OFFICE OF UNDERGRADUATE RESEARCH
LAMAR UNIVERSITY

THE EIGHTH ANNUAL

UNDERGRADUATE RESEARCH & CREATIVE ACTIVITY EXPO 2021

APRIL 16, 2021

BALLROOM OF THE SETZER CENTER
ZOOM PLATFORM ID 864-8738-3914
PASSCODE 844-875

LAMAR UNIVERSITY
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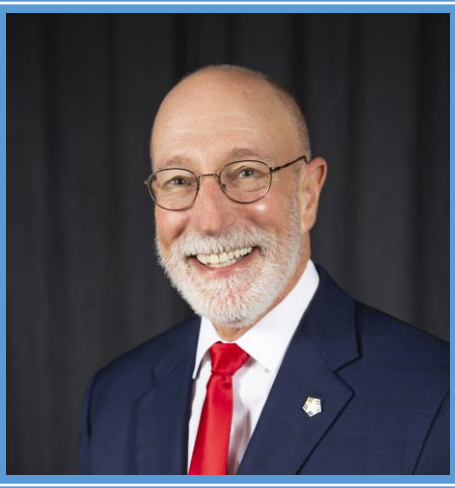
YOUR Moment IS HERE

Message from President Dr. Kenneth Evans



I'm delighted to have the opportunity to speak with you today. Congratulations to those of you who have been hard at work on your research to a point of presentation. I know you have pushed through some of the most difficult times and today we celebrate your scholarly achievements.

This EXPO is the last that I will attend as the President of Lamar University. Prior to my arrival here at LU, very little undergraduate research occurred. It was certainly not an organized program or activity. Typically, research is reserved for graduate students working on their master's thesis or doctorate dissertation and that was the thinking here at LU.

But we changed that tradition. We began undergraduate research in 2013 and held the first expo in 2014 where 26 students were awarded funding for research. Since that time, interest of Lamar University undergraduate students and faculty in research and creative activities has increased each year.

I appreciate the hard work of Dr. Cristian Bahrim, active director of the Office of Undergraduate Research, devoted faculty members who serve as mentors for student researchers, and to all of our undergraduate researchers who place a high value on the experience of research.

Undergraduate research was a priority to me when coming to Lamar University because of the invaluable benefits to students who conduct research. Through research, students increase their ability to think critically and become more aware of the world around them. Research improves a student's area of study and can make important contributions to the community and society, at large. Research is also helpful if you decide to further your education at the graduate level having already done faculty-mentored research.

Today has been full of significant research and presentations, posters, performances and the like, and keynote speaker Dr. Jay Prigmore, an LU alumnus who has had an illustrious career and is now with Google is slated to speak shortly, so let me say in closing… I am pleased with the undergraduate program we have built at Lamar University. I am proud of the students who have seen the value in research, have engaged in the program, worked hard and developed their research to a point of presentation, and I am confident your research will have a defining impact on your future and your careers.

Thank you for allowing me to address you all. Enjoy the event.

Dr. Kenneth Evans
President of Lamar University
April 16, 2021

Message from Lamar University's Provost and VPAA Dr. Brenda Nichols

Welcome to Lamar's Eight Annual Undergraduate Research and Creative Activity Exhibition. EXPO 2021 is organized by the Office of Undergraduate Research and is the showcase of undergraduate research and creative activities done at Lamar University during the current university year. The event offers the opportunity to undergraduate students for presenting research projects and ideas of their own design, developed under the mentorship of Lamar faculty.

This year's event brings nineteen oral presentations and seventeen posters, on topics ranging from Fundamental Sciences and Engineering, to Humanities, Arts, Social and Behavioral Sciences, Political Sciences, Communication, Sociology, Education, and Business.

Kudos to both students and faculty for their efforts in developing exciting projects and for reporting today, at EXPO 2021, so many innovative ideas and very interesting results. EXPO 2021 reflects the genuine creativity spirit of Lamar students and the commitment to student success from our faculty mentors. Enjoy the conference!

Dr. Brenda Nichols
Provost and VPAA - Lamar University
April 16, 2021

Welcome to EXPO 2021 from O.U.R. Director

Good morning, everyone!
And welcome to the Eighth Annual Undergraduate Research and Creative Activity Exhibition, EXPO 2021. This is the most comprehensive annual showcase of undergraduate research at Lamar University covering all academic areas. The nineteen talks and seventeen poster presentations are the result of our students' keen interest for discovery and for understanding our world. Many presentations come after one- or even two-year long research effort done based on extensive literature, complicated theoretical or numerical algorithms, and hands on experience in our academic labs. Today's presenters will show the potential Lamar has in offering research facilities and adequate support for running competitive undergraduate research projects at national and international levels.

The morning session will offer fourteen O.U.R. sponsored projects which started in early fall 2020 with a competitive selection process, where the successful proposals have been selected by two dozen Lamar faculty after careful review based on rigorous criteria. Up to $1,000 was offered by O.U.R. in research support for each project. Our students developed interesting projects which are reflected in high quality papers included in this book, as well as informative and inspiring videos available on Lamar's O.U.R. webpage as a legacy and inspiration for the next generation of students.

Today we have a special guest, Dr. Jay Prigmore, who started his successful professional career about fourteen years ago with an undergraduate research project in power engineering, here with us, for becoming now a technical program manager at Google Inc. Jay's successful journey was triggered by his curiosity and thirst of discovery, by unrest in understanding why and how things work in power engineering.

This EXPO event we host today, would not have been possible without the strong support from President Kenneth Evans and Provost Brenda Nichols to whom I want to thank heartly. My special thanks go also to all academic Deans and Chairs for their constant support and encouragement to faculty and students to follow the pathway of research and creativity.

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

Organizing Committee:

Dr. Nicki Michalski
Dr. Robert Kelley Bradley
Dr. Gevorg Sargsyan

ADVISORY BOARD of O.U.R. 2020-2021

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

Dr. Tracy Benson
College of Engineering

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Dr. Gevorg Sargsyan
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Dr. Monica Harn
College of Fine Arts & Communication

Dr. Matthew P. Hoch
College of Arts and Sciences

Dr. Xiangyang (Sunny) Lei
College of Arts and Sciences

Dr. Nicki Michalski
College of Fine Arts & Communication

Dr. Mamta Singh
College of Education and Human Development

Dr. Dorothy Sisk
College of Education and Human Development

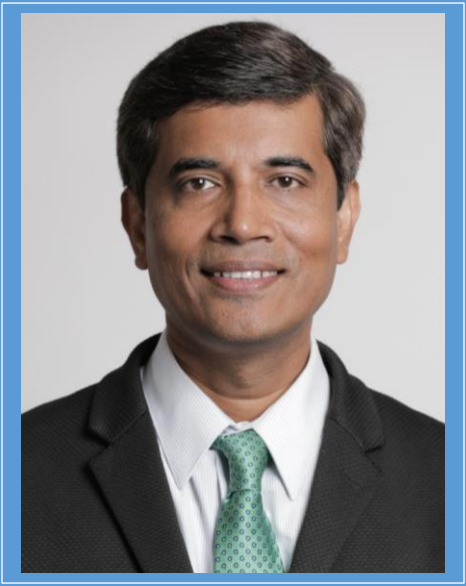
Dr. Robert Worley
College of Arts and Sciences

Dr. Juan Zabala
University Advancement

CONTACT US: CHEMISTRY BUILDING, ROOM 115A/B
P: 409-880-8290 Email: cristian.bahrim@lamar.edu

Message from the Founding Director of O.U.R. at Lamar University

Dr. Kumer Das



Dear Students, Colleagues, and Guests,

I would like to congratulate each of you who are involved in the Eighth Annual Undergraduate Research and Creativity Expo hosted by the Office of Undergraduate Research.

Participation in undergraduate research helps these students clarify their career path. Moreover, it helps students build transferable skills. This expo will provide them an opportunity to showcase their research activities from throughout the past year. Today, students from various disciplines will present their scholarly accomplishments done at Lamar, all done with an enthusiasm characteristic to their apprentice role in research and creative activity, thus showing their efforts to become good professionals in their field of interest. These papers highlight the impact done by Lamar students' research at the regional or national level. Students, today is the day for a celebration of your scholarly accomplishments. I would like to thank all the students, and their faculty mentors, for taking the time to share their work with the university community.

The COVID-19 pandemic has had a major impact on all academic research enterprises. While all researchers are facing issues with research due to pandemic related shutdowns, undergraduate researchers are facing a unique set of challenges. Many senior graduate students have adapted to perform work remotely, while some other graduate students have returned to the laboratory on a limited basis. However, in most cases undergraduate research has been paused or been postponed, as their work is not the topmost priority for most of the campuses. One of the primary objectives of undergraduate research is to “get your hands dirty” with in person experiences, which is not a reality during the pandemic. However, even after all those barriers, I am glad to see that Lamar has remained committed to undergraduate research. I would like to convey my sincere gratitude and thanks to President Evans, Provost Nichols, Director Bahrim and the entire OUR Advisory Council for providing support to all students and their mentors. Most importantly, students have finished their projects and are presenting their work today. It is a testament to their tenacity and their commitment. Congratulations, again!

I want to thank the Acting Director of OUR, Dr. Cristian Bahrim, for inviting me to speak to this event. I am glad to see that the Expo has expanded significantly under the leadership of Dr. Bahrim and the OUR Advisory Council. The journey that we started eight years ago has become a major component of Lamar culture and we all should feel proud of it!

Dr. Kumer Das
AVP for Research, Innovation and Economic Development and Assistant Provost
University of Louisiana at Lafayette
April 16, 2021

OFFICE OF UNDERGRADUATE RESEARCH
LAMAR UNIVERSITY

SPECIAL GUEST SPEAKER

(3:10 – 4:00 P.M.)

Dr. Jay Prigmore

Electrical Field Reliability Technical Program Manager
Google Inc.

Dr. Jay Prigmore received his bachelor's degree in electrical engineering from Lamar University and his M.S. degree and Ph.D. degree in electrical engineering from Arizona State University. His focus for all three degrees was Power Engineering.

He is presently employed at Google Inc. as an Electrical Field Reliability Technical Program Manager. Prior to his employment at Google, he was employed by Exponent Inc. and performed numerous failure analysis and root cause investigations. Upon graduation he was employed at G&W Electric Company where he was responsible for short-circuit protection devices, their manufacture and applications.

Dr. Prigmore developed a peer-reviewed arc flash mitigation device which won "product of the year" in electrical safety. He is a founding member of NFPA 78 and 1078 which provide guidance on performing electrical inspections and the qualifications of electrical inspectors, respectively. Dr. Prigmore has published approximately 20 peer-reviewed articles and has written two book chapters. He is actively involved in IEEE standards meetings, NFPA committees, and CIGRE workgroups. Dr. Prigmore presently holds twelve professional engineering licenses and he is certified to climb wind turbines.

OFFICE OF UNDERGRADUATE RESEARCH
LAMAR UNIVERSITY

All events will take place on Zoom platform with ID: **864 8738 3914**

WELCOME TO THE 8th UNDERGRADUATE RESEARCH EXPO

9:00 AM – 9:10 AM	Conference Overview – Dr. Cristian Bahrim, Acting Director of O.U.R.
9:10 AM – 9:15 AM	Welcoming Remarks – Dr. Brenda Nichols, Provost & VPAA
9:15 AM – 9:20 AM	Remarks – Dr. Kumer Das, AVP for Research, Innovation and Economic Development and Assistant Provost at the University of Louisiana at Lafayette

O.U.R. Sponsored Research

9:30 AM – 9:35 AM	Introduction of the O.U.R. program and 2020-21 O.U.R. grant winners
9:35 AM – 9:50 AM	**Talon Weaver** – Major in Civil Engineering and Physics Mentor: Dr. Evgeny Romashets and Dr. Cristian Bahrim Department of Physics Project *"Identifying Solar Sources of the Most Geo-Effective Interplanetary Disturbances."* (video 10:47)
9:50 AM – 10:03 AM	**Rebekah Schilberg** – Major in Chemistry Mentor: Dr. Suying Wei and Sylvestre Twagirayezu, Department of Chemistry and Biochemistry Project "*Rotational Signature of Perfluorooctanoic Acid (PFOA) as Revealed by Molecular Rotational Resonance Spectroscopy."* (video 7:55)
10:03 AM – 10:18 AM	**Nathan Rose** – Major in Mechanical Engineering Mentor: Dr. Sushil Doranga Department of Mechanical Engineering Project "*Designing and Testing an Event Data Recorder using Environmentally Friendly Thermal Insulation Materials."* (video 10:05)
10:18 AM – 10:36 AM	**Sarah Roden** – Major in Nursing Mentor: Dr. Gina Hale JoAnne Gay Dishman School of Nursing Project *"Standardized Patients' Perception of Student Nurse Care Compared to Registered Nurse Care."* (video 13:40)

10:36 AM – 11:00 AM **Katia Ortiz and Carlee Whitehead** – Major in Speech and Hearing
Mentor: Dr. Nandhakumar Radhakrishnan
Department of Speech and Hearing Sciences
Project *"Acoustic and Auditory Effects of COVID-19 Masks on Speech/Voice Communication."* (video 21:23)

11:00 AM – 11:14 AM **Lac Nguyen** – Major in Industrial Engineering
Mentor: Dr. Robert Kelley Bradley
Department of Industrial and System Engineering
Project "*Carding to Align Dry As-Produced Single Wall Carbon Nanotubes."* (video 8:31)

11:14 AM – 11:30 AM **Katelyn Maxwell** – Major in Mechanical Engineering
Mentor: Dr. Sushil Doranga
Department of Mechanical Engineering
Project "*Development of New Generation Electronic Chassis to Suppress Vibration During Transportation."* (video 11:34)

11:30 AM – 11:45 AM **Sierra Kondos** – Major in History
Mentor: Dr. Brendan Gillis
Department of History
Project "*Political Responses to the Satanic Panic in Texas"* (video 9:45)

11:45 AM – 11:56 PM **Cymone Houston** – Major in Civil Engineering
Mentor: Dr. Thinesh Selvaratnam
Department of Civil and Environmental Engineering
Project "*Development of Algal-based System for Produced Water Bioremediation*" (video 8:20)

11:56 AM – 12:10 PM **Kelvin Edgar** – Major in Chemical Engineering
Mentor: Dr. Clayton Jeffryes
Department of Chemical Engineering
Project "*Conversion of Corn Ethanol Waste to Value-Added Products by Algae"* (video 10:00)

12:10 PM – 12:27 PM **Katherine Correa** – Major in Drawing and Biology
Mentor: Dr. Robert Kelley Bradley
Department of Industrial and Systems Engineering
Project "*The Babe Zaharias Medals: Exploring Methods of Replication for a Promising Non-Contact Based Approach."* (video 12:42)

12:27 PM – 12:42 PM **Viviana Denova** – Major in Business and Finance
Mentor: Dr. Gevorg Sargsyan
Department of Economics and Finance
Project "*The Financial Impact of COVID-19 on Small and Medium Enterprises in Southeast Texas"* (video 10:33)

12:42 PM – 12:55 PM

Megan Cooper – Major in Biology
Mentor: Dr. Ian Y. Lian
Department of Biology
Project "*Analysis of cell growth and therapeutic efficacy of pancreatic cancer cells under varying oxygen environments."* (video 8:38)

12:55 PM – 1:13 PM

Kalen Baker – Major in Mechanical Engineering
Mentor: Dr. Ping He
Department of Mechanical Engineering
Project: "*Evaluation of Pair Potentials at Different Temperatures for Molecular Dynamics Simulation of Sintering*." (video 13:30)

1:13 PM – 1:15 PM

Closing the morning session and remarks for the afternoon sessions.

Poster Session I

Chairs: STEM areas Dr. Robert Kelley Bradley and Dr. Matt Hoch

Chairs: HASBSEB areas Dr. Dorothy Sisk and Dr. Gevorg Sargsyan

1:30 PM – 1:45 PM

Setting up the posters

1:45 PM – 2:45 PM

Presenters will deliver five-minute speeches for judges at 1:45, 2:05, and 2:25pm.

Special Sessions

2:45 PM – 2:55 PM

Choreography with performers from the Department of Theater and Dance
NEVER THE SAME
Choreographer..... Golden Wright
Music.....Experience by Ludovico Elinaudi
Performers.....Mia Paul, Serinity Schmitt, Jayda Winters
Costume Designer.....Liz Freese

2:55 PM – 3:00 PM

Remarks to EXPO 2021 event by President Kenneth Evans

3:00 PM – 3:10 PM

THE FACULTY MENTOR AWARD – a lifetime achievement award offered by The Advisory Board of O.U.R. to a faculty mentor with outstanding results in mentoring undergraduates – general presentation by Dr. Cristian Bahrim

RECOGNITION OF 2021 FACULTY MENTOR AWARD
Nomination by Dr. Sunny Lei, Assoc. Dean of the College of Arts and Sciences

Dr. Ozge Gunaydin-Sen, *Associate Professor of Analytical Chemistry, and Interim Chair of the Department of Chemistry*
Memories of being mentored by Dr. Sen by Caitlyn Clark and Emily Ingram

Congratulations, Dr. Sen!

Keynote Speaker at EXPO 2021

3:10 PM – 4:00 PM

OUR SPECIAL GUEST IS **DR. JAY PRIGMORE**, *ELECTRICAL FIELD RELIABILITY TECHNICAL PROGRAM MANAGER AT GOOGLE INC.*

Introduction by Dr. Gleb Tcheslavski, Associate Professor and Interim Chair of Drayer Department of Electrical Engineering

Dr. Prigmore's talk is about "*My career pathway: From prospective professional baseball player to engineer manager at Google Inc. How Lamar University played a pivotal role in my career path.*"

HASBSEB Breakout Session

Chair: Dr. Nicki Michalski

4:00 PM – 4:15 PM

Maissa Salibi – Major in Political Science
Mentor: **Dr. James Nelson**
Department of Political Science
Talk: "*Mail-In Voting*"
Research stage – advanced

4:15 PM – 4:30 PM

Elizabeth Nimmons – Major in Music Education
Mentor: **Ms. Debra Greschner**
Department of Music
McNair Program
Talk: "*The Pedagogy of Body Alignment*"
Research stage – advanced

4:30 PM – 4:45 PM

Olivia Malick – Major in Communication, Journalism Concentration
Mentor: **Dr. Kenneth Ward**
Department of Communication and Media
Talk: "*The Spread of Misinformation Online: A Different Kind of Pandemic*"
Research stage – advanced

4:45 PM – 5:00 PM

Herman McElroy – Major in History
Mentor: **Dr. Jeff Forret**
Department of History
Talk: "*The Strange Case of Mooney Allen: Lynchings in Jefferson County, Texas, 1900-1910*"
Research stage – in-progress

5:00 PM – 5:15 PM

Tim Cohrs – Major in Communication, Journalism Concentration
Mentor: **Mr. Stephan Malick**
Department of Communication and Media
Talk: "*Civic Engagement in a Small Texas City*"
Research stage – in-progress

Poster Session II

Chairs: STEM areas Dr. Robert Kelley Bradley and Dr. Matt Hoch

Chairs: HASBSEB areas Dr. Dorothy Sisk and Dr. Gevorg Sargsyan

5:15 PM – 5:45 PM Presenters will deliver five-minute speeches for judges at 5:20 and 2:40pm.

6:15 PM Setting down the posters

Recognition of Awardees at EXPO 2021
5:50 – 6:15 PM

Best Presentations for OUR Sponsored Research

Best Presentations for Early-Stage Research Level

Best Presentations for In-Progress Research Level

Best Presentations for Advanced Research Level

Most Interactive O.U.R. Presenter

THE CENTER FOR HISTORY AND CULTURE OF SOUTHEAST TEXAS AND THE UPPER GULF COAST AWARDS PRIZES OF $200 FOR THE BEST TALKS OR POSTERS PRESENTATIONS THAT SHED LIGHT ON OUR REGION. CENTER DIRECTOR DR. JUDITH LINSLEY WILL DO THE AWARDS PRESENTATION AND ANNOUNCE THE WINNERS.

Posters

Setting up Posters 1:30 to 1:45PM (or earlier)

Session 1 : 1:45 – 2:45 PM
Session 2 : 4:15 – 5:45 PM

Setting Down the Posters at 6:15 PM

Chairs: STEM areas Dr. Robert Kelley Bradley and Dr. Matt Hoch

Chairs: HASBSEB areas Dr. Dorothy Sisk and Dr. Gevorg Sargsyan

RESEARCH STAGE – EARLY STAGE

P.1

Cost and Benefit Analysis of 3D Printing Robot in Construction

Jesus Cardenas

Major in Construction Management

Co-authors: **Magdiel Torres** and **Holden Lewis**

Mentors: **Dr. Zhe Luo** and **Dr. Seokyon Hwang**

Reese Construction Management Program

P.2

Productivity, Cost, and Safety Benefits of Utilizing Concrete 3D Printing in the Construction Industry

Jesse Odom

Major in Construction Management

Co-authors: **Mario Cisneros** and **Noah McGallion**

Mentors: **Dr. Zhe Luo** and **Minkyum Kim**

Reese Construction Management Program

P.3

High Frequency Radar for Sabine-Neches Waterway and Galveston Bay

Rubi Garcia

Major in Civil Engineering

Co-authors: **Nayana Muppavarapu**

Mentor: **Dr. Liv Haselbach**

Civil and Environmental Engineering

P.4

Attitudes and Misconceptions of the Black Lives Matter Movement

Kyra Rost

Major in Sociology

Mentor: **Dr. Stuart Wright**

Department of Sociology, Social Work, and Criminal Justice

RESEARCH STAGE – IN-PROGRESS

P.5

Highly Selective Sensor based on Molecular Rotational Resonance Technique for Fast Monitoring Sulfur Dioxide in Ambient Air

Md Abrar Jamil

Major in Chemistry and Biochemistry

Co-authors: **Gregory D. Twing**[#,*]

Department of Chemistry and Biochemistry

Mentor: **Dr. Suying Wei**[#] and **Dr. Sylvestre Twagirayezu**[#]

[#]*Department of Chemistry and Biochemistry*

[*]*Department of Chemical Engineering*

P.6

Beta-Amyloid's Antibacterial Effects on Alzheimer's Disease

Caroline LeBlanc

Major in Chemical Engineering

Co-authors: **Paityn Warwick**

Mentor: **Dr. Maryam Vasefi**

[#]Department Biology

P.7

Fifty Year temporal and Spatial Trends in Water Quality of Sabine Lake Estuary

Jill Culp

Major in Biology

Co-authors: **Jared Brottem**

Mentor: **Dr. Matt Hoch**

Department Biology

P.8

Quantifying Aquatic Bacteria and Algae by Flow Cytometry using a BD FACS Melody

Nyah Sciarrilla

Major in Biology

Mentor: **Dr. Matt Hoch**

Department Biology

P.9

Knowledge and Awareness about Hearing Health and Conservation among College Students: The Use of Technological Devices

Sierra Hunnicutt

Major in Speech and Hearing Sciences

Mentor: **Dr. Lilian Felipe**

Department of Speech and Hearing Sciences

RESEARCH STAGE – ADVANCED

P.10

Investigating Traffic Crashes Involving Autonomous Vehicles

Jesus Torres

Major in Industrial Engineering

Department of Industrial Engineering

Mentor: **Dr. Yueqing Li**

Director of Driving Simulation Lab
Director of Human-Computer Interaction Lab
Department of Industrial and Systems Engineering

Department of Industrial and System Engineering

P.11 *(withdrew)*

Stabilization of Dredged Material

Zachariah Payne

Major in Civil Engineering

Co-authors: **Bryan Brown, Danae Licatino,** and **Taylor Rogers**

Mentors: **Dr. Mien Jao**

Dr. Paul Bernazzani, Dr. T.Thuy-Minh Nguyen, and **Jasmin Harmon**

Department of Civil and Environmental Engineering

P.12

Impact of Dizziness on the Quality of Life and Prevalence of Falls in the Elderly Population of Beaumont

Ashley Staggs

Major in Speech and Hearing Sciences

Mentor: **Dr. Lilian Felipe**

Department of Speech and Hearing Sciences

O.U.R. SPONSORED RESEARCH

P.13

Standardized Patients' Perception of Student Nurse Care Compared to Registered Nurse Care

Sarah Roden
Major in Nursing
Mentor: Dr. Gina Hale
JoAnne Gay Dishman School of Nursing

P.14

Acoustic and Auditory Effects of COVID-19 Masks on Speech/Voice Communication

Katia Ortiz and Carlee Whitehead
Major in Speech and Hearing
Mentor: Dr. Nandhakumar Radhakrishnan
Department of Speech and Hearing Sciences

P.15

The Financial Impact of COVID-19 on Small and Medium Enterprises in Southeast Texas

Viviana Denova
Major in Business and Finance
Mentor: Dr. Gevorg Sargsyan
Department of Economics and Finance

P.16

The Babe Zaharias Medals: Exploring Methods of Replication f or a Promising Non-Contact Based Approach

Katherine Correa
Major in Drawing and Biology
Mentor: Dr. Robert Kelley Bradley
Department of Industrial and Systems Engineering

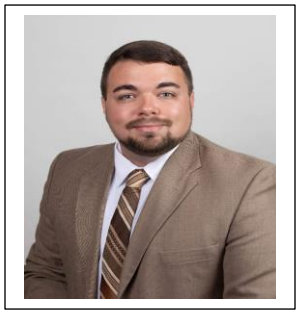
P.17

Analysis of cell growth and therapeutic efficacy of pancreatic cancer cells under varying oxygen environments

Megan Cooper
Major in Biology
Mentor: Dr. Ian Y. Lian
Department of Biology

O.U.R. Sponsored Research - Grantees for 2020-21 Research Narratives

Talon Weaver
Major in Civil Engineering and Physics
Mentor: Dr. Evgeny Romashets and Dr. Cristian Bahrim
Research in Physics
Department of Physics



Identifying Solar Sources of the Most Geo-Effective Interplanetary Disturbances.

