

Acknowledgement – This work was supported by NSF funded Northwestern University Materials Research Science & Engineering Center’s Research Experience for Undergraduate program.
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THE NATIONAL CONFERENCE FOR UNDERGRADUATE RESEARCH
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PLAN TO JOIN
THE EXPO 2021 EVENT IN APRIL 2021
AT LAMAR UNIVERSITY
Dear STEM Conference Winners,

I am very sorry that I was unable to attend the 8th Texas STEM Conference. I was looking forward to congratulating each of you for your outstanding achievements, particularly in light of the pandemic and hurricanes. Your projects were excellent and each of you are very deserving of the recognition that you received. I am very proud of each of you and encourage you to continue pursuing research in your future academic endeavors and beyond.

-with Cardinal Pride!

Brian N. Craig, PhD, PE, CPE
Dean of Engineering
Charles and Eleanor Garrett Endowed Chair
Director, Mariner Safety Research Initiative
TEES Regional Director for Lamar University
University Scholar
Lamar University
Winners of the 8th Texas STEM conference

MY WARMEST CONGRATULATION FOR YOUR PERFORMANCE!

STEM SURF Session

First place – for Best STEM SURF presentation

Olivia Rigsby – Major in Geology
Mentor: Dr. Edgardo Pujols, Department of Earth and Space Sciences
Project “Onset of the Sevier Fold and Thrust Belt and Associated Foreland-Basin Sedimentation in Central Utah.”

Runners-up

Talon Weaver – Major in Physics and Civil Engineering
Mentor: Dr. Evgeny Romashets and Dr. Cristian Bahrim, Department of Physics
Project “Studying the Dynamics of Interplanetary Magnetic Clouds using a Toroidal Coordinate System.”

Menna Elsaka – Major in Chemistry and Biochemistry
Mentor: Dr. Ashwini Kucknoor, Department of Biology
Project “Akkermansia Muciniphila Correlation with Obesity and Metabolic Disorders.”
Best Presentation in the Session of Graduate Research at LU

First place – Graduate presentation

Divine Sebastian – Department of Mechanical Engineering / LU

Mentor: Dr. Chun-Wei Yao, Department of Mechanical Engineering / LU

Runner-up – Graduate presentation

Sayedah Farzana Aktar – Department of Computer Science / LU

Mentor: Dr. Stefan Andrei, Department of Computer Science / LU
Paper: “Classification of Heart Diseases using a Stethoscope-based Heart Sound Method.”
Best Presentation in the Session of Undergraduate Research at LU

First place – Undergraduate presentation

Emily Ingram¹ – Major in Chemistry  
Mentor: Dr. Ozge Gunaydin-Sen, Department of Chemistry and Biochemistry  
Paper: “Effects of Entry-level chemistry courses in STEM majors”  
Co-authors: Berna Eren-Tokgoz², Ashikur Rahman Abid², Morshedul Alam², and Mamta Singh³  
²Department of Industrial Engineering  
³Department of Teacher Education

Runner-up – Undergraduate presentation

Hannah Thompson – Major in Biology  
Mentor: Dr. Maryam Vasefi, Department of Biology  
Paper: “A Structured Intervention for Cognitive Decline”
JOIN OUR STUDENT ORGANIZATION

LAMAR UNDERGRADUATE RESEARCH ASSOCIATION (LURA)

“LURA was founded in fall 2019 to fulfill the need for a community by and for undergraduate students to discuss, collaborate, and learn how effectively one can conduct research. The consistent quality and volume of research conducted by undergraduate students at Lamar University has made it clear that there is a need for an organization to act as a vital resource for building young researchers. Thus, LURA provides an academic forum that connects all level students from freshmen to seniors with their professors and mentors, and facilitates communication between Lamar undergraduates and their peers around the nation.

LURA is a platform for offering panel discussions about

- Research opportunities inside and outside Lamar,
- Better ways to deliver undergraduate research results in poster and oral presentations,
- Ways to perform peer mentoring,
- Organizing workshops on various topics, including how to successfully apply to graduate schools.

LURA is the premier student organization at Lamar University for any undergraduate student interested in doing research. The Office of Undergraduate Research provides strong support and offers logistics to this student organization.” Please contact URA@Lamar@gmail.com or visit the Office of Undergraduate Research
Thank you