Premises of our Theoretical Model and Background

This research considers different types of solar events such as disappearing solar filaments, solar flares (eruptive and non-eruptive) and associates them to geo-magnetic storms that have been recorded between 1998 and 2000. This corresponds to a period when an unusually large number of solar activities took place. The stronger solar events are responsible for the ejection of proton and electron streams which form Interplanetary Magnetic Clouds (IMC). The ejected material detaches from Sun's corona and propagates towards the Earth as clouds of toroidal shape. Eligible solar events for producing geomagnetic storms should fit the geo-effective cone of -40° to 40°. Using the data provided from the Wilcox Solar Observatory (WSO), one can determine if these clouds will fit within a geo-effective cone that has been established. Should these clouds be ejected with coordinates that are less than 40°, they are considered acceptable candidates for modeling magnetic clouds responsible for known geomagnetic storms.

Our dynamic model describes the evolution of the IMC through the Heliosphere using certain characteristics such as cloud speed, magnetic field strength, and proton number density, and compares key reference data with experimental data offered by reliable sources. Using documented solar and geo data offered by such sources including Wind and ACE satellites, our dynamic model is assessed, and our results validated. The key refence data used for the validation of our dynamics model are the speed of the cloud and the time of travel from 2.5 solar radii to 1 AU through the Heliosphere. One of the key findings is the ratio of the outer versus inner radii of the toroidal shaped cloud called 'aspect ratio'.

The modeling process uses data collected in real time measurements done by satellites and adopts four adjustable factors. These factors deal with three forces responsible, according to Ivanov et al. [1993], for driving the magnetic cloud through Heliosphere, including the gravitational pull from the Sun, the drag force, and the diamagnetic force. The adjustment of these parameters is done until an agreement of few percentile difference is reached between observed values for the speed of the magnetic cloud and the time of travel from 2.5 solar radii to 1 AU through the Heliosphere and the numerical values calculated with our model.

In our model we assume that the dynamics of the magnetic clouds are determined mostly by the action of diamagnetic force from [1]. In [1] the cloud was considered as prolate ellipsoidal of rotation. Ivanov et al. [2] used this idea in application to the oblate ellipsoidal magnetic cloud. Romashets and Vandas [3] considered motion magnetic clouds in the form of a toroid. Romashets et al. [4] and Vandas and Romashets [5] modeled

toroids' acceleration in interplanetary magnetic field (IMF) modified by heliospheric current sheet (HCS). Vandas and Romashets [6] determined bow shock surface around toroidal magnetic cloud. Romashets and Vandas [7] developed linear force-free configuration which fits toroidal boundary conditions.

Purpose Statement

The study of geomagnetic storms is relevant because they can produce significant disruptions of power grid lines and negative impact on the low altitude artificial satellites. One better known example of this negative impact happened on March 13, 1989, when a strong geomagnetic storm struck the Earth causing a 9-hour outage of the Hydro-Quebec electricity transmission system. The Quebec Blackout was produced by a strong solar storm that happened about 3 days earlier when a one-billion-ton of particles was ejected from the Sun's surface as a Coronal Mass Ejection (CME). This event was unique because of the unambiguous correlation between a specific solar activity and a strong geomagnetic storm. In most of cases when geomagnetic storms form, we do not know for sure what solar activity out of a set of solar events happening within 1-2 days is the one responsible for that geo-storm. *The purpose of this research project is to find the unambiguous correlation between a known geomagnetic storm and the solar activity that produces it.*

In general, it is important to alarm people on Earth and nearby satellites about the possible impact of solar activities, so proper preventive actions can be taken while the magnetic cloud travels toward Earth (which takes about 2-3 days). Having accurate data that can be used to determine probable outcomes of strong CME would be beneficial for spacecraft and other land-based systems, which are badly impacted when the cloud reaches the Earth's orbit.

Method

Once an IMC becomes eligible for study, we choose a set of parameters for our dynamical model. This data is necessary to describe the "quiet period" before the storm and defines the background level characteristic to the unperturbed Heliosphere before the solar activity disturbs it. The needed parameters are extracted from plots like in Figures 1 and 2. Thus, Figure 1 provides the proton number density near Earth's orbit prior to the disturbances in the outer heliosphere caused by an IMC, while Figure 2 shows the solar wind during the same time interval. The typical value of the solar wind near Earth's orbit is about 400 km/s. Figure 1(a) and (b) provide one-minute data for the proton number density and solar wind speed values.

Figure 2 allows to find the time interval when the cloud impacts the Earth's orbit, including the arrival and departure time of the cloud in the proximity of the Earth, as well as the arrival of the cloud's center of mass near the Earth's orbit. Their determinations are shown in Figure 3. The proton density and solar wind speed graphs provide data in one-minute intervals. The plasma β parameter is defined as:

$$\beta = \frac{nkT\mu_0}{B^2} \qquad [1]$$

and is displayed in Figure 2(c). In Eq. [1] n represents the number density (m^{-3}), k is the Boltzmann constant, μ_0 is the permeability of free space, T is the temperature (K), and B is the magnetic field strength (T) near the Earth's orbit.

The β-factor is unitless and it varies largely before, during, and after the time of interaction. Before the cloud arrives, the β-factor is much greater, while during the cloud's passage by the Earth, the β-factor drops to a minimal value. This is an indication that the cloud has reached the Earth's orbit, allowing now to determine 1) the number density of the particles inside the magnetic cloud and 2) the average speed of the particles inside the cloud needed

by our dynamical model. These values are used as input parameters in our model for the purpose of describing the motion of the magnetic cloud.

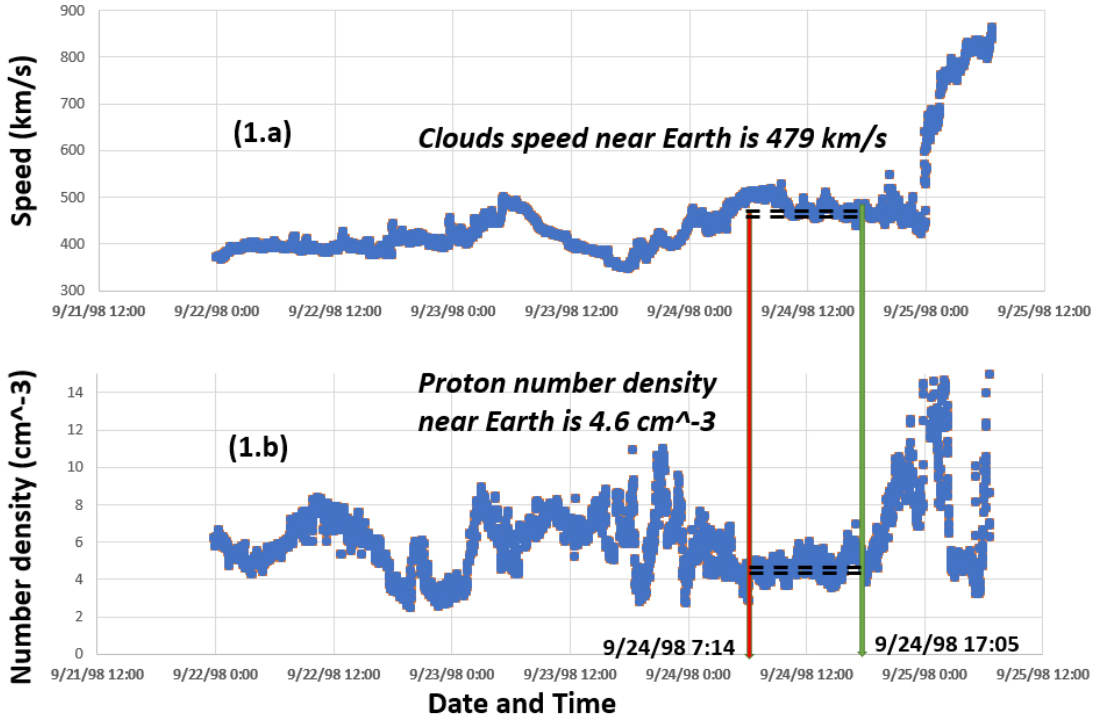


Figure 1 *Data for the solar wind speed (1.a) and proton number density (1.b) during the "quiet period" prior to the IMC arrival. The vertical lines mark the time interval used for our calculations and the average values of speed of the solar wind and the interplanetary proton density before IMC arrives near Earth are marked on each graph.*

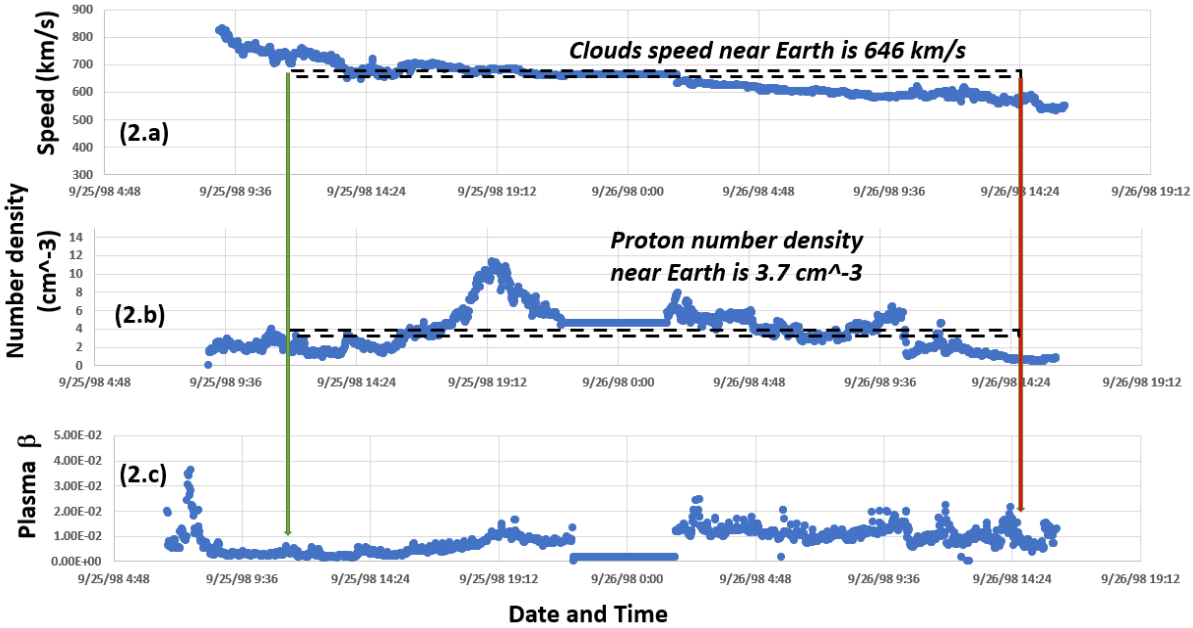


Figure 2 *We show the IMC speed (2.a) and the proton number density (2.b) near the Earth's orbit; (2.c) shows the plasma β parameter defined in eq. [1] during the IMC passage near Earth. The vertical lines mark the time interval used for our calculations and the average values of IMC's speed and proton density near Earth are marked on each graph. The case shown here is for event 5 from Table 1.*

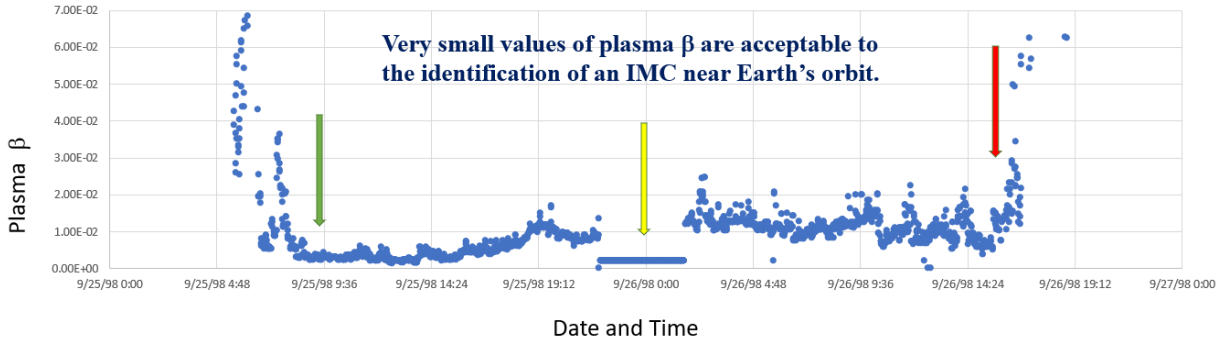


Figure 3 *We show the plasma β parameter defined in eq. [1] for event 5, which will be discussed in detail in the section "Results and Discussion". The vertical left arrow indicates the arrival of the IMC near Earth's orbit; the vertical right arrow indicates the departure of the same IMC, while the middle arrow indicates the arrival of IMC's center-of-mass.*

Using the data provided by the Wilcox Solar Observatory (WSO) it is possible to extract the Sun's magnetic field at 2.5 solar radii at the point where the IMC is launched. The value for this field (labelled B) is unique for each solar event and for a particular set of solar activities will be reported (see later, in Table 2). Using the values discussed above, our dynamic model calculates the arrival time of the center of mass of the cloud (see Figure 3).

Four adjustable parameters are used for finding values of the time of flight of IMC from source surface located at 2.5 solar radii to the Earth's orbit and its speed upon arrival to the Earth's orbit. These parameters are the coefficient of drag, the aspect ratio of the toroid, the expansion factor of its inner and outer radii. Finally, the similarity S-factor defined as:

$$S=\sqrt{\left(\frac{(Model\ time-Experimental\ time)}{Experimental\ time}\right)^2+\left(\frac{Model\ speed-Experimental\ speed}{Experimental\ speed}\right)^2} \qquad [2]$$

is evaluated. The S-factor can be as small as a few percent for a correct identification of the solar activity responsible for a specific geomagnetic storm. The aspect ratio is typically close to 1.5. Even if the S-factor is small, but the speed of IMC is large near 2.5 solar radii, it rules out these sets of adjustable parameters. At 2.5 solar radii, the solar wind typically does not exceed 2000 km/s.

Results and Discussions

We study 14 geomagnetic events that happened between May 15, 1997 and July 15, 2000 (listed in Table 1) and their possibly related solar activities. This corresponds to a period with a significantly large number of solar activities than usual.

We consider the event 5 particularly attractive to be reported here, as a trial case for our studies. In table 2 we give various solar activities included in the WSO database that can be associated to event 5. For some of these solar activities, the similarity S-factor is calculated and reported in the last column of Table 2, so a trend for its variation can be easily observed. In principle, the smaller the S-factor the better our dynamic model is describing the propagation of the IMC through heliosphere. Therefore, it seems that having a S-factor close to zero is the best-case scenario, and that solar activity can be responsible for a particular geomagnetic storm. However, other additional factors come into consideration for a correct correlation of the geomagnetic storm to a particular solar activity, which should occur typically about 3 days earlier.

NN	**yyyy mm dd**	DOY	**Ap-Index**								
			0-3h	3-6h	6-9h	9-12h	12-15h	15-18h	18-21h	21-24h	Ap avg
1	**1997 / 5 / 15**		135	27	18	111	111	94	56	15	15	56
2	**1997 / 11 / 23**		327	154	132	39	56	39	7	15	27	59
3	**1998 / 5 / 4**		124	80	300	236	67	80	22	9	15	101
4	**1998 / 8 / 27**		239	207	207	179	111	111	111	132	94	144
5	**1998 / 9 / 25**		268	179	207	236	132	94	67	12	9	117
6	**1998 / 10 / 19**		292	56	111	27	48	94	80	48	32	62
7	**1998 / 11 / 9**		313	39	67	111	94	80	56	111	39	75
8	**1999 / 2 / 18**		49	39	80	111	111	111	56	80	48	80
9	**1999 / 10 / 22**		295	132	179	207	56	39	32	67	18	91
10	**2000 / 2 / 12**		43	80	80	80	111	67	32	18	15	60
11	**2000 / 4 / 6**		97	6	32	12	9	18	111	236	236	82
12	**2000 / 5 / 24**		145	207	179	80	67	48	48	80	32	93
13	**2000 / 6 / 8**		160	12	22	32	94	132	94	80	48	64
14	**2000 / 7 / 15**		197	15	22	39	32	207	300	400	300	164

Table 1 *Fourteen geomagnetic storms (the first column indicates the event#) that happened between May 15, 1997 and July 15, 2000. Column 3 gives the day of the year associated to the calendar day (e.g. 1997/5/15 is the 135th day of year 1997). From column 4 to 11, we have the Ap index calculated for every three hours. In the last column we have the daily Ap average.*

We consider the event 5 particularly attractive to be reported here, as a trial case for our studies. In table 2 we give various solar activities included in the WSO database that can be associated to event 5. For some of these solar activities, the similarity S-factor is calculated and reported in the last column of Table 2, so a trend for its variation can be easily observed. In principle, the smaller the S-factor the better our dynamic model is describing the propagation of the IMC through heliosphere. Therefore, it seems that having a S-factor close to zero is the best-case scenario, and that solar activity can be responsible for a particular geomagnetic storm. However, other additional factors come into consideration for a correct correlation of the geomagnetic storm to a particular solar activity, which should occur typically about 3 days earlier.

For event 5 we observe a continue decrease of the similarity S-factor for solar activities reported between 9/21/98 at 6:22 (AR 2110) and 9/23/98 at 12:22 (AR 2380). AR stands for 'active region'. This trend is typical for any set of solar activities that happened to be in a short temporal interval and could potentially be associated to a geomagnetic storm. This is a reliable way for hunting the actual solar activity which is responsible for a given geomagnetic storm. In the case of event 5, we found that while the S-factor reaches a minimum value of 0.5, one should not hurry to conclude based solely on this very small value that the solar activity with minimum S is unambiguously responsible for a given geomagnetic storm. An important analysis comes from the trend in the velocity of the IMC near 2.5 solar radii, as well as the trend of the aspect ratio from close distance to Sun, to the edge of the heliosphere (which is 220 solar radii from the Sun). In Figures (4.a) and (4.c), we show the speed of the IMC through the heliosphere for two solar activities: at 9/22/98 at 23:55 (AR 2110) and 9/23/98 at 12:22 (AR 2380), respectively. The AR 2110 produces an IMC with a maximum speed near 2.5 solar radii of about 6000 km/s. This value is way too large for an acceptable speed of a typical IMC, and therefore, it is completely unacceptable. This leads us to the definitive conclusion that AR 2380 cannot be associated to the geomagnetic storm.

One last observation: The variation of the major and minor radii of the toroid can be a good indicator of the eligibility of the flare. Having dimensions of IMC almost constant as the IMC travels, as shown for the flare of AR 2380 in Figure (4.b), is not realistically possible, due to the static magnetic pressure. As the IMC travels away from the Sun the total external pressure decreases and then the cloud should expand. The dimensions of the IMC increase as the cloud approaches the Earth's orbit, consistent with Figure (4.d) for the flare of AR 2110. Therefore, we can say that only AR 2110 is a good candidate for generating event 5.

						Time of travel of CoM				S-factor
Time and Date	Index	θ (deg.)	φ (deg)	Δφ	B	Model	Measurement	A	B	$S=\sqrt{A^2+B^2}$
9/21/98 6:22	1580	20	10.02	-37.00	4.405	4.73	4.11	Δt/t_exp (%)	Δv/v_exp (%)	36.8
9/21/98 7:14	1590	18	11.55	-35.00	4.413	4.69	4.07			36.3
9/21/98 18:18	1680	18	11.46	-29.00	4.403	4.23	3.61			
9/22/98 4:59	1840	20	9.59	-25.00	4.130	3.79	3.17			
9/22/98 11:07	1940	21	14.21	-17.00	4.996	3.53	2.91			
9/22/98 11:05	1970	39	358.08	-33.00	3.131	3.53	2.91			19.9
9/22/98 12:07	1980	-21	2.66	-28.00	0.228	3.49	2.87			31.7
9/22/98 23:55	2110	18	10.17	-14.00	5.190	3.00	2.38	5.7%	4.6%	7.3
9/23/98 0:37	2140	-20	1.79	-22.00	0.126	2.97	2.35			
9/23/98 4:39	2240	40	357.42	-24.00	3.102	2.80	2.18			
9/23/98 7:06	2320	18	11.22	-9.00	4.377	2.70	2.08			5
9/23/98 12:22	2380	22	14.33	-3.00	5.057	2.48	1.86			0.5
9/23/98 19:49	2450	21	15.23	2.00	5.195	2.17	1.55			9.9
9/23/1998 20:42	2460	37	358.59	-14	3.117	2.13	1.51			13.8
9/23/1998 22:24	2500	-19	359.66	-12	0.130	2.06	1.44			
9/23/1998 22:47	2510	21	15.60	4	5.216	2.05	1.43			

Table 2 *This table lists solar flares that happened a few days before geomagnetic storm associated with the event 5. The table includes: the angles θ and φ of the solar coordinates of the flares; the magnetic field B (in T) at 2.5 solar radii surface; the time of travel of the center of mass (CoM), calculated with our model (titled 'Model') and measured with satellites (titled 'Measurement') given in days. The last column shows the S-factor for selected ARs to observe a trend. The flare in AR 2380 is presumed being responsible for event 5 due the small value for S-factor, of 0.5%. After the analysis of the IMC's speed and aspect ratio from Figures 4, the flare from AR 2110 became the most likely source for event 5.*

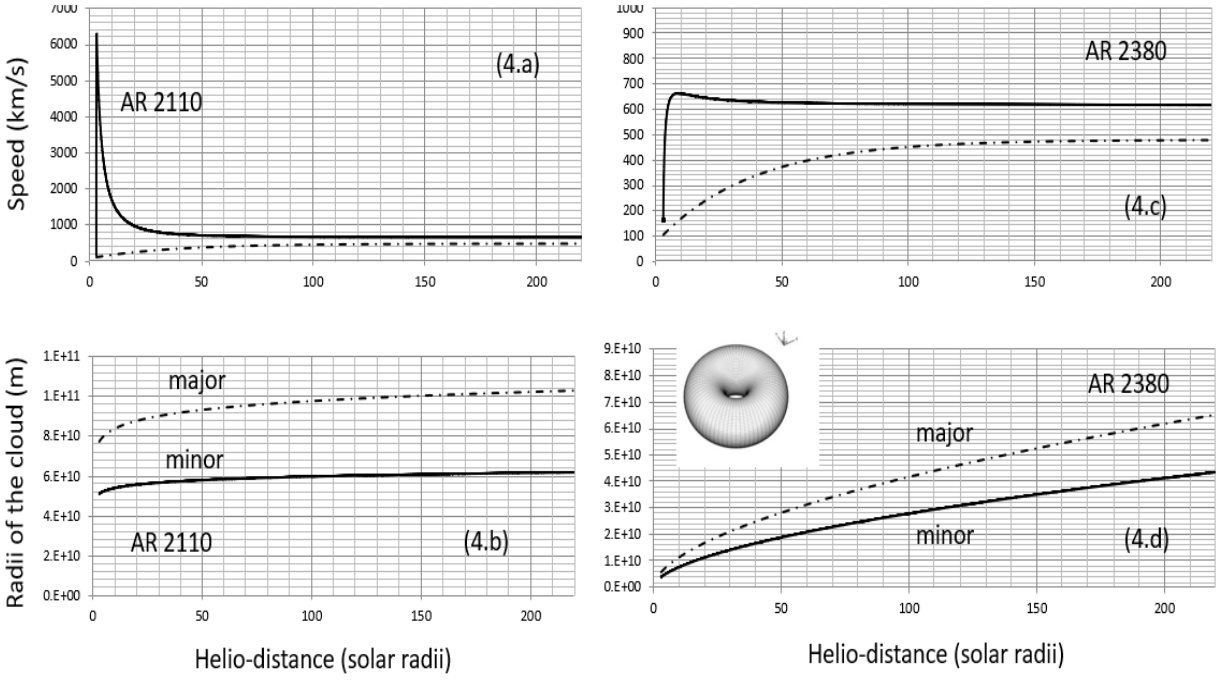


Figure 4 *Analysis of AR 2110 (4.a) and (4.b) and AR 2380 (4.c) and (4.d). For the top graphs labelled (4.a) and (4.c) the solid line shows the model speed of an IMC, while the dot-dashed line shows the solar wind speed. The peak speed of AR 2110 at 2.5 solar radii in (4.a) is approximately 6000 km/s and it is slowing down to about 580 km/s, while for AR 2380 in (4.c), it remains at about the same value of 600 km/s. The bottom graphs (4.b) and (4.d) show the major (dot-dashed) and minor (solid) radii of the magnetic cloud as the IMC moves from Sun to the Earth. The inset of toroidal shaped cloud has a typical aspect ratio of 1.5 as given in [7].*

In summary, despite the solar flare of AR 2110 has a larger S-factor 7.3%, than that of AR 2380, the variation of the IMC's speed and the increase of cloud's dimensions lead unambiguously to the conclusion that AR 2110 is responsible for the geo-event 5.

Conclusion

Finding relevant patterns for selecting the most geo-effective storms to disappearing filaments and solar flares provides the basis for developing new theories into forecasting strong solar activities which could have the potential to produce strong magnetic storms near/on Earth. Designing a statistical model in this direction requires reliable information and robust physical model such as what was detailed in this report for predicting a potential danger for Earth, and proactively responding to eliminate possible large-scale electric power blackouts and other massive disruptions of our electric grid lines and electronic equipment.

References

[1] E. Parker, *The Gross Dynamics of a Hydromagnetic Gas Cloud*, Astrophysical Journal Supplement, **3**, 51-76, 1957.

[2] Ivanov K. G., Kharshiladze A. F., Romashets E. P., *Solar Flares, Magnetic Clouds, and Geomagnetic Storms*, Solar Physics, **143**, 365-372, 1993.

[3] Romashets E. P. and M. Vandas, *Dynamics of a toroidal magnetic cloud in the interplanetary space*, Journal of Geophysical Research, **106**, 10615-10624, 2001.

[4] Romashets, E., M, Poedts, S., *Plasma flows around magnetic obstacles in the solar wind*, Astronomy and Astrophysics, **475**,1093-1100, 2007.

[5] M. Vandas, E. P. Romashets, *Dynamics of a toroidal magnetic cloud: A semi-analytic approach*, AIP Conference Proceedings, **1539**, 287-290, 2013a.

[6] M. Vandas and E. Romashets, *Magnetic field disturbance in front of a super-sonic toroidal magnetic cloud*, AIP Conference Proceedings, **1539**, 28 283-286, 2013b.

[7] Romashets, E., Vandas, *Modeling Irregularities in Solar Flux Ropes*, Solar Physics, **284**(1), 235-243, 2013.

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Rotational Signature of Perfluorooctanoic Acid (PFOA) as Revealed by Molecular Rotational Resonance Spectroscopy

Introduction

Perfluorooctanoic acid (PFOA) is one of many perfluorinated chemicals which has found use in industrial processing due to their resistance to heat, water, and oil[1]. This versatility has placed PFOA in fire-fighting foams, food packaging, clothing, cleaning products, and many other industrial applications. Although this molecule is beneficial for these industries, PFOA has recently been connected to various environmental and health issues developed from PFOA groundwater contamination[2], creating a need for the fast detection of this molecule. The current methods of PFOA identification include chromatographic methods, but the accuracy of these methods require long periods of hours of operation, sample treatments, and frequent internal standard calibrations[3]. Molecular Rotational Resonance (MRR) Spectroscopy, which characterizes polar molecules through their rotational signature, is highly suited for the analysis of different species in complex mixtures. The first step in an MRR study is to record broadband spectra of the compound(s) of interest to identify the conformational isomers that are present, and to determine the characteristic spectral signature of the molecule. In this project, we analyzed the first rotational signature of PFOA using quantum chemistry calculations to guide our experimental observations. A total of six conformers have been assigned and their structures identified in these measurements.

Methods and Discussion

The MRR spectrum of PFOA, which is recorded in the 2-8GHz frequency range, is presented in the Fig.1. From this spectrum, six conformers were identified and confirmed using ab-initio calculations. These calculations were performed using 1-D potential energy scans at a WB97X-D/6-311+G[21] level of theory, implemented in Spartan 18. Each of the rotatable bonds in PFOA was scanned in steps of 10 degrees to determine the possible minima for each dihedral angle. The resulting conformers were then re-optimized in Gaussian 16 at the B3LYP-D3BJ/6-311++G(d, p) level of theory to determine relative energy, optimized geometry, dipole moments, and rotational constants of PFOA.

To confirm the identity of each observed conformer, the measured parameters are compared to calculations. The assignment is considered solid if (i) the difference between experimentally determined rotational constants and ab-initio predictions is 1.5% or better, and (ii) the experimental ratio of dipole moments agree with *ab initio* predictions. Using the above criteria, six conformers are identified and given in Figure 1.

Conclusion

The rotational signature of PFOA in 2-8 GHz frequency range is obtained using MRR spectroscopy. Six conformers have been assigned in the spectrum and their structures identified through comparison to *ab initio* calculations. The factors in determining the stable conformers include the minimization of repulsion interactions between F atoms and carboxylic acids, and (2) the induction of possible weak intramolecular interactions upon rotating one or more internal carbon-carbon atoms. This work set the stage for MRR applications as potential of the analysis of PFOA in environmental matrices.

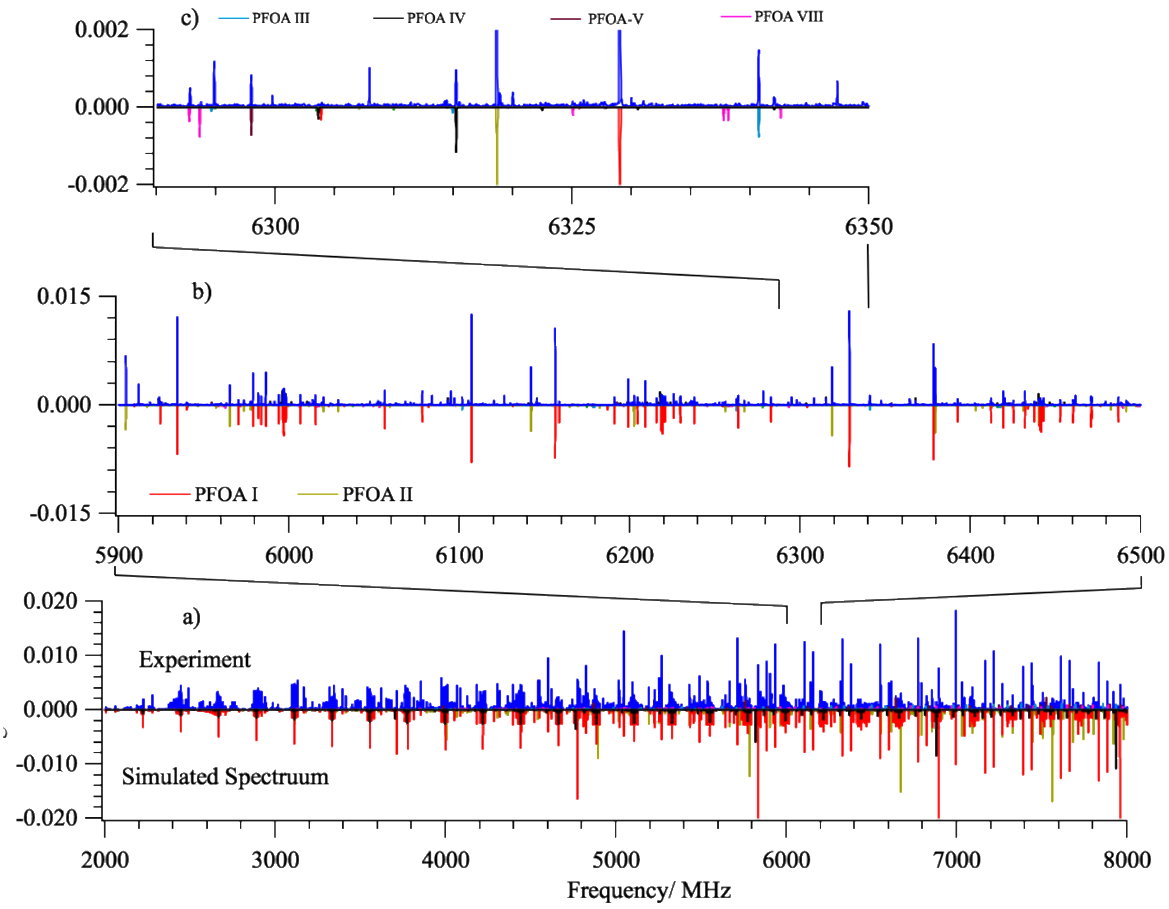

Figure.1. The molecular rotational resonance spectrum of perfluorooctanoic acid(PFOA) resulting from signal averages of 200,000 shot in the 2-8GHz. (a) Observed rotational patterns of PFOA(blue) matched to simulated rotational patterns using experimental best fit parameters and calculated dipole moments components. (b) and c zoomed spectrum to show the patterns of for seven identified conformers.

References

[1] A. B. Lindstrom, M. J. Strynar, E. Laurence Libelo, Polyfluorinated Compounds: Past, Present, and Future, Environ. Sci. & Technol. 45 (2011) 7954–7961. doi:10.1021/es2011622.

[2] H.M. Shin, V.M. Vieira, P.B. Ryan, R. Detwiler, B. Sanders, K. Steenland, S.M. Bartell, Environmental fate and transport modeling for perfluorooctanoic acid emitted from the Washington works facility in West Virginia, Environ. Sci. Technol. (2011). doi:10.1021/es102769t.

[3] A.E. Robel, K. Marshall, M. Dickinson, D. Lunderberg, C. Butt, G. Peaslee, H.M. Stapleton, J.A. Field, Closing the Mass Balance on Fluorine on Papers and Textiles, Environ. Sci. Technol. 51 (2017) 9022–9032. doi:10.1021/acs.est.7b02080.

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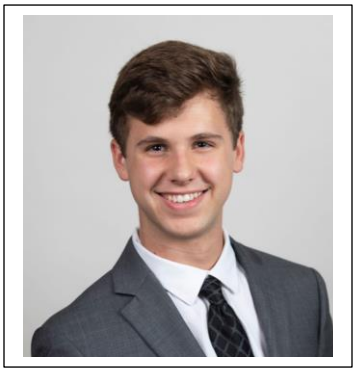

Designing and Testing an Event Data Recorder Using Environmentally Friendly Thermal Insulation Materials

An Event Data Recorder (EDR) is responsible for recording the events before, during, and after an accident involving an aircraft, locomotive, or automobile. The data that is collected and stored allows for investigators to examine the events that occur during an accident and determine the cause. The electronics of an EDR are comprised of programable Printed Circuit (PC) board that contains the memory and power chips necessary in order for the EDR to record data. These electronic components are housed in an insulated metallic container. The purpose of the container is to protect the memory chips from heat, static, crushing impact, penetration, and in-service vibration. In order to protect against ambient heat, most EDR's utilize phase change materials which are often toxic and harmful to the environment. The purpose of this project was to identify materials that are environmentally friendly while also being capable of protecting sensitive electronics from high temperatures and integrate them into a design for a new type of EDR.

The initial goal of my research was to identify the best insulating materials for use in the EDR. After careful consideration and many simulations, it was decided that the best insulation to use would by a type of flexible microporous insulation from Morgan Thermal Ceramics called WDS® LambdaFlex™ Super. This insulation is known for its extremely low thermal conductivity and lack of any hazardous substances. In addition to the microporous insulation, my EDR design would require a type of thermal block that would encapsulate the electronics. After a few days of research, I decided that the best material for the thermal block would be Muscovite HP5 Mica Paper from Asheville-Schoonmaker Mica Co. This material is comprised of natural mica that is bonded with silicone to add strength and ductility. This material was chosen because of its low thermal conductivity and its ability to absorb and disperse heat in a way that would not only protect the electronics from ambient heat in the case of an accident, but also allow heat generated by the electronics during operating conditions to escape.

After deciding the best materials to use, I was able to work on designing the 3D model in Solidworks so that I would be able to run thermal simulations using both computational fluid dynamics (CFD) and finite element

analysis (FEA). It was important to use multiple designs during simulations in order to best determine the chip orientation, insulation thickness, and other important design characteristics.

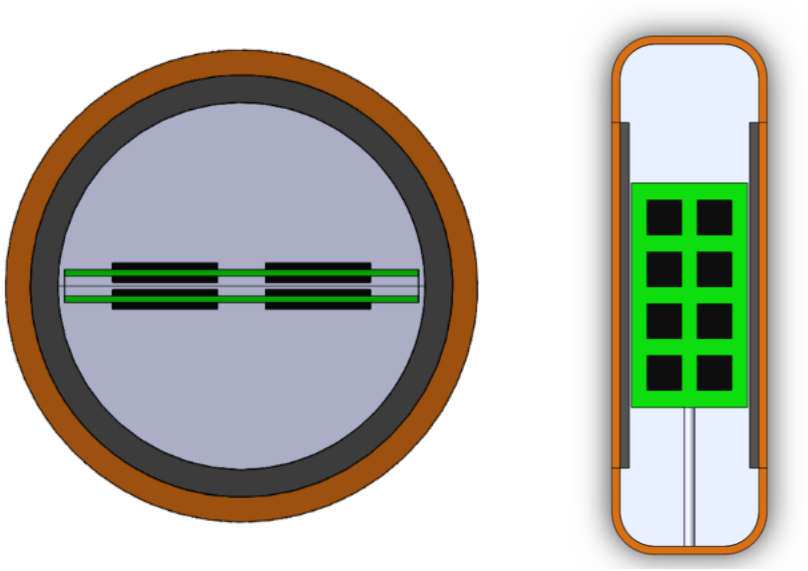

Figure 1: Design I Cross Sections

Figure 1 shows two cross sections of the first design. The FPGA chips are situated on two sperate PC boards and are each placed into a groove cut into the thermal block upon assembly. This design ensures a easy assembly process, but allows for a pocket of air in between the PC boards that is not ideal.

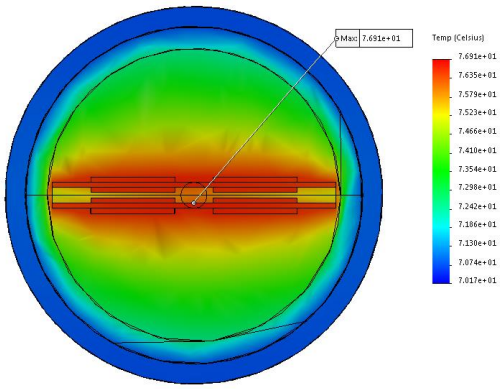

Figure 2: Design I During Operating Conditions

Figure 2 shows the temperature distribution across the different layers of the event records during the operating condition. The operating condition simulation (steady state thermal simulation) was done by using the finite element tools. The thermal conductivity, specific heat, and deansity for each material was extracted from the manufacturer data sheet. In Figure 2 we can see how the mica thermal block dissipates the heat generated by

the chips. Because the chips never reached 90°C during operating conditions, Design I was deemed successful during the initial simulations.

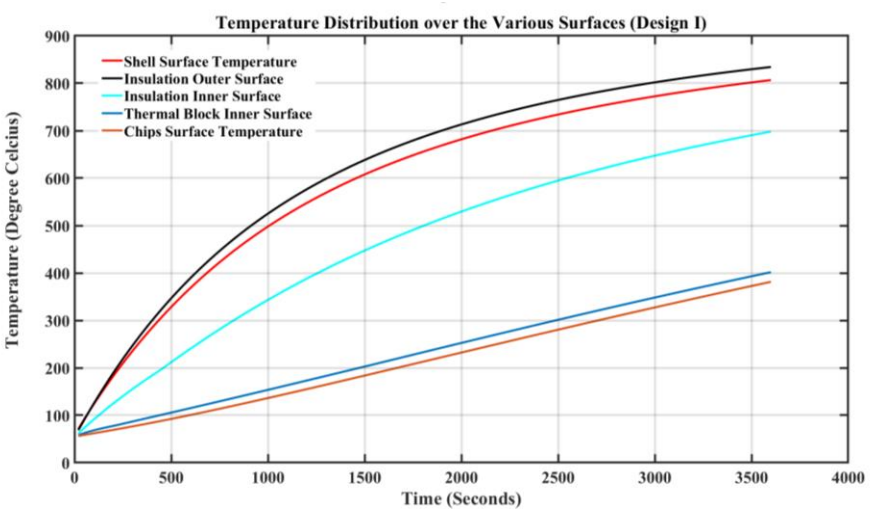

Figure 3: Design 1 Non-Operating Condition Simulation Results

Figure 3 shows the temperature distribution over various surfaces in the design during the non-operating condition. The non-operating condition simulation was done by using the finite element tools over a period of one hour with an ambiant temperature of 1000°C. We can see in Figure 3 how the temperature of the chips rises steadily, reaching close to 400°C at the end of the simulation. Design II was deemed a failure at this point, as the chips are not capable of withstanding temperatures in excess of 280°C.

The first design was expected to fail. It mainly served as reference point to see by how much my design needed to change and whether or not the chosen insulating materials would be sufficient. Though it was initially successful, where the design failed was during the non-operating conditions. I decided that the largest issues with Design I was the large air gap that was present between the circuit boards and the lack of material between the edges of the circuit board and the insulation layer. I modified these problem areas and was able to finalize Design II.

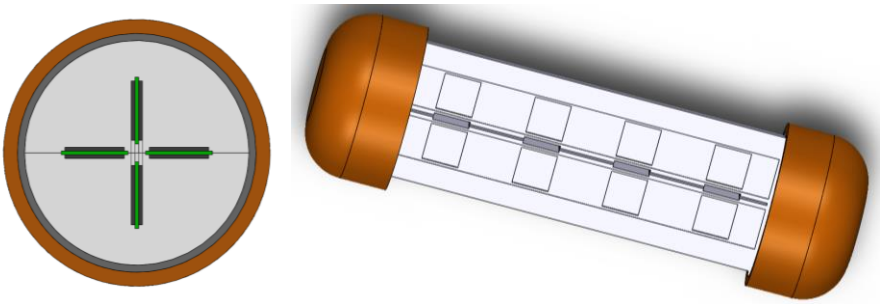

Figure 4: Design II Cross Sections

Figure 4 shows two cross sections from the second design. This design improved the air gap issue by reorienting the PC board in a radial pattern, therefore decreasing the amount of air present inside the event recorder. This design also increased the amount of material between the chips and the insulation layer, allowing for a more even temperature distribution and less heat transfer through the thermal block.

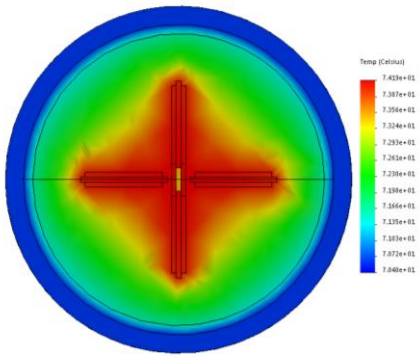

Figure 5: Design II During Operating Conditions

Figure 5 shows the temperature distribution across the different layers of the event recorder during the operating condition for Design II. As with Design I, the operating condition simulation was done by using the finite element tools, with the material properties being extracted from the manufacturer data sheet. As with Design I, Design II was deemed successful during operating conditions. Due to the modified chip orientation and air gap reduction, the mica thermal block was able to dissipate even more heat, keeping the chips under 75°C for the entirety of the simulation.

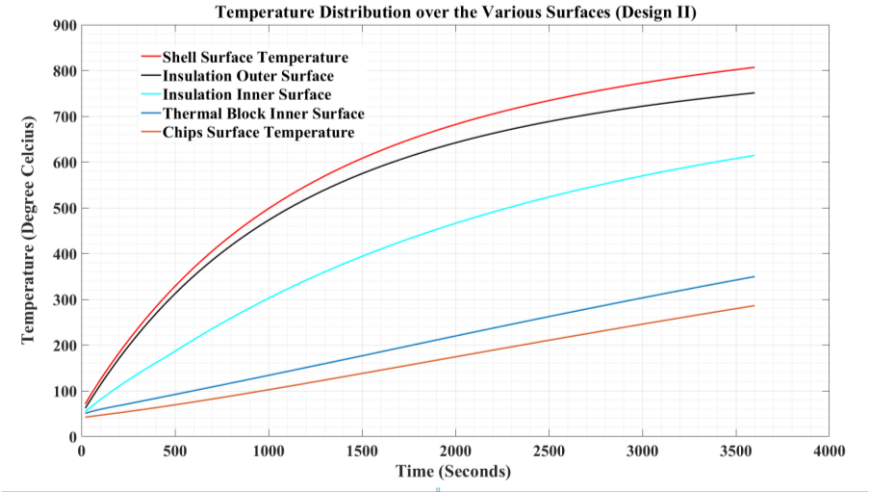

Figure 6: Design II Non-Operating Condition Simulation Results

Figure 6 shows the temperature distribution over various surfaces in Design II during the non-operating condition. As with Design I, the non-operating condition simulation was done by using the finite element tools over a period of one hour with an ambiant temperature of 1000°C. Unlike Design I, Design II was able to keep the internal temperature right below 280°C during non-operating conditions. This is likely due to the significant increase in thermal block material between the chips and the insulation layer, as well as the air gap reduction. After finalizing the design and running multiple simulations, Design II was deemed a success.

Following the successful simulation results, the project goal was completed. I was able to design, model, and analyze a new type of EDR that is capable of withstanding temperatures up to 1000°C while ensuring data retrieval is still possible. This EDR design is fully functional during operating conditions, allowing heat generated by the internal electronics to escape, while also preventing excess heat from destroying important data during non-operating conditions. This design uses only environmentally friendly components and materials, and does not require expensive, toxic phase change material. The next steps for this project would include using the purchased material to fabricate and physically test a prototype. This physical testing would be much more expensive than computer simulations but would provide real-world results that could be used to further determine the viability of the proposed EDR design.

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Standardized Patients' Perception of Student Nurse Care Compared to Registered Nurse Care

Purpose and Literature Review

The research purpose was to explore patients' perspective of the care they received from student nurses compared to that of registered nurses. Modeling and Role Modeling (MRM) theory served as the theoretical framework; MRM seeks to understand the patient's perspective and guides nurses in assisting patients in the attainment of their goals with that understanding in mind (Erickson, 2006). The research questions were: 1) How do patients perceive student nurse care differs from registered nurse care? 2) What domains of nursing care provided by nursing students and registered nurses do patients perceive need improvement?

Research on hospitalized patients' perception of student nurse care revealed varied perceptions. Student nurses were viewed as caring, competent, and able to meet patients' needs (Mukumbang & Adejumo, 2014; Oskay, et al., 2015). On the other hand, patients also reported feeling uncomfortable when being cared for by students (Shakya and Aryal, 2018). Other research focused on patients' perception of hospitals or family care (Jha et al., 2008; Hudon et al., 2011) Research on Standardized Patients' (SP) perception of care provided by nursing students is lacking, revealing a gap in the literature.

Design, Sample, and Methodology

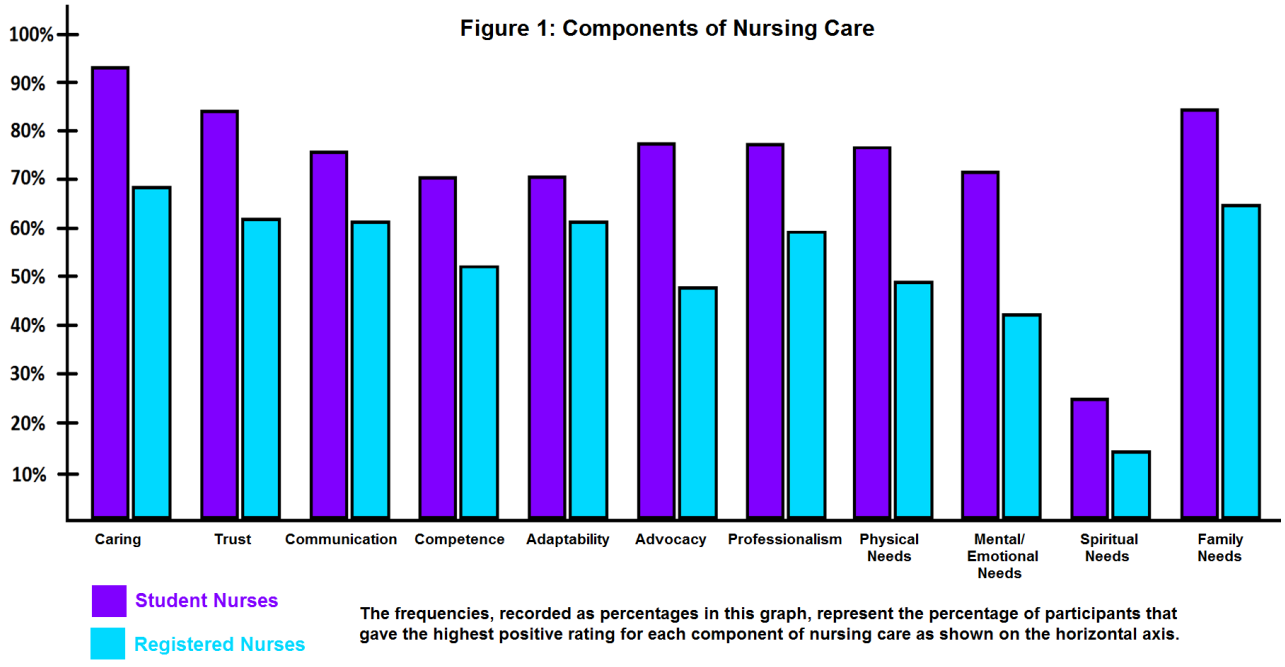
A mixed-method exploratory design was used to explore SP's perception of nursing care. SPs act as patients in clinically based simulations that nursing students participate in with clinical courses. A 22 item Likert scale (e.g., 1 = strongly agree, 2 = agree, 3 = disagree, 4 = strongly disagree) survey with 3 open-ended questions was developed using 11 patient care domains as the survey variables (e.g., caring, trust, competence, advocacy). All of these patient care domains are components of the Dishman School of Nursing (SON) curriculum. The participants rated student nurses (SN) and registered nurses (RN) on each domain; the possible total scores ranged from 11-44. A recruitment email, which contained a link to the Qualtrics survey, was sent to the SPs by the Director of the Dishman SON Simulation Center. The first page of the Qualtrics survey contained the informed

consent. Completion of the survey indicated agreement to participate. No IP addresses or any other identifying data was collected. Lamar University IRB approval was obtained prior to participant recruitment.

Thirteen out of the fifteen SPs employed by the SON completed the survey, resulting in a response rate of 87%. The participants' ages ranged from 60 – 79; the majority of participants (69%) had participated in a simulation within the past year. Ninety-two percent reported being hospitalized at least once in their lifetime and 54% reported being hospitalized within the past 5-10 years.

Analysis

The quantitative data was analyzed in SPSS statistical software using descriptive and parametric analysis. The qualitative data was analyzed using qualitative descriptive analysis. Analysis of frequencies and percentages for each individual nursing care domain revealed that student nurses scored higher in each domain compared to registered nurses. See Figure 1.



Total survey scores, representing all nursing care domains, were calculated for perception of student nurses and registered nurses; scores ranged from 11 – 22. The lower numeric value represents the highest agreement with the related nursing care domain. The total score was higher for student nurses. See Table 1. A paired sample t-test revealed a statistically significant difference (t = -2.221, p = .048) in mean total scores between student nurses (M = 14.32) and registered nurses (M = 16.50).

The qualitative data was gathered from the responses of eleven participants to the open-ended questions and was overall positive for student and registered nurses. In analyzing their answers, several concepts were found threaded throughout the SP's responses including anxiety, experience, time, confidence, and care. Registered nurses were generally described as more experienced, confident, and efficient. There were a few negative comments describing some registered nurses as "snooty" or appearing "busy". Student nurses were more often described as caring compared to registered nurses. Student nurses were also seen as more nervous, less confident, and slower in the provision of care compared to registered nurses. In several cases, SP's believed these qualities in student nurses to be a result of inexperience.

Table 1: Total Scores for Registered and Student Nurses

	Registered Nurses		Student Nurses	
Total Score	**Frequency**	**Percentage**	**Frequency**	**Percentage**
11 – 13	4	33.3	5	38.5
14 – 16	2	16.7	7	53.8
17 – 19	2	16.7	1	7.7
20 – 22	4	33.3	0	0
	Total: 12	Total: 100%	Total 13	Total: 100%
	M = 16.50 / SD = 3.75		M = 14.32 / SD = 2.02	

Scoring Range = 11 – 44 M = Mean Total Score
Results Range = 11 – 22 SD = Standard Deviation
Lowest Numeric Value = Highest Quality of Care
Highest Numeric Value = Lowest Quality of Care

To improve care, participants suggested that student nurses be more calm in their manner and communication and continue their education. A common belief seemed to be that students would become better nurses with time. Others suggested that students need to be more professional, prepared, and disciplined. A suggestion was also made to place students in a "less controlled situation" each semester.

Discussion

The results were unexpected in that student nurse care frequently had higher scores than registered nurse care. Some reasons behind these results were provided by the participants and included: 1) The higher patient load carried by registered nurses, which reduces the time they are able to spend with individual patients and can potentially increase stress. 2) Registered nurses also do not know for certain what will happen; whereas student nurses are in a "controlled situation" so that if an error is made, there will not be consequences for a real person. This could also make it easier for patients to be more trusting of student nurses. 3) Student nurses are also being evaluated during the duration of care and must meet certain standards. Registered nurses, on the other hand, are not supervised this closely and may be held to different standards than students. In addition, students' anxiety and/or decreased level of confidence (compared to RN's) may also play a role in motivating students to be more careful or listen to their patient. Some of the participants' responses seemed to support this as they noted that students spent more time in general caring for and communicating with the SPs.

Implications

The results showed that, for every component of nursing care, 60% or more of participants perceived student nurses provided very high quality care. The only exception was in regards to SPs spiritual needs. Only 23.1% of participants felt that student nurses did very well in this area. This may indicate the need for a stronger emphasis on spiritual care in nursing education. Another implication is the need for improvement among registered nurses as the scores for their care were generally lower than those of student nurse care. The results appear to suggest that maintaining the standards that student nurses are held to may improve registered nurse care. A limitation to this study was the small sample size, which limits the generalizability of the results.

Possible Continuation

There is certainly a possibility of continuing this research in the future on a wider scale. I have learned a significant amount about the research process as well as patients' perceptions of nursing care. My hope is to conduct a study with the same goals on a larger scale by using a sample of hospitalized patients. I believe this could provide more detailed information on patients' perception of nursing care and ways to improve both the clinical and educational aspects of nursing.

References

Erickson, H. (2006). Modeling and role-modeling: A view from the client's world. Texas: Unicorns Unlimited.

Hudon, C., Fortin, M., Haggerty, J. L., Lambert, M., & Poitras, M. (2011). The Annals of Family Medicine, 9(2), 155-164. DOI: https://doi.org/10.1370/afm.1226

Jha, A. K., Orav, E. J., Zheng, J., & Epstein, A. M. (2008). Patient's perception of hospital care in the united states. The New England Journal of Medicine. 359, 1921-1931. https://doi.org/ 10.1056/NEJMsa0804116

Mukumbang, F. C., & Adejumo, O. (2014). Patients' experiences of being nursed by student nurses at a teaching hospital. Curationis, 37(1), 1-10. http://dx.doi.org/10.4102/ curationis.v37i1.1230.

Oskay, U., Gungor, I., & Basgol, S. (2015). Evaluation of patients' satisfaction with nursing students' care on a perinatology ward. *Journal of Nursing Education*, *54*(12), 696-703. https://doi.org/10.3928/01484834-20151110-06

Shakya, P., & Aryal, P. (2018). Attitude of patients towards student nurses. *Journal of Health Education Research & Development*, *6*(3),1-5.

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Acoustic and Auditory Effects of COVID-19 Masks on Speech/Voice Communication

Introduction

COVID-19 is a world-wide pandemic that has affected components of everyday living. Amidst this pandemic, The World Health Organization recommends people to *"maintain at least a 1-metre distance between yourself and others to reduce your risk of infection when they cough, sneeze or speak."* They also recommend to *"make wearing a mask a normal part of being around other people."* Because of this, there is a barrier between speaker and listener(s). This hindrance in speech and several other areas of communication is an issue that can potentially lead to the development of a voice disorder. Speech communication is hindered by Personal Protective Equipment (PPE). PPE includes the use of face masks and shields, which prevent the free flow of air from the mouth and nose during speech. This muffles the individual's spoken utterances, reduces visual cues such as the movement of the lips, facial expression, and makes inhalation difficult. The absence of visual cues and altered speech put the listener and speaker at a disadvantage. PPE forces speakers to communicate and put more effort into projecting themselves when in conversation. This research seeks to measure the change in speech in spectral characteristics and at the decibel level. Testing the acoustic and auditory changes of speech/voice using these measurements will provide empirical evidence on what listeners may miss during conversation.

Methods

Subjects: Subjects were recruited through advertisements placed within the campus of Lamar University, Beaumont, Texas. Recruited subjects also were recommended by friends and family to participate in this study. Only subjects with a healthy voice were accepted to participate in the study. We were given consent from the subjects to participate in this study and each subject was scheduled a specific time to record the speech sample. A total of 18 subjects were scheduled (10 males, 8 females), however, data that qualified for analysis were from 8 males and 8 females. The age range was between 18-24 years with a mean of 21.2 years. All the subjects were

students. Following COVID-19 protocol, sanitation was done at the end of each session on items that were used by researchers and subjects.

Protocol: All subjects were given the same directions and list of sentences for the speech/voice sample.

Speech sample included the following:

(a) Steady vowel /a/ and /i/

(b) Sentences from CAPE-V form, a form with standard sentences and tasks for clinical voice analysis.

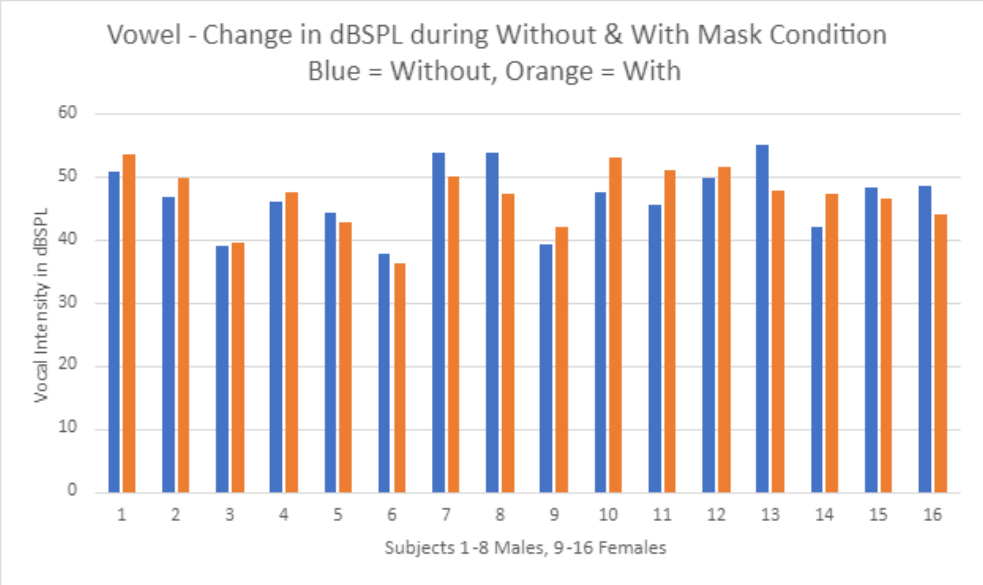
Analysis:

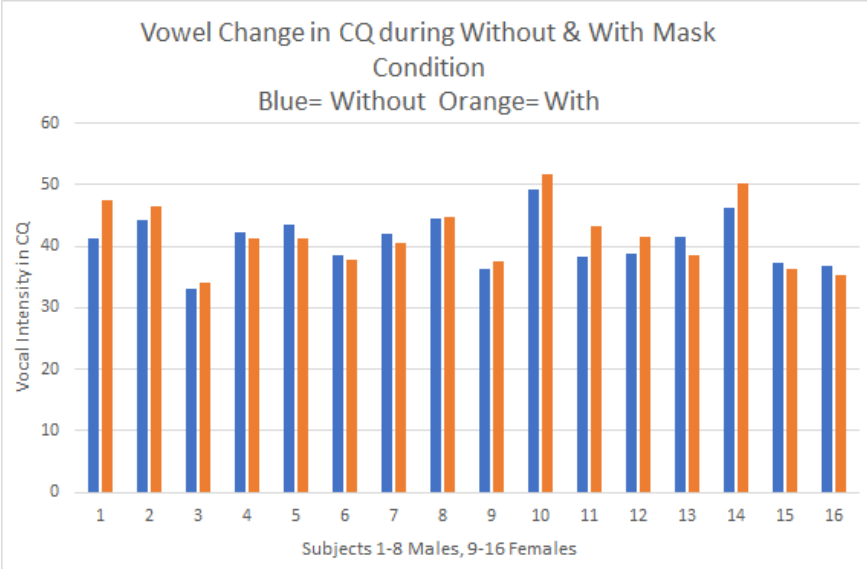
Subjective Analysis: Data from subjects who were perceived to be phono-normal were analyzed.

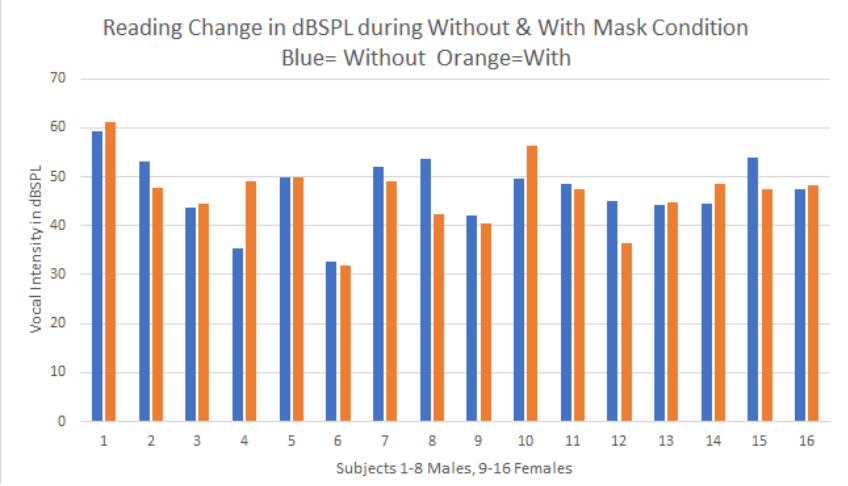
Objective Analysis: Acoustic and Closed Quotient measures were analyzed for vowel /a/ and the sentence /we were away a year ago/. Acoustic measure reported here is the decibel level in dBSPL measured using Praat 6.0.37 a software frequently used for voice and speech analysis. Closed Quotient, a measure reflecting the contact duration of vocal folds during speech, measured by EFxHist 2.0.

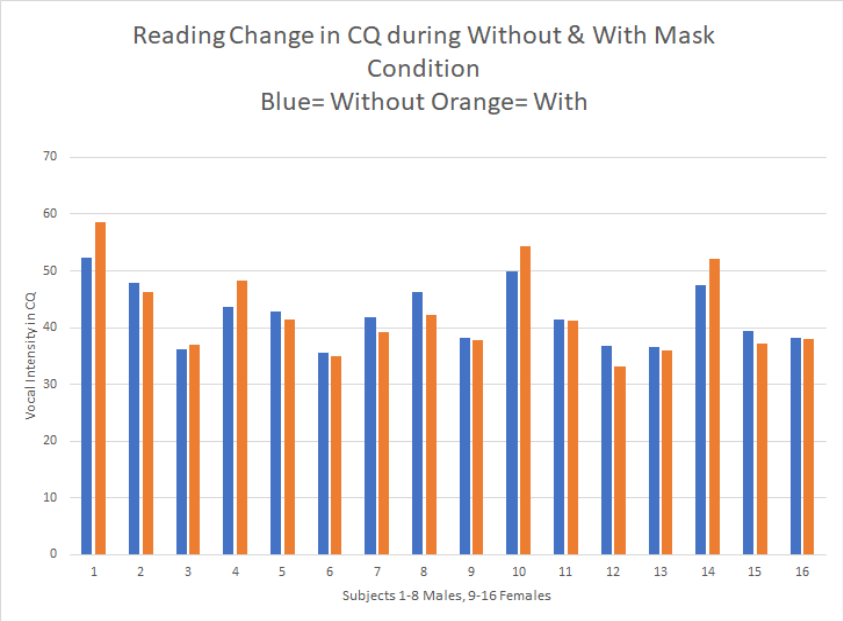
Results

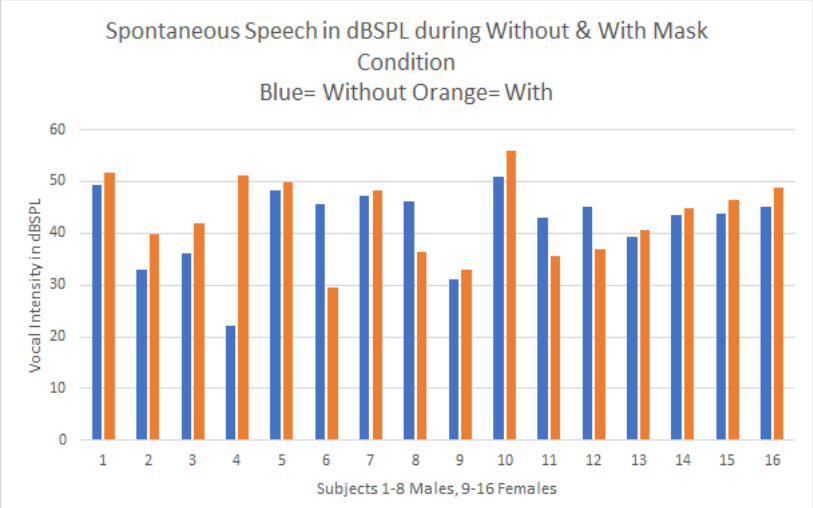
Comparisons were made for the vocal intensity of vowels, sentence reading, and spontaneous speech with and without masks. The closed quotient and decibel levels were recorded for each of these vocal tasks with and without masks. Spontaneous speech was only measured in decibels. A difference greater than 1.5 dB is classified as the criterion for significant change in vocal intensity. The vowel change data shows that 8 out of 16 subjects (3 male and 5 female) increased in vocal intensity in order to project through the face mask, and the remaining subjects projected at a softer vocal intensity or at the same volume as without mask. 4 out of 16 subjects (2 male and 2 female) in the reading task increased in volume as the remaining 12 did not exceed the intensity without mask. However, the spontaneous speech chart shows that 12 out of 16 subjects (6 male and 6 female) showed significant increase in vocal intensity. The increase in subjects projecting with the masks in spontaneous speech may be due to the spontaneity of the subjects' response, whereas the vowel and reading tasks required more of an experimental sample.


Vowel - Change in dBSPL during Without & With Mask Condition
Blue = Without, Orange = With
Vocal Intensity in dBSPL
0
10
20
30
40
50
60
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Subjects 1-8 Males, 9-16 Females


Vowel Change in CQ during Without & With Mask Condition
Blue= Without Orange= With
Vocal Intensity in CQ
0
10
20
30
40
50
60
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Subjects 1-8 Males, 9-16 Females


Reading Change in dBSPL during Without & With Mask Condition
Blue= Without Orange=With
Vocal Intensity in dBSPL
0
10
20
30
40
50
60
70
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Subjects 1-8 Males, 9-16 Females





Discussion

Wearing a mask covers the oral and nasal area, which dampens the energy of sound going through the mask. Our subjects were realizing this subconsciously during communication, which increased their vocal effort shown by the increase in vocal intensity and closed quotient. If a subject continues to speak at that increased vocal effort level, it will lead to vocal fatigue and a progressive loss of vocal endurance. Mask usage creates a barrier that hinders voice communication which will increase the chance of a subject to develop a voice disorder. Because of this, communities need to be educated on how to safely use and project voice while wearing face masks.

Professions that rely on vocal communication need to invest in vocal hygiene training in order to decrease the likelihood of voice disorders.

At the beginning of the research, a small Bluetooth speaker playing a triangular wave at 120 Hz was placed at the mouth level of a mannequin head to simulate a scenario of speech communication. A high-fidelity condenser microphone was placed 12 inches away from the head and acted as the listener. A sound level meter was placed at the same level as the microphone to measure sound pressure level in decibels. This was done in order to accurately measure how much sound a face mask blocks from a listener. Praat results indicated a drop in 1 dBSPL during "with mask" condition. Spectral analysis surprisingly showed that sound from the speaker loses higher harmonics without the mask interfering. This means that the face mask is somehow able to project higher levels of harmonics with clarity. Further research needs to be conducted in order to explain this phenomenon.

Acknowledgements

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References

"Advice for the Public On Covid-19." Web. 07 Apr. 2021. World Health Organization

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Carding to Align Dry As-Produced Single Wall Carbon Nanotubes

Introduction

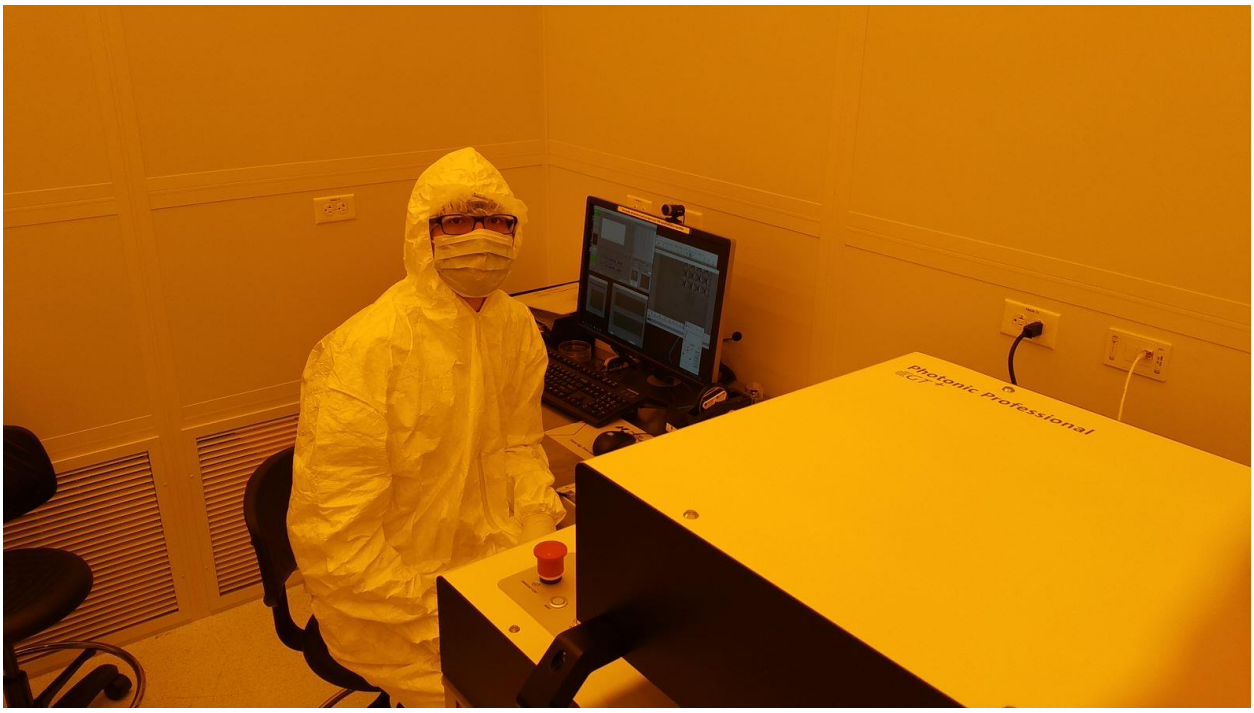
Single Wall Carbon Nanotubes (SWCNTs), produced via the High-Pressure CO (HiPCO) method (Pavel Nikolaev, Michael J Bronikowski, R.Kelley Bradley, Frank Rohmund, Daniel T Colbert, K.A Smith, Richard E Smalley, 1999, p 603-605) are in the form of a randomly oriented felt-like material. In many applications aligning the SWCNTs is a necessary step (Yanfeng Ma, Bin Wang, Yingpeng Wu, Yi Huang, Yongsheng Chen, 2011, Pages 4098-4110), but existing methods require the as-produced material to be suspended in a liquid (M. E Kozlov, R. C. Capps, W. M. Sampson, V. H. Ebron, J. P. Ferraris, R. H. Baughman, 2005, Pages 614-617). SWCNTs have small diameter and large aspect ratio, they are considered a one-dimensional material. The reason why SWCNTs are named because of their hollow structure and number of walls. SWCNs are cylindrically shaped allotropes of carbon that have a high surface area and aspect ratio. Dry aligned SWCNTs could lead to advances in existing applications as well as new applications in the field.

Objective:

In this research we investigated a method based on carding to align dry as-produced SWCNT material. The method is intended as a first step toward spinning carbon nanotubes fibers and thread. The current methods for making fibers involve suspending the SWCNTs in a liquid or polymer media, which must be removed in a later process is fiber made from SCWNT alone is desired(M. E Kozlov, R. C. Capps, W. M. Sampson, V. H. Ebron, J. P. Ferraris, R. H. Baughman, 2005, Pages 614-617). The ideas of the carding device comes from carding wool or cotton. During the eighteenth century, wool was being carded using pairs of hand cards in England (Carding, 2021). SWCNTs have much smaller loops than wool or cotton so a much smaller structure is needed. The objective of the research is to investigate whether or not it is possible to align dry as-produced SWCNTs using a method similar to carding. We used a 2-photon SLA 3D printer in order to create out the carding device.

2-photon SLA 3D printing:

The Photonic Professional GT2 (Nanoscribe, Germany) uses two-photon polymerization to manufacture microscopic structures that can have sum-microscale features. We used the Nanoscribe Photonic Professional GT2 at the Rice University Shared Equipment Authority (SEA) cleanroom in Rice University to print out the carding device.



Experiment:

After printing the carding device, we used the Scanning Electron Microscope (SEM) at the Lamar College of Engineering Materials Instrumentation Center (COE MIC) to image the device SWCNTs and the SWCNTs. The SWCNT material was secured to a glass microscope slide using a double sided sticker. Five layers of Copper tape were added on each side of the sticker to build up a spacer. We lid the microscope slide with Carbon Nanotubes across the fused quarts substrate that the carding device was printed on. Carbon Nanotube were captured by the carder and the sliding force aligned dry as-produced SWCNT material. We observed nanotube material hooked onto the tips of the carding device pyramids. After additional strokes, we could see aligned materials even by the naked eye.

Result and Conclusion

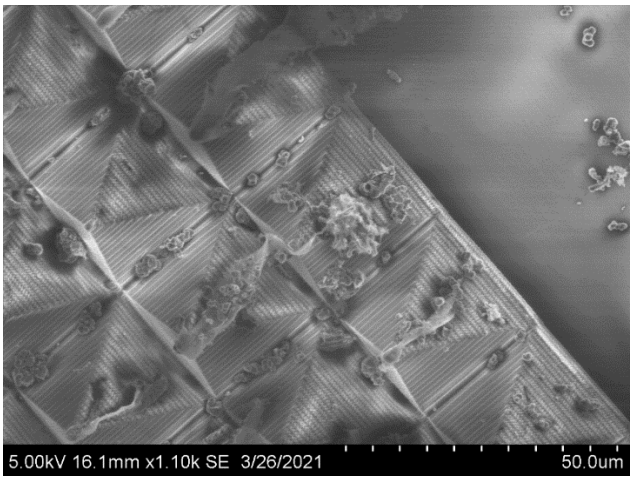


Figure 1 – SEM images of the device

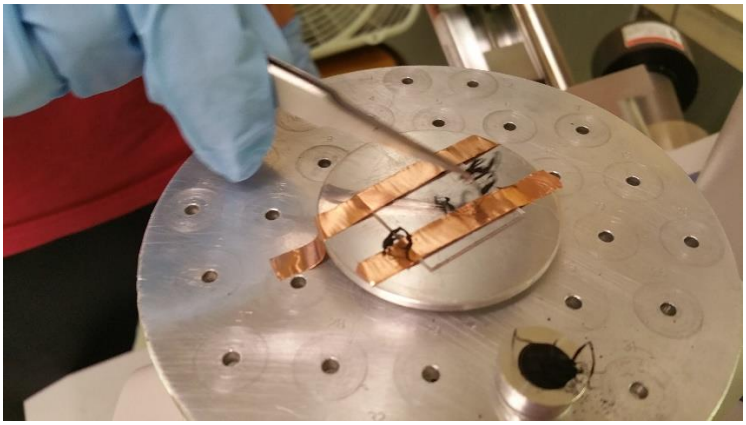


Figure 2: Carding the nanotube with the micro carding device

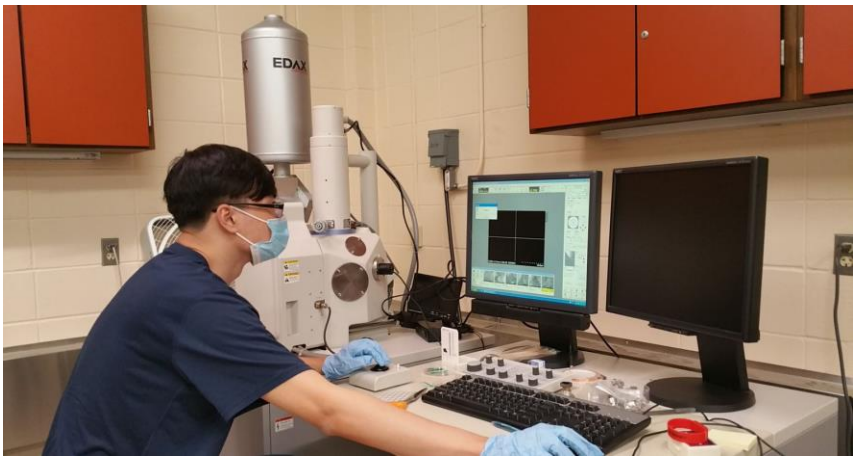


Figure 3: Scanning the image of the micro carding device

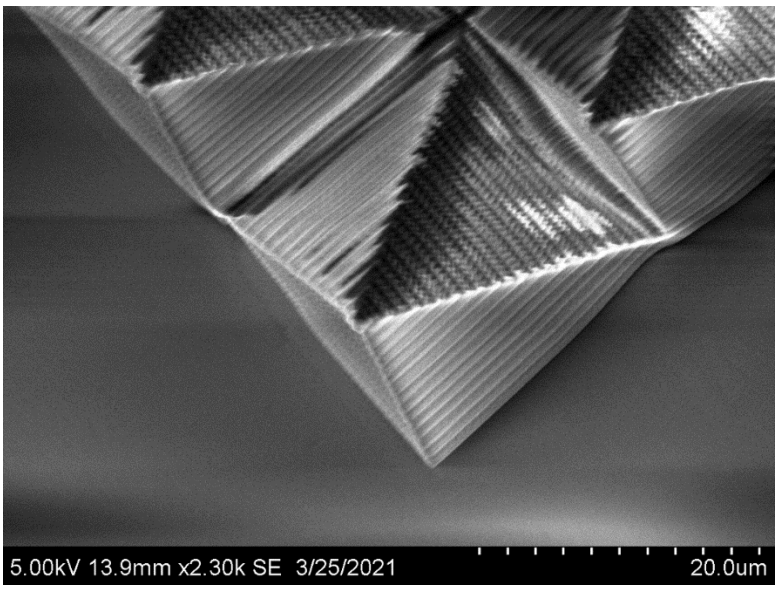


Figure 4: SEM image of the device

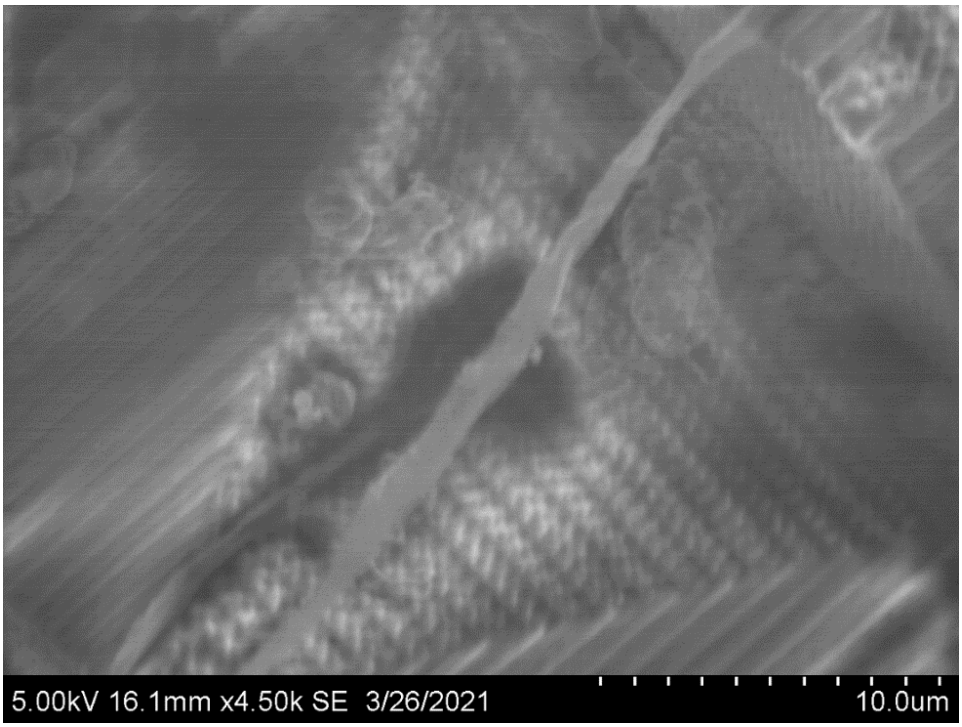


Figure 5: SEM image of the device

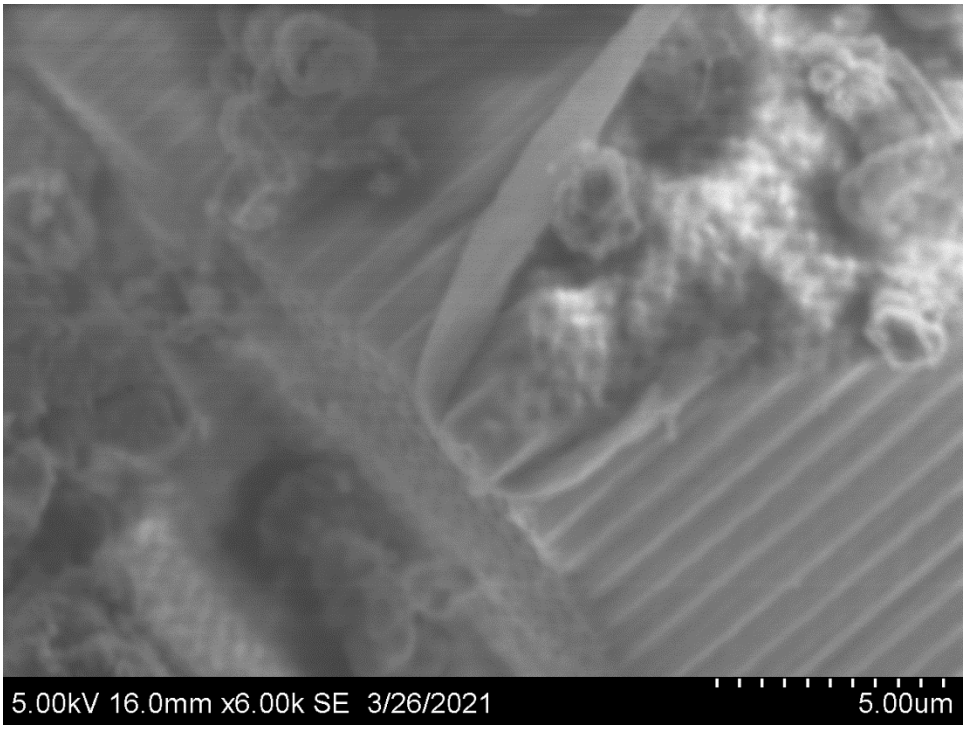


Figure 6: Nano Carbon tube on hook of the pyramid

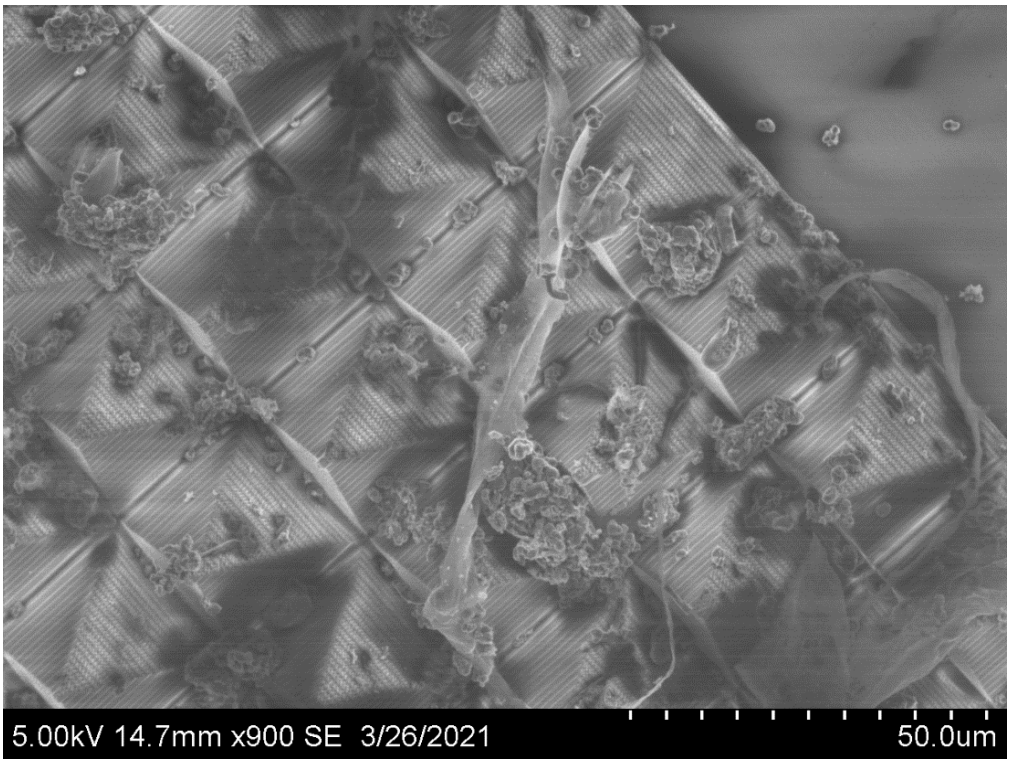


Figure 7: SEM image

References

1. "Carding." Wikipedia, Wikimedia Foundation, 10 Mar. 2021, https://en.wikipedia.org/wiki/Carding
2. "Nano scribe" Photonic Professional gt2: World's highest resolution 3d printer, https://www.nanoscribe.com/en/products/photonic-professional-gt2
3. "Single walled carbon nanotubes products" Cheap Tubes, https://www.cheaptubes.com/product-category/single-walled-carbon-nanotubes/.
4. M. E Kozlov, R. C. Capps, W. M. Sampson, V. H. Ebron, J. P. Ferraris, R. H. Baughman, Spinning Solid and Hollow Polymer-Free Carbon Nanotube Fibers, Volume 17, Issue 5, 2005, Pages 614-617, https://doi.org/10.1002/adma.200401130.(https://onlinelibrary.wiley.com/doi/abs/10.1002/adma.200401130) Abstract: Polymer-free carbon nanotube fibers are spun from aqueous dispersions using a flocculation-based process that was developed. It produces hollow fibers, folded ribbon fibers, and solid fibers
5. Pavel Nikolaev, Michael J Bronikowski, R.Kelley Bradley, Frank Rohmund, Daniel T Colbert, K.A Smith, Richard E Smalley, Gas-phase catalytic growth of single-walled carbon nanotubes from carbon monoxide, Chemical Physics Letters,Volume 313, Issues 1–2, 1999, Pages 91-97, ISSN 0009-2614, https://doi.org/10.1016/S0009-2614(99)01029-5. (https://www.sciencedirect.com/science/article/pii/S0009261499010295) Abstract: Single-walled carbon nanotubes (SWNTs) have been produced in a gas-phase catalytic process. Catalysts for SWNT growth form in sit

6. Yanfeng Ma, Bin Wang, Yingpeng Wu, Yi Huang, Yongsheng Chen, The production of horizontally aligned single-walled carbon nanotubes, Carbon, Volume 49, Issue 13, 2011, Pages 4098-4110, ISSN 0008-6223, https://doi.org/10.1016/j.carbon.2011.06.068. (https://www.sciencedirect.com/science/article/pii/S000862231100515X) Abstract: The current progress on the production of aligned single-walled carbon nanotubes (SWCNTs), particularly the horizontally aligned

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Development of New Generation Electronic Chassis To Suppress Vibrations During Transportation

Introduction

The electronic chassis referenced herein is a metallic enclosure used to support programmable printed circuit boards (PCBs), heat sinks, and mounting brackets. The PCBs are assembled using electronic chips and several sets of signal and power connectors. Together, the electronic chassis and printed circuit board assembly (PCBA) form an electronic system unit. Electronic systems have various applications in the transportation industry within control systems, navigation systems, wireless communication systems, data storage systems, etc.

Problem Statement

Electronic systems are installed in specific locations within transportation vehicles, where they are exposed to excessive vibrations due to ground motion and aerodynamic activity in ground vehicles and aircraft, respectively. If the excitation frequency matches one of the natural frequencies of the electronic system, the system will experience resonance. The electronic system may fail due to fatigue from the high stresses associated with resonance if such harsh conditions were not considered during design. For example: the failure of electronic connectors due to pin fretting. The failure of the electronic components decreases the integrity of the signal, and the entire electronic system fails once power is lost inside the unit.

Solution and Approach

The objective of this research is to develop an electronic chassis that utilizes a passive device to suppress such vibrations - inherently improving the reliability of the system. This device proposition is based on the concept of vibration isolation and requires that the device be composed of polymeric materials. To begin, the theoretical model was designed, and frequency simulation (modal analysis) was carried out on the designed assembly. Following modal analysis, the step sine simulation was carried out in the range of (5-1000) Hz. Based on the results of the step sine simulation, the dimensions, shape, and material of the isolators were selected. After

selecting the desired vibration isolation devices, a model was created to include the isolators. **Figure 1** and **Figure 2** below show the models of the electronic system without and with the vibration isolation devices.

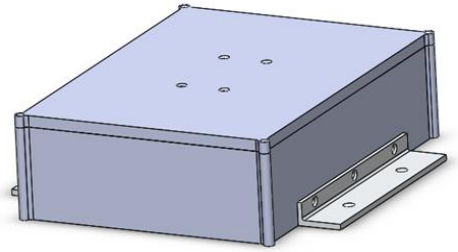

Figure 1: Electronic System Model Without Isolators

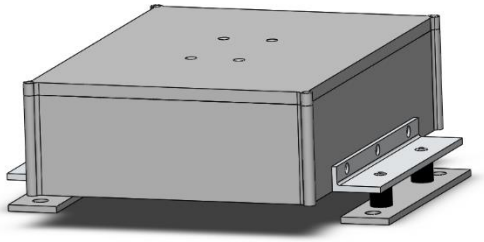

Figure 2: Electronic System Model With Isolators

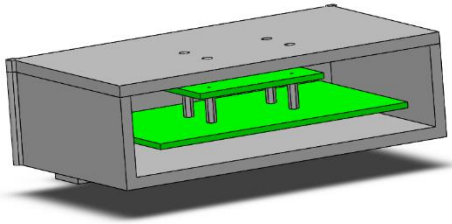

Figure 3: Cut-View of Electronic System Model

Extensive dynamic simulation was performed to verify the efficacy of the proposed isolation concept. The vibration profile used for this simulation was superimposed from the Association of American Railroads (AAR) and the United States Military (MIL) standards. Performing dynamic simulations using this superimposed profile, as seen in **Figure 4**, allows the design to be tested against both standards simultaneously.

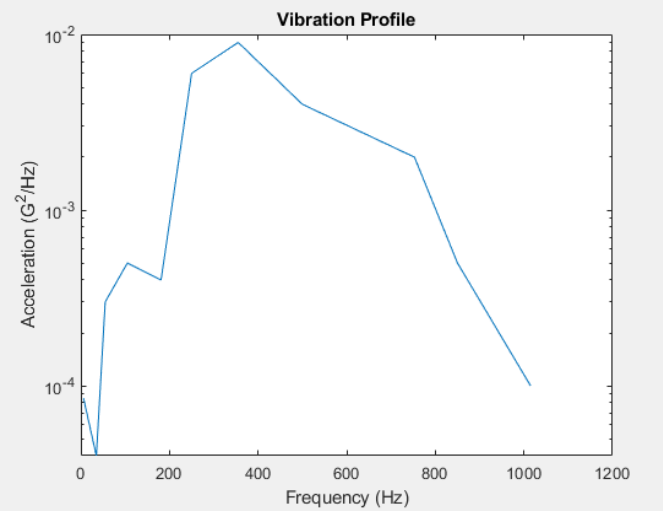

Figure 4: Superimposed Vibration Profile (PSD as a Function of Frequency)

The simulation was performed using random vibration in the lateral, longitudinal, and vertical axes. The simulation results theoretically validated the proposed design, with the resulting profiles exceeding the AAR and MIL standards, thus, satisfying both standards. **Figures (5 -7)** compare the responses of the electronic system with and without the isolators in the lateral, longitudinal, and vertical axes. The response graphs are plotted in the form of power spectrum density (PSD) as a function of the excitation frequency. It should be noted that the response of the electronic system was measured from the top surface of the enclosure. **Figures (5-7)** indicate that the vibration of the electronic system is completely isolated above 50 Hz. As the first order frequency of the printed circuit board (PCB) and printed circuit board assembly (PCBA) is above 150 Hz, there will be no failure in the PCBA if any significant response below 50 Hz occurs.

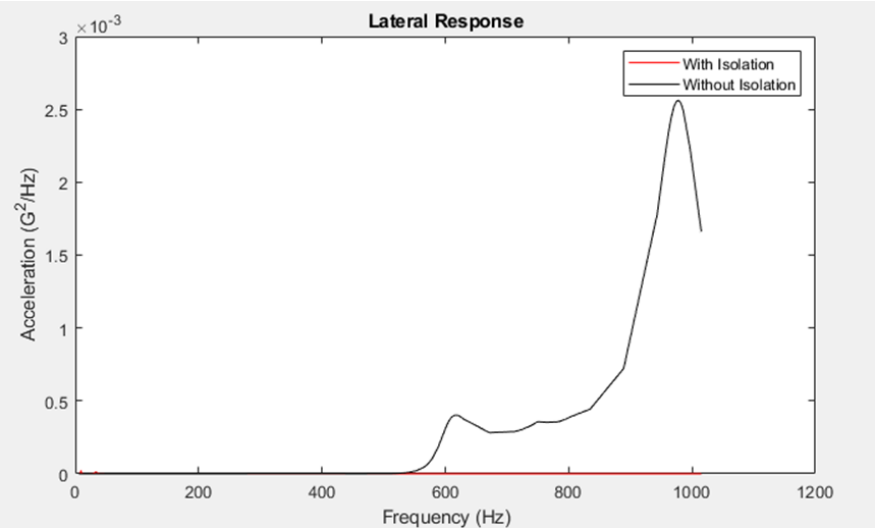

Figure 5: Lateral Response of Electronic System Model With and Without Isolators

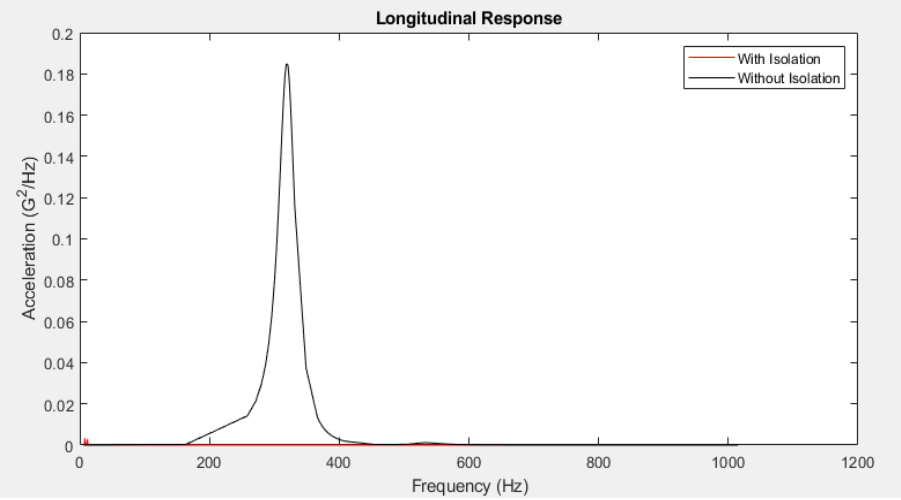

Figure 6: Longitudinal Response of Electronic System Model With and Without Isolators

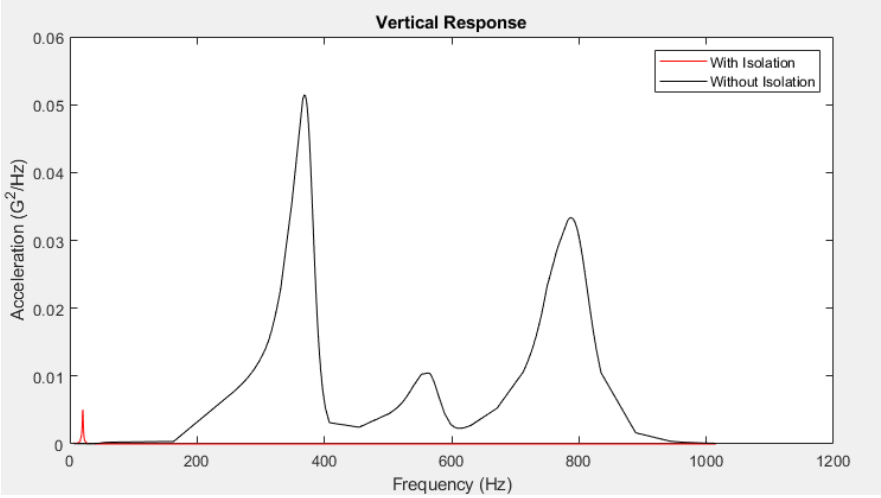

Figure 7: Vertical Response of Electronic System Model With and Without Isolators

Based on the dynamic simulation results included in **Figures (5-7)**, a prototype is being developed for experimentation. The next phase of this research is to physically test the developed unit using different vibration signals including step sine, sweep sine, and random vibration.

Acknowledgements

Special thanks to the Office of Undergraduate Research at Lamar University for granting me this opportunity and providing continuous support and encouragement. I am very appreciative of the time and effort that Dr. Cristian Bahrim has poured into this program, as it has allowed me to grow intellectually and individually.

The progress made thus far in this project could not have been accomplished without the support of my mentor, Dr. Sushil Doranga. His passion for research, scholarly advice, and enthusiasm has driven me towards academic success.

I would also like to acknowledge my mentor, Dr. Kendrick Aung. Although he is no longer with us, he continues to inspire by his example. He was extremely supportive of his students, welcoming everyone and their ideas with a big smile, and always happy to share the wealth of his knowledge. I am deeply saddened by the loss of such a great professor/mentor, but forever grateful for the positive influence he has been throughout my education.

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Political Responses to the Satanic Panic in Texas

In 1989, Texas was gripped by a "Satanic Panic" following a discovery of a mass grave in Matamoros, Mexico. The grave filled with 15 dismembered bodies were discovered from a routine missing-persons investigation of Mark Kilroy, a Texas college student who disappeared on spring break. What followed is a tale of ritual sacrifice that exploded in the media during the same time that anti-ritual legislation was being created by Texas officials. I took a journalistic approach toward the anti-ritual legislation and answered the questions who, what, when, where, why and how of the process. During that time, I contacted the Texas official offices of Senator Zaffirini and Senator Whitmire, whose staff worked diligently to provide me with the materials that I needed. I also worked with the state reference librarians who were quick to respond to my questions.

During my investigation, I uncovered that Abilene Police officer, Lee Reed, asked Senator Zaffirini for a bill, S.B. 30, that law enforcement could "work with" dealing with a growing problem in Texas with ritual abuse and murder.

According to the Fort Worth Star Telegram story titled, "Lawmaker proposes study of cult activity," stated that "Increasing focus has been placed on diabolic cults since the Matamoros murders," and "With the Matamoros group in mind, members of these cults and the crimes they engage in are not to be tolerated in a civilized society. Grabbing the minds of young people, these cults have turned their members into mindless creatures who commit horrific crimes for pleasure and profit."

Senator Buster Brown, R-Lake Jackson, asked the Senate Criminal Justice Committee to conduct hearings and prepare a report by 1991, when the legislature meets again in regular session. Brown said testimony is sure to bring out concerns about religious and speech freedoms. "We want to be careful that we don't infringe on the first amendment right of freedom of religion, keeping in mind that the U.S. Supreme Court has distinguished between a person's right to believe, which is absolute, and a person's right to act on that belief, which is limited."

The purpose of S.B. 30 was to help police officials to determine the scope of the "Satanic" problem and to collect and report the data.

In 1993, Senator Whitmire proposed Committee substitute senate bill (CSSB) 1067 which would streamline the penal code, merging like offenses and eliminating some offenses. Which means the new bill would reconfigure the severity of offenses, based on factors such as intent of the person and the interests of the state, whether the crime would involve a victim, and the value of property taken or damaged. The new "person offense ranking" would be used to determine whether a defendant, person accused in a court of law, could be considered for a certain proceeding that defer prosecution without an adjudication of guilt, which means a person has been formally convicted of a crime by the court. Capital murder would be the only offense within its category.

The bill was in effect by September of the same year which struck the language from S.B. 30 from the penal code.

The Office of Undergraduate research provided me with a platform to share my findings with others as well as finance much needed documents provided from the state reference library and police department records. I plan to further my research as I study the Fall River Satanic Murders in Massachusetts from 1979 to 1980 to uncover potential legislation that stemmed from the early "Satanic panic" timeline.

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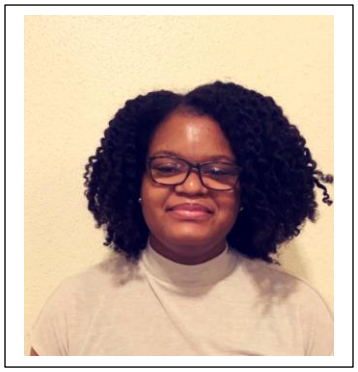

Development of Algal-based System for Produced Water Bioremediation

Introduction:

In oil and gas industry, the influx of produced water (PW) in the United States is known to generate billions of barrels of produced water. Hence, making it the largest waste to produce a substantial number of hydrocarbons. Produced water is the largest waste stream generated from oil and gas companies. This produced water is known to carry heavy metals, high saline levels, chemicals and radioactive materials. Currently the price for treating one barrel of PW is between USD 0.77 to 8. As a result of this treatment the continuation of growth is expensive and energy consuming. The pollutants in produced water being released into the environment decrease the water quality and affect the integrity of the soil. The traditional removal of containments happens to be costly, labor intensive and environmentally unsustainable. In contrast, algal bioremediation of produced water has benefits of being environmentally cautious and reliable to treat produced water. Thus, the pollutants in PW serve as nutrients for the algae and other microorganisms inhabiting the produced water. However, significant dilution of produced water is often required in algal-based systems due to complex chemical contaminants present in PW. For that reason, the current work has investigated the potential of cultivating *Galdieria sulphura*ria and *Chlorella vulgaris* in produced water using multiple dilutions; 0%, 5% , 10% , 20% , 50%, and 100% PW.

The strain of algae grown in an on-site lab *G. sulphuraria* was grown under 24 hrs of continuous illumination inside the incubator at 42°. The carbon dioxide levels inside the incubator were kept at 3%. The culture that was obtained was streaked onto agar plates where they were able to form single colonies. These single colonies then created axenic cultures. The cultures were all streaked under the Labconco purifier. As a result, of the cultures being isolated from the culture plates that were streaked they were transported to the Cyanidium medium in one-liter Erlenmeyer flasks. *C. Vulgaris* is an alga that was cultivated on-site as well. The strain grew in an incubator 16/8-hour light and dark cycle at 28°. All media was prepared under the purifier to decrease contamination. Hence, all specimens added to the media were filtered through a filtration system. Additionally, for sterilization the media was autoclave at 121°C. With all sub culturing being done under the purifier with a clean bench the cultures were scaled to one-liter Erlenmeyer flasks prior to all experiments.

Materials and Methods:

In the beginning of the experiment, the inoculum was centrifuged at 2000 ×g for 10 min at 25 °C (accuSpin 400 centrifuge, Fisher Scientific, USA.. The incubator's CO_2 level was kept constant at 2–3% (vol/vol). The two algae strains were analyzed in the five different dilutions; 0%, 5%, 10%, 20%, 50%, and

100% PW. Sterilized deionized water was used to dilute the produced water in all experiments. Cyanidium and BBM were used as controls for algal growth. Inculum algae was grown in one-liter Erlenmeyer flasks and at the start of the experiments they were centrifuged, and the supernatant was discarded to collect all biomass. Then, each media was poured into the sterile Erlenmeyer flasks while after being transported into six groups of borosilicate glass tubes. This glass tubes contained a volume of six milliliters, and they were closed with plastic caps. To seal the tubes parafilm was placed to decrease evaporation of the media. Next, the tubes were placed back into the incubator where they were kept in the Tissue Culture Roller Drum Apparatus. This roller drum rotated continuously at sixteen rotations per minute. All ammonia nitrogen, nitrate nitrogen, phosphate-phosphorus were measured by using an on-site spectrophotometer. The vials and reactant powders used were for different parameters and measurement ranges. A Hanna pH meter was used to calculate the pH and conductivity of the produced water. The optical density of the biomass from the produced water was measured with the spectrophotometer. The use of the HACH DR 3900 (HACH, Colorado, USA) spectrophotometer with the different standard HACH vials or powder provided different measurement ranges. These measurement ranges correlated with reading the OD value of the biomass density. The biomass density values were analyzed in terms of the 'ash free dry weight'. The algal strain *G. sulphuraria was* evaluated at 750 nm. While *C. vulgaris* was evaluated at 680 rm.

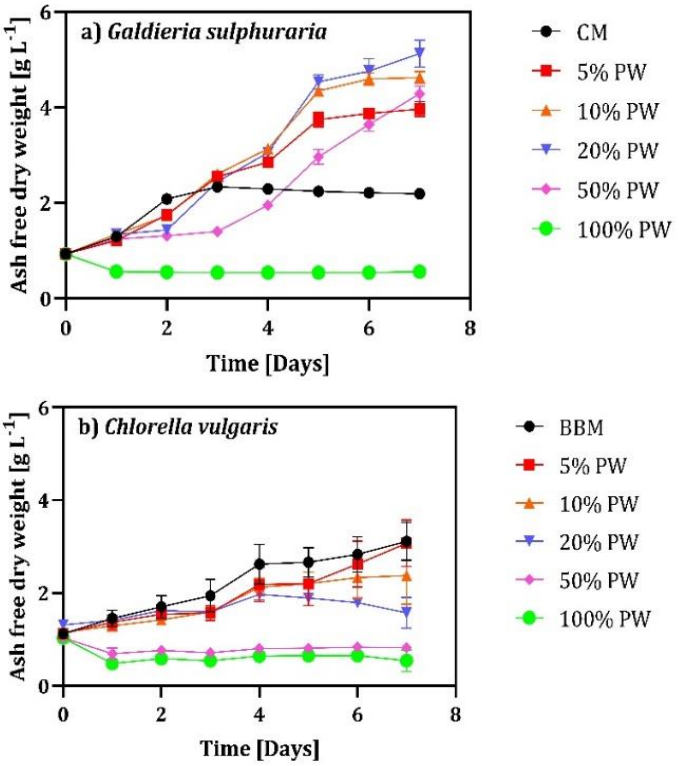

Figure 1*: Growth curve for a) Galdieria sulphuraria; b) Chlorella vulgaris*

Discussion:

The algae growth rates and growth curves for strains *G. sulphuraria* and *C. Vulgaris* are shown is Figure 1. For instance, *G. sulphuraria* showed its greatest increase of growth in 5%,10%,20% and 50% PW (Figure 1a). The biomass density produced went beyond the standard media. Furthermore, the ultimate potential for growth was found in 20% PW. Thus, making the biomass density three times higher than the standard media. In contrast, *C. vulgaris* grew significantly in 5%, 10% PW experiments and tended to grow in 20% PW experiments (Figure 1b). The treatment at 5% PW resulted into a biomass density and growth rate like the standard media, as can be seen from Figure 1b.

The removal of NH_4-N and PO_4-P by *G. sulphuraria* in CM and different PW dilution experiments over 7 days are presented respectively in Figures 2a and 2b. Therefore, the initial concentration of ammoniacal nitrogen varied depending on the PW percentage in the experiments, from Figure 2a. Nevertheless, all the NH_4-N were removed by *G. sulphuraria* at 5%, 10%, 20%, and 50% PW. Therefore,

almost 100% removal efficiency was observed for these experiments. These findings are strongly verified by the growth and biomass density of *G. sulphuraria* at these PW percentages, as were discussed in Figures 1a. The initial NH_4-N concentration at 50% PW was the closest to that of the CM. Interestingly, the former resulted in ~100% removal efficiency of the ammoniacal nitrogen while the latter achieved only ~44% removal.

The removal of NH_4-N, NO_3-N and PO_4-P by *C. vulgaris* in BBM and different PW dilution experiments over 7 days are presented respectively in Figures 3a, 3b 3c. Almost all the NH_4-N was removed by *C. vulgaris* at 5%, 10%, and 20% PW .In the case of 50% and 100% PW, no significant amount of NH_4-N was removed. From Figure 3c, it is evident that PO_4-P remained in excess at all the PW dilution experiments, including the BBM.

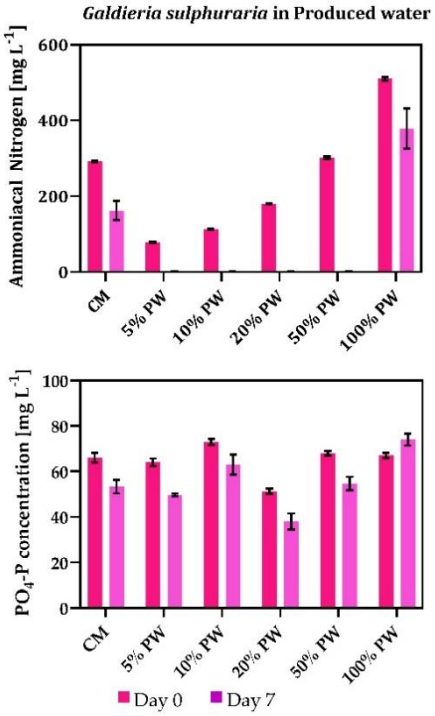

Figure 2. *(a) NH_4-N removal (b) PO_4-P removal by G. sulphuraria in CM and different PW dilution experiments over 7 days.*

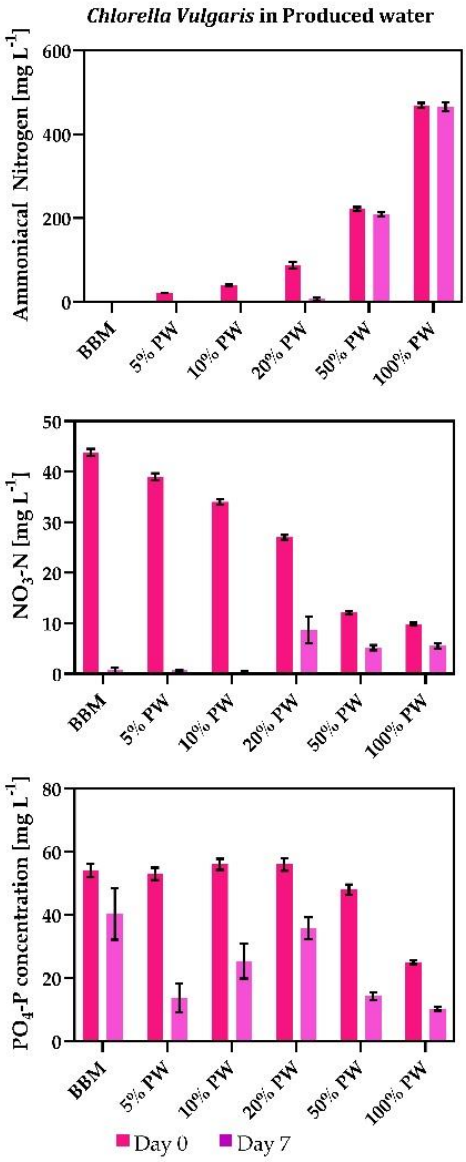

Figure 3*. a) NH_4-N removal, (b) NO_3-N removal, and (c) PO_4-P removal; by C. vulgaris in BBM and different PW dilution experiments over 7 days.*

Conclusion:

This research indicated that *G. sulphuraria* efficiently took up the required nutrients (N and P) present in the PW. Furthermore, the growth rate and the final biomass density indicated no further nutrient supplementation was needed to improve the biomass. Therefore, this algal approach can remediate PW and provide biofuels, nutrients supplements, and bioactive compounds upon further harvested biomass processing.

Reference:

Rahman, A., Pan, S., Houston, C., & Selvaratnam, T. (n.d.). Evaluation of Galdieria sulphuraria and Chlorella vulgaris for the bioremediation of produced water. 1-13.

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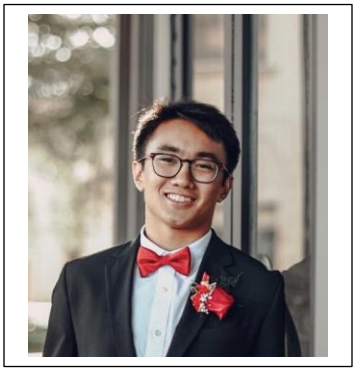


Conversion of Corn Ethanol Waste to Value-Added Products by Algae

Abstract: *My OUR research project quantifies the removal of nutrients from a waste stream produced during the production of corn ethanol, called stillage, by the microalgae Chlorella vulgaris. The growth of C. vulgaris biomass was measured in a cultivation environment with various compositional combinations of Bold's Basal Medium (BBM) and stillage. Experiments observed the rate of removal of organic and nitrogen-based compounds by C. Vulgaris in both a small scale (35 mL) and a bench scale (650 mL) photobioreactor (PBR). The growth was measured by optical density by measuring the spectrophotometric absorbance at 680 nm and dry cell mass concentration by gravimetry. Nutrient uptake was measured by the change in total nitrate (mmol L^{-1}), Total Nitrogen (mg L^{-1}), and the decrease in COD (mg L^{-1}). Finally the biomass collected was centrifuged, dried and stored for use as an animal feedstock.*

Keywords: *C. vulgaris, Corn- Ethanol Stillage, BBM, Nitrogen, PBR, COD, Absorbance, Biomass Productivity (P), Specific Growth Rate (μ), Removal Efficiency, Elimination Capacity*

1. Introduction: The most common gasoline blend is E-10, containing 10% ethanol as an additive. As the world moves towards alternative fuels, the demand for ethanol is increasing. Corn is the largest source of raw material for ethanol production. Unfortunately, a large problem that ails the corn ethanol industry is the treatment and disposal of waste, particularly a high nutrient waste stream called stillage, due to substantial energy-based costs of industrial methods. This project aims to test the efficacy of a potential biological solution to the problem by introducing *Chlorella vulgaris* into a cultivation environment and observe its growth by subjecting it to various concentrations of nutrients by varying the compositional combinations of BBM and stillage..

2. Materials and Methodology:

2.1 Culture and Cultivation medium- Microalgae *C. Vulgaris* was purchased from Carolina Biological Supply, Burlington, North Carolina, USA. Sub-culturing was done by pipetting 10 ml cell suspension into a 500 ml Erlenmeyer flask containing 80 ml of autoclaved Bold's Basal Media (BBM). Sub-culturing was done bi-monthly in an ESCO Lab culture Class II, Type A2 Biological Safety Cabinet with eight flasks of fresh culture prepared each cycle. The cultivation medium, BBM that was used to grow *Chlorella Vulgaris* and is composed of mostly inorganic salts with EDTA di-sodium serving as the only major source of organic carbon with trace organic compounds present in the antifoam, and sodium nitrate serving as the only source of nitrogen. For the experiment the age of the cultivation medium used was 19- 20 days old. The compounds used for the preparation are listed in Appendix A. In Table 1, a breakdown of the different compositions and combinations of experimental parameters and photobioreactors (PBRs) are presented along with the purpose of testing along with the reactors used.

Table 1. Breakdown of the different compositions and combinations used for testing

SPECIES COMPOSITION	TYPE OF REACTOR	PURPOSE OF TESTING	Light intensities, μmol m^{-2} s^{-1}
BBM-CV-X-X	35 ml PBR	Check growth without nitrate source	100
BBM-CV-N-X	35 ml PBR	Benchmark Standard Growth	100
BBM-X-N-X	35 ml PBR	Baseline absorbance of media	100
BBM-X-N-S	35 ml PBR, 650 ml PBR,	Baseline absorbance of media + stillage and contamination check	100, 0
BBM-CV-X-S-LIGHT	35 ml PBR, 650 ml PBR	Growth without Nitrate with controlled light intensity	100, 1500
BBM-CV-X-S-NO-LIGHT	650 ml PBR	Growth without Nitrate	0
BBM-CV-N-S- LIGHT	35 ml PBR, 650 ml PBR	Growth with Nitrate with controlled light intensity	1500
BBM-CV-N-S- NO LIGHT	650 ml PBR	Growth with Nitrate	0

CV- *C.Vulgaris*, N-Sodium Nitrate, S- Stillage, X- Absent Nutrient, MVR- Multivessel Reactor

2.2 Cultivation Systems: The initial experiments were conducted in the multi-vessel-reaction system (MVR) (shown in figure 1) with 30 reactors of working volume of 35 ml, placed in a circular set up around the light source and were sampled daily for the duration of the experiments for COD (mg L^{-1}) using a HACH Photometer DR 3900, spectrophotometric absorbance (at 680 nm) by using a Shimadzu UV1700 spectrophotometer, nitrate concentration (mmol L^{-1}) and biomass density (mg L^{-1}) by centrifuging, washing and drying at 80^0C for 24 hrs. The light source was set to an average light intensity of 100 μmol m^{-2} s^{-1} incident to the light source facing lateral surface area of the reactors. This average was calculated by arithmetically averaging values obtained over a cross sectional area using a Walz Universal light meter 500. The process variables for the experiment was the temperature, rate of culture aeration and light/dark cycle. The temperature of the setup was maintained at 25^0 C and air flow provided for the purpose of agitation and addition of CO_2 was set to a vessel volume per minute (VVM, the air flow divided by total volume of culture) ~1.47 min^{-1}. The cultivation medium was kept under a 16/8 light/dark cycle.

Based on the growth and uptake of nutrients, we scaled up our experiments to a Phenometrics PBR (figure 2) with an increased working volume of 650 ml, while maintaining the temperature at 25^0 C, providing a VVM of ~1.27 min^{-1} and agitation of 400 RPM carried out by stir bar at the bottom of the cultivation vessel. pH was checked every seven minutes by the Algal Command software and the light intensity at the surface of the top surface of the culture in pond/ PBR (650 ml) could be controlled. For the first set of experimental runs, the light intensity was set 100 μmol m^2 s^{-1} at the surface of the pond.

For the final experiment runs we tested the growth of biomass by subjugating *C.vulgaris* to different light intensities outline in Table 1 in the same cultivation medium composition. The light environment was provided an incident light intensity of 1500 μmol m^{-2} s^{-1} for 16 hours and 8 hours of darkness, while the non-light environment was kept in continuous darkness. We tested for COD (mg/L), spectrophotometric absorbance (at 680 nm), nitrate concentration (mmol/L), biomass density (mg L^{-1}) by the previously mentioned methods and total nitrogen (mg/L) by using the HACH Photometer DR 3900.

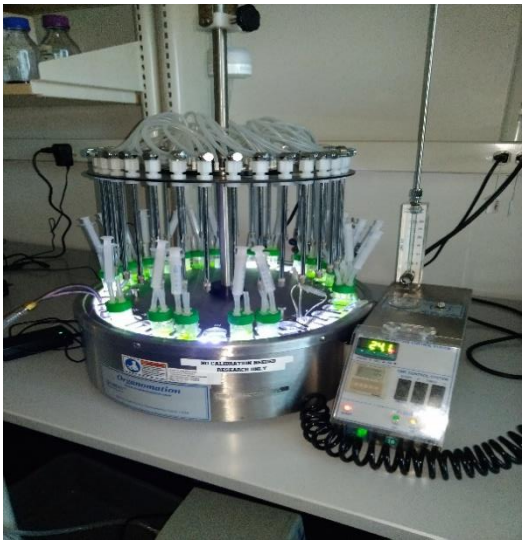


Figure 1. Multi-vessel Reactor (MVR)

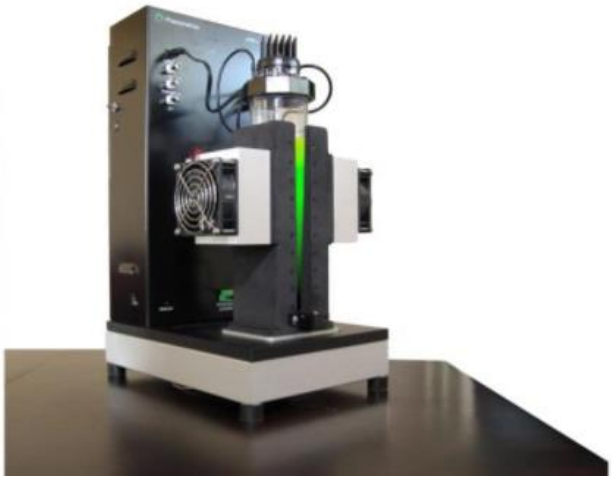


Figure 2. Photobioreactor (PBR)

2.3 Allocation of OUR funds for materials: Using the OUR budget, we were able to procure vital components namely: nitrate standard, nitrate module for the Ionic Selective Electrode (ISE) used to measure the nitrate concentration, Ionic strength adjustors for nitrate ISEs to increase the signal of the nitrate , and ISE slope check buffers from Hanna Instruments. Aluminum dishes, a vessel to keep the algae during oven drying, and micro centrifuge tubes for the centrifuge were bought from VWR. The rest of the equipment and sampling apparatuses were found within Dr. Jeffryes's laboratory

2.4 Explaining Biomass Growth: Based on the experimental values obtained daily for COD (mg L^{-1}), absorbance (at 680 nm), nitrate concentration (mmol L^{-1}), total nitrogen (mg L^{-1}) and biomass density (mg L^{-1}) we categorized the growth on the following statistics-

a) **Specific Growth Rate (μ):** The specific growth rate was calculated using the absorbance readings α_1 and α_2 taken at times t_1 and t_2 respectively.

$$\mu = \ln(\alpha 2/\alpha 1)/(t2 - t1) \qquad \text{Eq. (1)}$$

b) **Biomass Productivity (P):** biomass productivity (P, g L^{-1} hr^{-1}) was calculated using X_0 = initial biomass density (mg L^{-1}); X_i = biomass at time i (mg L^{-1}) and t_i = the time intervals in hours between X_0 and X_i and calculated on a day to day basis using the change in cultivation time between biomass density sample measures. Total biomass productivity (P_{total}, g L^{-1} hr^{-1}) was calculated over the duration of the experiment.

$$P = (X_i - X_0) / t_i \qquad \text{Eq. (2)}$$

c) **Removal Efficiency, R.E. (%):** The removal efficiency was calculated by using nutrient concentrations as a percentage change where, Ci is the initial nutrient concentration, C_n is the final nutrient concentration.

$$R.E = (Ci - C_n) / C_i * 100 \qquad \text{Eq. (3)}$$

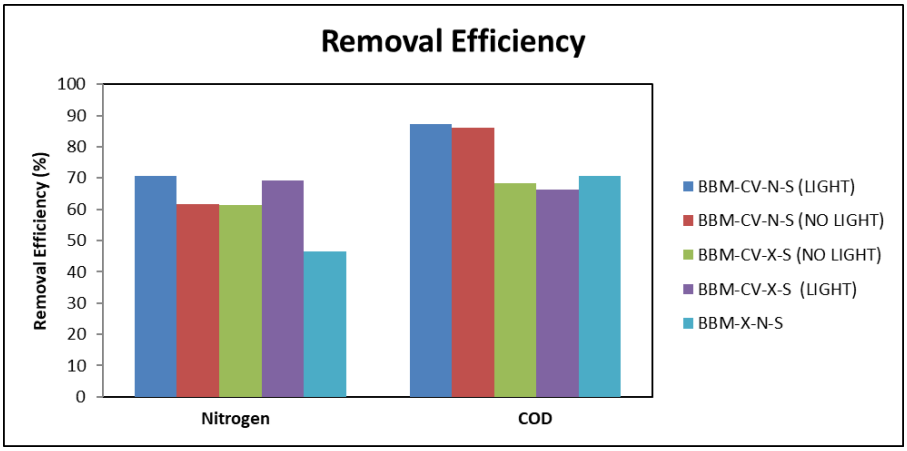
d) **Elimination Capacity, E.C:** The elimination capacity was calculated by using nutrient concentrations where, Ci is the initial nutrient concentration, C_n is the final nutrient concentration and t_{n-i} is the time elapsed between them.

$$E.C = (Ci - C_n) / t_{n-i} \qquad \text{Eq. (4)}$$

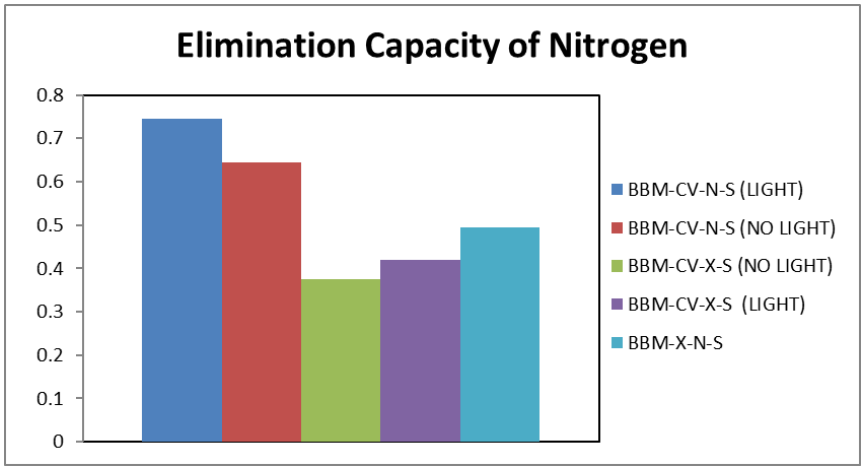
3) Results and Discussion:

Initially the PBR behaved differently from the MVR as there was no change in nitrate concentrations and the biomass growth was far less than for the MVR experiments. This was probably due to the MVR's having a higher surface area to volume ratio and since the propagation of light intensity was more evenly distributed there was better growth. On the other hand, due to the attenuation of light over the length of the PBR there was chances of more dark spots which could affect biomass growth adversely.

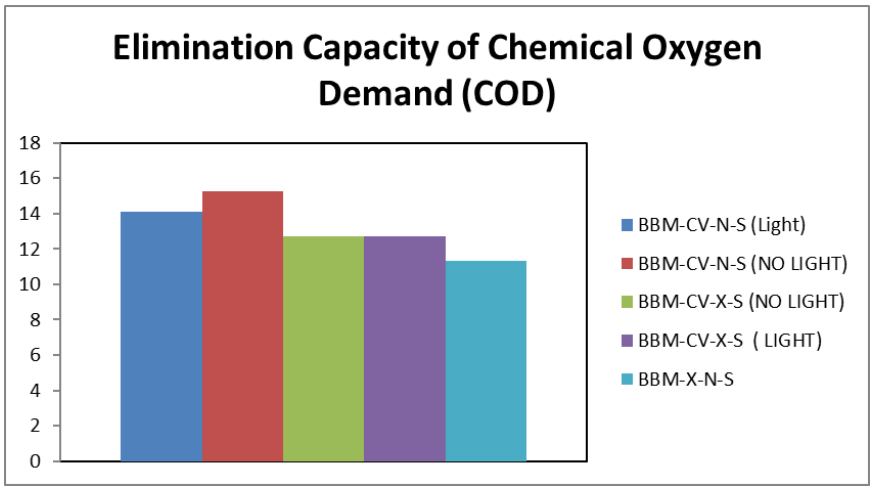
The removal efficiency of nitrogen determined between the first day and last day of sampling was higher with the added nitrogen was added and the highest removal efficiency was in the presence of light (Graph 1). The same conditions had the highest elimination capacity (Graph 2) This suggests that the *C. Vulgaris* removed more nitrogen for the combinations with added nitrate and consumes a higher percentage of nitrogen in this environment per biomass produced. The removal efficiency of the chemical oxygen demand between the same period also was higher for the combinations with the added nitrate, compared to those in the absence of nitrate (Graph 1). This occurs because other organic materials are consumed in conjunction with nitrogen. Again, the elimination capacity of COD reflects a higher value with added nitrate (Graph 3). The purpose of BBM-X-N-S is to act as a control. In Graph 1, it claims that BBM-X-N-S has a reduction of nitrate. However. The total biomass productivity of BBM-X-N-S is 0 (Graph 5), and total specific growth rate is zero (Graph 4), meaning that this removal of nitrogen and COD is due to water loss or evaporation losses throughout the experiment.



Graph 1. The removal efficiencies of nitrogen and COD for the different compositions and combinations tested



Graph 2. The elimination capacity of nitrogen for the different compositions and combinations tested

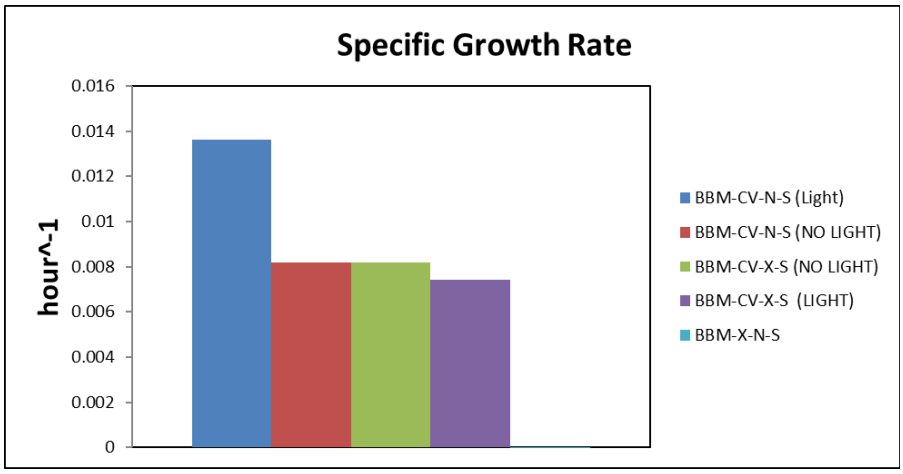


Graph 3. Elimination Capacity of Chemical Oxygen Demand (COD) for the different compositions and combinations tested

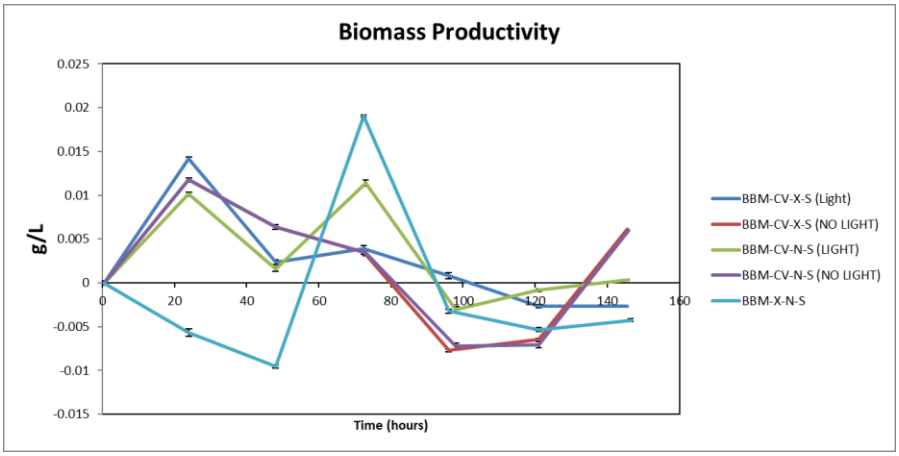
from Graph 4, which plots the Overall specific growth rate of the different combinations between the first day and the last day of sampling, BBM-CV-N-S in the Light environment was almost 80 % higher than the other environments which dispayed similar values (0.007-0.008 $hr^{-1)}$. The cultivation environment BBM-X-N-S which didn't contain *C.Vulgaris* displayed zero overall specific growth rate which suggests contamination was negligible.

From Graph 5, which plots the biomas productiviy vs time, we can observe the highest biomass productivity was achieved by the BBM-CV-X-S light on day two (24.5 hours after start of experiment). Excpet for the BBM-CV-N-S Light environment which displayed a max peak on day three (73rd hour since start of experiment), the other series achieved their highest biomass productivity on day two before showing a downward trend. reflects a higher value for the combinations in the abscence of nitrate (Graph 5). This suggests that the growth of the algae with only nitrogen from the waste stillage was erratic and at times limited by the nitrogen concentration. biomass growth is increased in the presence of light as can be seen by the biomass density changing over time (Graph 6), which shows steeper growth for the BBM-CV-N-S Light environment upto day three (73rd hour

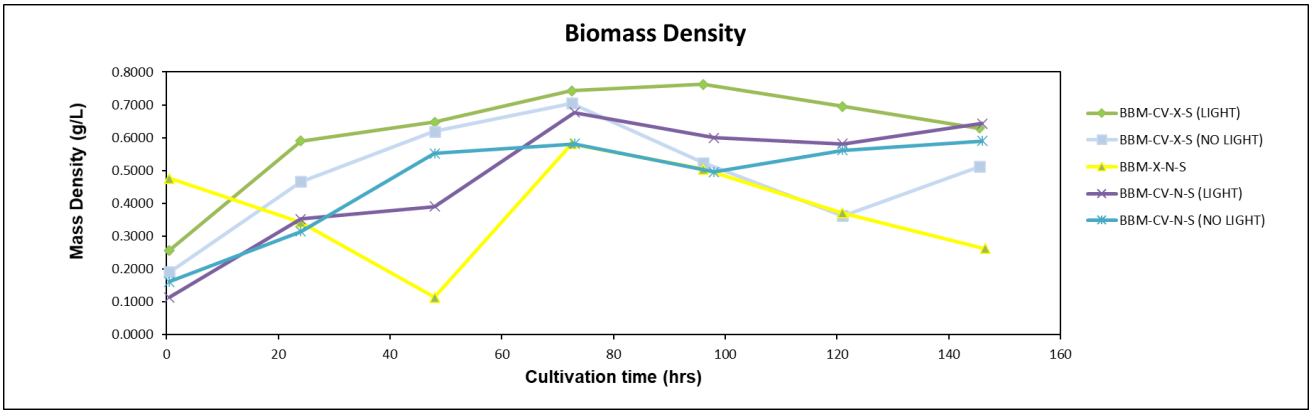
since start of experiment) and more prolonged growth periods for both the algae series with/without nitrate in light environments.



Graph 4. The Specific Growth Rate for the different compositions and combinations tested



Graph 5. Biomass Productivity for for the different compositions and combinations tested



Graph 6. Biomass Density vs. time for the different compositions and combinations tested

Conclusion: By measuring the growth of the microalgae *Chlorella vulgaris* in varying combinations of Bold's Basal Medium (BBM) and stillage in a light versus dark environment by measuring its changes in optical density, changes in dry cell mass, nutrient uptake in total nitrate (mmol L^{-1}), nutrient uptake in total nitrogen (mg L^{-1}), and its decrease in COD (mg L^{-1}), the removal efficiency, elimination capacity, specific growth rate, and biomass productivity for these different combinations were determined. The removal efficiency of nitrogen and COD and elimination capacity of nitrogen and COD were higher for the environments with added nitrate with the highest having added light. Similarly, the specific growth rate and biomass productivity suggests growth of *C. Vulgaris* is affected by the total nitrogen concentration. Furthermore, the addition of light provides better growth for *C. Vulgaris* compared to an environment absent of light. Overall, the BBM-CV-N-S Light environment had the highest nitrogen and COD Removal efficiencies. The nitrogen consumption was clearly affected by light intensity whereas the COD wasn't dependent on light intensity. The PBR provided a uniform light intensity throughout the vessel that provided better growth for the combinations that were tested in light. Based on the original purpose to reduce both nitrogen and organic matter, the Light environment performed the best, which the PBR was able to provide. It was useful for the provision of uniform light intensity and also temperature control, stirring, air flow rates.

APPENDIX A- BBM COMPOSITION

S.No	**Chemical Name**	**CAS #**	**Molecular Formula**	**Final concentration** ($mg\ L^{-1}$)
1)	Sodium Nitrate	7631-99-4	$NaNO_3$	250
2)	Calcium Chloride	10043-52-4	$CaCl_2$	25
3)	Magnesium Sulfate Heptahydrate	7487-88-9	$MgSO_4.7H_2O$	75
4)	Sodium Chloride	7647-14-5	NaCl	25
5)	Dibasic Potassium Phosphate Trihydrate	2139900	$K_2HPO_4.3H_20$	75
6)	Monobasic Potassium Phosphate	7778-77-0	KH_2PO_4	175
7)	EDTA di-sodium	6381-92-6	$C_{10}H_{14}N_2Na_2O_8 \cdot 2H_2O$	50
8)	Iron(III) Chloride	7705-08-0	$FeCl_3$	0.07
9)	Ferrous Sulfate Heptahydrate	7782-63-0	$FeSO_4 \cdot 7H_2O$	5
10)	Concentrated Sulphuric Acid	7664-93-9	H_2SO_4	184
11)	Boric Acid	10043-35-3	H_3BO_3	12
12)	Manganese Chloride	7773-01-5	$MnCl_2$	0.006
13)	Cupric Sulphate	7758-99-8	$CuSO4 \cdot 5H_2O$	0.25

Viviana Denova
Major in Business and Finances
Mentor: Dr. Gevorg Sargsyan
Research in Business and Finances
Department of Economics

The Financial Impact of COVID-19 on Small and Medium Enterprises in Southeast Texas

The goal of this research was to analyze the financial impact of COVID-19 on small and medium enterprises in Southeast Texas (SETX). Because approximately half of the Texas workforce is employed by small and medium enterprises, many employees were at risk of losing their job. This was such an important research topic because it would allow small and medium enterprises (SMEs) of SETX to know how to react or prepare for natural disasters or economic disruptions.

Dr. Sargsyan and I designed a survey that measures business performance, investment attitudes, and investment decision behavioral control and intentions. Within business performance measurements there are customer, production, human resources, and financial dimensions that give us an understanding of the impacts of COVID-19 on the various aspects of the business/enterprise. Another part of the survey asks about the level of financing that the business/enterprise used during the pandemic. The last section of the survey is open-ended in which we ask SMEs to share their best practices on how to manage risks in unforeseen or unpredictable situations like the pandemic.

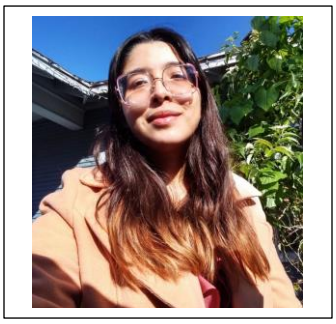
I created a list of 200 different SMEs in Southeast Texas ranging from lawyer's office, funeral homes, event planners, doctor's offices, restaurants to golf courses and tattoo shops. I wanted to have a variety of diverse responses to thoroughly analyze the impacts of COVID-19. The SMEs selected range from Beaumont, Silsbee, Lumberton, Orange, Nederland, Port Arthur, and more. By selecting different towns within the SETX region, I would be able to analyze the effects of COVID-19 on different sub-regions.

Currently, I am waiting for the IRB approval, so I am unable to distribute my survey to the selected SMEs. Once my research is approved, I will be able to begin sending the survey. SMEs will choose from the three options that I have to take the survey. I will email them the link to the survey, meet with them in person with the necessary precautions and have them take the survey on a tablet, or give it to them in paper form. By offering different avenues of taking the survey, I anticipate a higher response rate. Some business owners may have questions and

would prefer to have it in person while others may not be knowledgeable about computers and would rather a paper copy.

Once my IRB approval comes through, I will be able to distribute my survey, collect data, and reach conclusions. I am expecting great results from these responses because the survey we created touches the various elements of a business/enterprise. The conclusions reached in this research will help SMEs be able to implement strategies when facing challenges and risks.

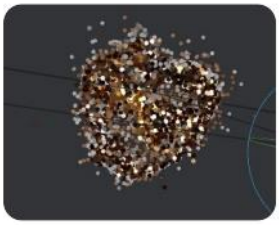
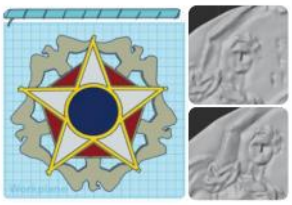
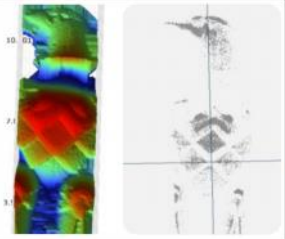
Katherine Correa
Major in Drawing and Biology
Mentor: Dr. Robert Kelley Bradley
Research in Industrial Systems and Design
Makespace in Rice University



The Babe Zaharias Medals: Exploring Methods of Replication for a Promising Non-Contact Based Approach

Throughout my time in the OUR program I was able to explore four different methods of non-contact replication for the protected recreation of the Babe Zaharias medals. The medals won by Mildred "Babe" Didrikson Zaharias not only showcase her great athletic ability but show the resilience, hard work, dedication, and result of a woman in sports in the 20th century. We aim to recreate these medals in order to preserve Babe's legacy and inspire future generations. Since her story is encased in her medals, we must reduce any risk of damage to the historic pieces. Thus, our research focused on testing the efficacy, and limitations of the following methods for non-contact replication: hand-sculpting, photogrammetry, digital sculpting, and profilometry.

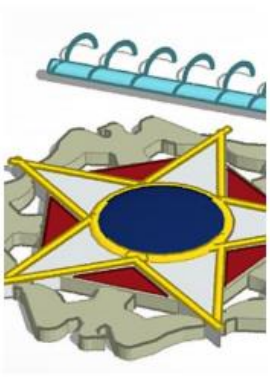
Approach and Results

Method	Approach	Result	Surface	Detail
Hand Crafted	Measurement were taken of the medals and used to guide the creation of the replica by hand-sculpting. The materials used were polymer clay and available sculpting tools		• Lacks Precision • Rough texture • Uneven	Low
Photogrammetry	A series of photographs were taken from sequential angles and were uploaded in the photogrammetry program *Meshroom*. The program then interpreted and composited the two-dimensional photographic data into a three-dimensional model.		Program was unable to create a coherent mesh	N/A
Digital Sculpting	Using available digital sculpting and modeling software, we first crafted the geometric base of the medals (left) and added subsequent details with the creation of a digital stamp (top right) which were enhanced by hand correction (bottom right)		• Accurate • Smooth • But lacks unique surface textures	Medium with slight discrepancies
Profilometry 	Under Rice University's Shared Equipment Authority (SEA) we were able to be trained and use the NP Flex Optical Profilometer (Bruker, Billerica, MA) to obtain surface information of the medals by use of reflected light.		• Captures surface texture • Missing some surface information • Only raw data was able to be exported	High

Discussion and Conclusion

Handcrafting and photogrammetry resulted in often inaccurate or distorted models that needed much refinement. Meanwhile, the approach of digital sculpting resulted in a clean but simple model of the medal which often lacked specific detail. When attempting to imprint fine detail in digital sculpting method, detail may become distorted and need much refinement by hand which opens-up the possibility of human error during replication. The profilometry approach yielded a high detail scan of small areas, however the scan was not without problems, as the scan presented areas of missing information. Therefore, our conclusion for our current research is that instead of limiting the replication process to one certain approach, varying successful approaches should be incorporating within the final method. Through our research we now hypothesized that a potential successful approach to replicating the Babe Zaharias Medals is by first creating a simple geometric base in a digital modeling program. Next, a high-quality photograph is taken of any specific detailed design and used to create a digital 3D stamp. The geometric base is then imported into the digital sculpting software, and the stamp is used to create an imprint where needed. The raw data points collected from the profilometer scanning would then be imported and placed above the low-quality imprint made. Since the profilometer data provides information of detail height, these will be used to guide the vertical height of the detail within the medals. By combing these approaches, they would allow for a clean base and allow for the creation of detailed organic forms such as the eagle to be guided by computer generated data thus reducing human error. In conclusion, approaches to replication should not be limited to a single approach, but instead have various successful approaches be applied. By exploring non-contact replication, we not only are one step closer to preserving Babe's achievements but may also contribute a method to be used for other historical pieces



Megan Cooper
Major in Biology
Mentor: Dr. Ian Y. Lian
Research in Biology
Department of Biology

Analysis of cell growth and therapeutic efficacy of pancreatic cancer cells under varying oxygen environments

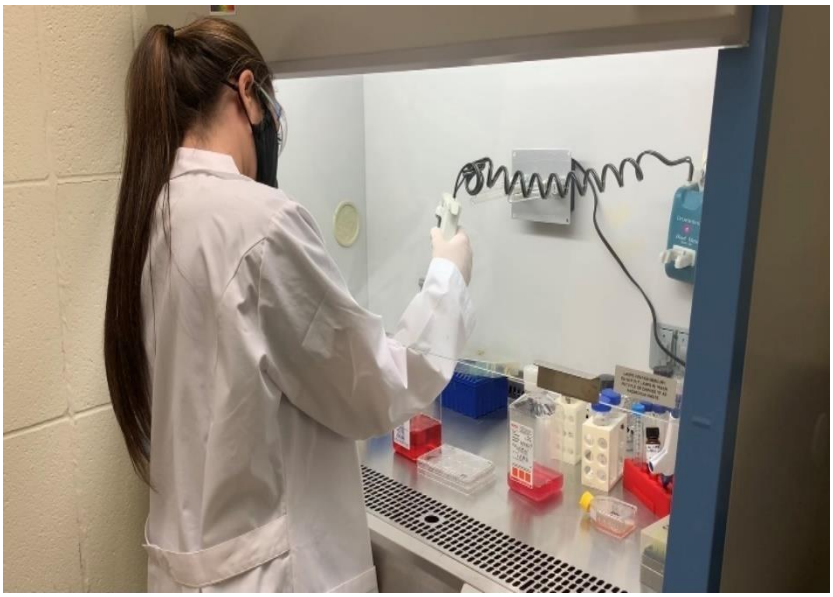
Pancreatic cancer is more difficult to treat than most other cancers because it is usually diagnosed at a late stage. This is due to the fact that pancreatic cancer does not cause symptoms until it is too late. The common symptoms for pancreatic cancer are weight loss, abnormal pain, back pain, nausea, vomiting, jaundice (yellowing of skin from toxic buildup in the liver).

Only about 10-15 percent of pancreatic cancer patients are diagnosed in a time frame considered for surgery. Even then the prognosis is poor, because 85 percent of the time the cancer will come back. In the best-case scenario only 25-30 percent of patients are alive five years after surgery.[1] The current therapy for surgery (early stages) is removing 95 percent of the pancreas including the tumor, but leaving 5 percent to serve as the insulin-producing functions. The commonly used drugs for pancreatic cancer (FDA approved) are Cisplatin, Capecitabine, Erlotinib (an EGFR inhibitor and targeted therapeutic drug), Fluorouracil, Gemcitabine, Irinotecan, Leucovorin, Nab-paclitaxel, Nanoliposomal irinotecan, and Oxaliplatin. Chemotherapy is used if the cancer is locally advanced or metastatic (late stage of cancer) pancreatic cancer.

Studies show that tumors are very well adapted at the hypoxia, low nutrient environment and are able to metastasize in that environment. Previous studies conducted to measure oxygenation in the pancreatic cancer tumor by probing into the exposed organ during surgery have shown that oxygen level is between 0-.03% in the pancreatic tumor. Normally the pancreas oxygen level is around 1%. Tumor cells farthest from the blood supply will have less oxygen. Hypoxia triggers a metabolic switch that drives growth. HIF-1 and HIF-2 induction induce drug resistance and metastasis. Hypoxic chamber is used in this experiment to mimic the pancreas in the human body since the oxygen level is only 1% in our body.

In our experiment design, we tested pancreatic cancer cells line PANC-1 in hypoxic environment using (Hypoxic chamber) as well as in normal conditions (incubator 37C) to document the grow rates. The choice of drugs we tested were Cisplatin and 5-Fluorouracil at concentrations between 1-100μmol. Cisplatin is a platinum

base drug, and its mode of action is apoptosis by causing mispairing of nucleotides. The mechanism of action for 5-Fluorouracil is forming a complex to inhibit DNA replication and repair. To reduce the oxygen concentration on the treatment group, the AnaeroPack system (Mitsubishi Chemicals) allowed us to create the oxygen-deprived and hypoxic environments that we need for the experiment without shifting any pressures or reducing possible confounding variables. Additionally, the anaerobic indictor strips will permit us to measure our atmosphere conditions without the extra and unnecessary expense of any sort of gauge. The analysis of the growth rates were measured over 72 hours (by Fiji Program) with the media being replaced (along with the drugs) on a daily basis. Based on our time course data, 5-Flurourcail inhibited PANC-1 growth more effectively under the hypoxia environment compared to the normoxia environment. Additional, Cisplatin inhibited cell growth more effectively in the hypoxia environment compared to the normoxia environment.



Kalen Baker
Major in Mechanical Engineering
Mentor: Dr. Ping He
Research in Mechanical Engineering
Department of Mechanical Engineering

Evaluation of Pair Potentials at Different Temperatures for Molecular Dynamics Simulation of Sintering

Sintering, also known as powder metallurgy, is material manufacturing process that starts with a finely divided metal powder that after processing results in a single solid. There are many different many means to perform sintering, such as laser, microwave, hydrothermal hot pressing, and hot isostatic pressing, etc. The driving force behind this fusion of material is a reduction of surface energy, the advantage is that the material does not have to be heated to the melting point saving energy. This final solid is also near net shape requiring very little post processing. The products formed from this include linings for furnaces, fuel pellets for nuclear reactors, crystal lenses for lasers, high speed cutting tools and many other everyday tools. Because of the wide variety of materials that sintering covers it is necessary to be accurately describe the progression of the process to prevented wasted time, energy, and material.

To aid in describing this process we have built a Molecular Dynamics (MD) model in LAAMPS. An MD model works on the atomic scale and describes the interaction between the atoms that compose a material. This interaction is specified by a potential type which uses input data to run the simulation. Because of the nature of sintering occurring below the melting point, a potential type needs to be chosen which accurately describes the motion of the atom. Four potentials were chosen Lennard-Jones 9/6 (LJ 9/6), Lennard-Jones 12/6 (LJ 12/6), Embedded-Atom Method (EAM), and Modified Embedded-Atom Method (MEAM). The LJ potential is one of the first and most widely used potentials and needs very little input data to describe its interaction. LJ potential was chosen because there was plenty of available information and because of the fluid like nature of the process. However, LJ systems are known for not matching reality because of their simplicity. The EAM and MEAM methods are empirical in nature and based on that data a potential is specified and used as the input to the simulation. EAM and MEAM are used for primarily for metallic systems and while the potential can be very accurate, they have issues at the melting point.

Our simulation was constructed as block to simplify specifications and mathematics of the calculations. The system is then heated to points between 0.7 and the full melting point of Aluminum and then allowed to run so that mass diffusion coefficients can be calculated. LAMMPS has two methods for performing this calculation mean squared displacement (MSD) and velocity auto-correlation function (VACF). The MSD method was chosen due to the excessive noise and fluctuation in the VACF method. Then a section from each part of the block (Aluminum, Copper, Grain Boundary) was measured for diffusion. The simulation was then run on a Raspberry Pi cluster built of 7 cards with 4 cores per card. The longest of the simulations were the MEAM and 1ook approximately 15 hours to run while the shortest was the EAM at about 2 hours. A series of 15 trials was run at each of the temperature points to generate the curves in Fig 3. In total we have run **175** simulations, which is **23,100** CPU·hours.

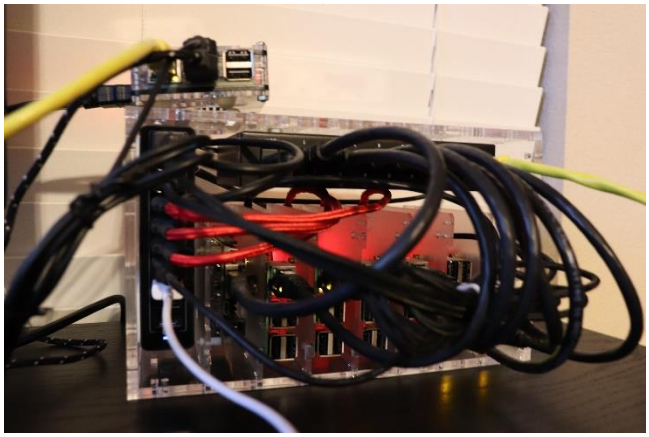


Figure 2: Cluster Computer for MD simulations

The EAM potential is the only one that was found to be suitable for the continued use, the other three tested produced no significant diffusion. While the EAM diffusion is low compared to the reference, this accounted for by the reference data being at the end of the range EAM potential and extrapolated backwards to form a curve and by the simplicity of the model itself, it only calculated volume diffusion while other means contribute to the diffusion rate. From here modeling effort can now be directed at fitting and refining so that a new model can built to provide accurate data to other models and other systems. This should provide ample opportunity for future expansion and testing of sintering MD models.

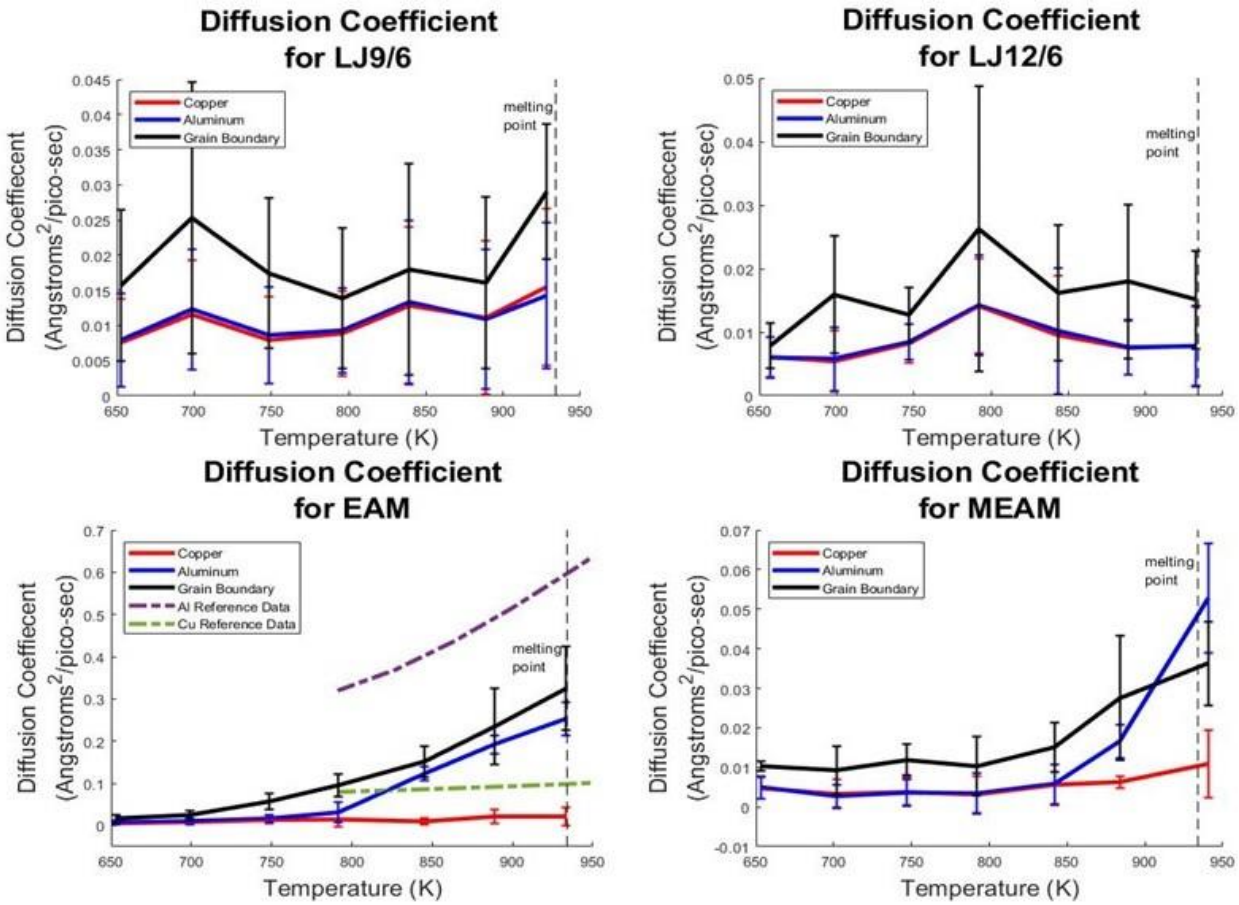


Figure 3: Diffusion Coefficient calculated by MD model

HASBSEB Breakout Session – 4:00 – 5:15 PM

4:00 PM – 4:15 PM
Research stage – advanced

Mail-In Voting

Maissa Salibi

Major in Political Science

Mentor: **Dr. James Nelson**

Department of Political Science

For my research, I used the scientific method to address the claims made against the use of mail-in voting in the United States. Due to the uncertain times upon us as a result of the coronavirus pandemic, ways of voting in the 2020 United States presidential election were a prominent concern across every state in our country. One specific method of voting, mail-in voting, brought forth arguments from both ends of the political spectrum, and was probably the most polarizing issue debated state-wide in regard to voting. I examined the history of mail-in voting, explained the claims made about the practice, fact-checked the statements made against mail ballots, advocated for a preferred approach to solving this problem, and addressed possible counterarguments that were introduced along the way. My results discovered that mail-in ballots do not cause massive amounts of voter fraud to occur, nor do they sway elections to favor one specific political party over another. In conclusion, after addressing the misleading claims regarding the occurrence of partisan bias and substantial voter fraud, it is clear that mail ballots are a safe and legitimate way for citizens to exercise their right to vote and make their voices heard.

4:15 PM – 4:30 PM
Research stage – advanced

The Pedagogy of Body Alignment

Elizabeth Nimmons
Major in Music Education
Mentor: **Ms. Debra Greschner**
Department of Music
McNair Program

The question of posture in relation to singing became pertinent to me during applied voice lessons as a college student. When I searched out resources, I was surprised by the limited information in choral sources that discussed the aspects of the pedagogy of body alignment for middle and/or high school choirs. Hence, I divided up my methodology into three sections. First, I distributed surveys to choral directors to evaluate their knowledge on the topic and evaluate how effective they transferred their understanding to their students. Secondly, I read books and took classes on body alignment to understand the topic myself. Thirdly, I hosted some interviews to understand the challenges choral directors face when approaching body alignment during rehearsal. There seemed to be several aspects of the pedagogy of body alignment that I encountered. The pedagogy of body alignment can be summarized in four aspects: imagery, diagrams, exercises, and modeling. The first three aspects allow students to map out the exterior/interior view of their body, experience the change physically from their habitual posture to the correct form of posture, and to remind and reinforce the sensation of alignment. Later in the research, I became aware of a fourth aspect which was indispensable to the pedagogy of alignment: modeling. This research found it to be ideal for teachers to be equipped to teach all four aspects to their students in a specific order to produce the most efficient and effective sound.

4:30 PM – 4:45 PM
Research stage – advanced

The Spread of Misinformation Online: A Different Kind of Pandemic

Olivia Malick

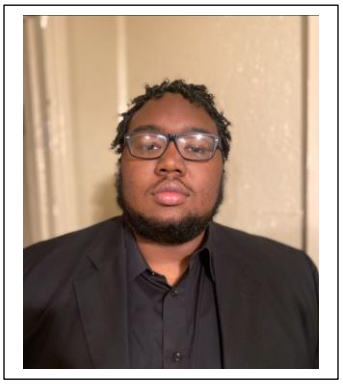
Major in Communication, Journalism Concentration

Mentor: **Dr. Kenneth Ward**

Department of Communication and Media

The spread of misinformation online has increasingly become a topic of interest for researchers as people start to dissect the effects social media has on people, especially in regard to who's susceptible to believing it. Comment sections on social media sites can serve as a breeding ground for misinformation spread. This topic has become more prevalent with the rise in conspiracy theories related to the ongoing COVID-19 pandemic. Previous research has explained what misinformation and conspiracy theories are and why people are inclined to believe them but the area lacks consensus on just how often these things are being spread in comment sections in particular and whether or not the misinformation is rebutted by other commenters. The researcher collected data from a local news station KFDM Channel 6's COVID-19 Facebook posts to see how often misinformation was commented and whether or not anyone refuted it, and the result of the refutation. Does being confronted with facts change anyone's mind? A "cure" that has often been cited for stopping the spread of misinformation is to consistently debunk it, but the results of this research show otherwise — many who believe misinformation or conspiracy theories believe them because they are not accepted by the general public. Therefore, the solution lies within the larger society to make sure that even if there are people who believe the misinformation, they don't have to infect the larger healthy society around it.

4:45 PM – 5:00 PM
Research stage – in-progress



The Strange Case of Mooney Allen: Lynching in Jefferson County, Texas, 1900-1910

Herman McElroy

Major in History

Mentor: **Dr. Jeff Forret**

Department of History

My research paper, still in progress, examines the lynching of James "Mooney" Allen on July 23, 1903, in Beaumont, Texas. It identifies the distinguishing characteristics of lynching in the early twentieth century and uses the case of Mooney Allen and other examples from Jefferson County to illustrate how they were conducted. The paper answers the questions of who was lynched in Jefferson County in the early 1900s, why, and by whom. My sources include newspapers such as the *Beaumont Enterprise*, obituaries, and, if available, court documents.

5:00 PM – 5:15 PM
Research stage – in-progress

Civic Engagement in a Small Texas City

Tim Cohrs

Major in Communication, Journalism Concentration

Mentor: **Mr. Stephan Malick**

Department of Communication and Media

How can news organizations address fake news, eroding trust, credible sources and the disruption of traditional media models and the impact of citizens' ability to be informed and engage with local government? Research has consistently shown that citizens trust their local media resources more than any other type of outlet. Research also shows that audiences often feel their interests or concerns are not being heard. How can local media outlets build civic engagement and regain trust with their communities? The University Press student editors created a program of listening events to foster better understanding of how community stakeholders get accurate, credible information about issues that affect their day-to-day quality of life. This student-led project's selected outlet was the Port Arthur News. Students moderated a live-streamed public forum on Facebook and YouTube between city government representatives and residents to discuss the May 1, 2021 election proposition to reallocate local sales tax funds to a park renovation project. Metrics were measured using social media application tools to compare and contrast engagement between previously covered material and audience response rates. Additionally, the live-streamed townhall is a new, and first-in-the-area, method for news media to engage their audiences. The event joined local officials and the public to ask-and-answer questions presented and moderated by the Port Arthur News publisher about the voter proposition and opened further discussion about other civic and government issues for the City of Port Arthur for future townhalls.

Judges of the Oral Session:

Ms Debra Greshner
Dr. Nicki Michalski
Dr. Robert Worley
Dr. Lilian Felipe
Dr. Shannon Jordan
Dr. Nandhu Radhakrishnan

Posters

Setting up Posters 1:30 to 1:45PM (or earlier)

Session 1 : 1:45 – 2:45 PM
Session 2 : 4:15 – 5:45 PM

Setting Down the Posters at 6:15 PM

Chairs: STEM areas Dr. Robert Kelley Bradley and Dr. Matt Hoch

Chairs: HASBSEB areas Dr. Dorothy Sisk and Dr. Gevorg Sargsyan

Judges of the Poster Session:

Dr. Kelley Bradley – Chair STEM Posters
Dr. Matt Hoch – co-Chair for STEM Posters
Dr. Chun-Wei Yao
Dr. Sunny Lei
Dr. Terry Randall
Dr. Liv Haselbach
Dr. Sushil Doranga
Dr. Zhe Luo
Dr. Thinesh Selvaratnam
Dr. Dorothy Sisk – Chair HASBSEB Posters
Dr. Gevorg Sargsyan – co-Chair HASBSEB Posters
Dr. Gina Hale
Dr. Lekeitha Morris

Research stage – Early Stage
STEM

P.1

Cost and Benefit Analysis of 3D Printing Robot in Construction

Jesus Cardenas

Major in Construction Management

Co-authors: **Magdiel Torres** and **Holden Lewis**

Mentors: **Dr. Zhe Luo** and **Dr. Seokyon Hwang**

Reese Construction Management Program

3D house printing robot is a roaring new technology in the construction industry. It has the advantages such as lower square footage cost, fast construction, less material waste, more design possibilities and promoted safety. However, because of the purchasing price of 3D house printing robot, contractors do not believe that this new technology may be more profitable over just using the traditional methods of human labor. To this end, this senior paper focuses on the cost comparison between 3D house printing robot and traditional construction method.

Research approach: The comparisons between the two approaches are based on the long-term cost, benefits, and risk factors. The cost data were collected using a comprehensive literature review. The collected cost data show that the one-time purchase cost of the four 3D printing machines investigated in this paper comes out to be $243,750 but using robotics the average square footage cost as reported in the case studies can range as low as $20 to $25. In contrast, using traditional construction methods the average square footage cost is between $100 and $155. In our comparison analysis, the average square footage cost of a 2000 ft^2 house using 3D house printing robot is already advantageous over that using traditional method. There will be more cost benefit of using 3D house printing robot in construction of square footage larger than 2000 ft^2.

Conclusion: It is concluded that 3D house printing is a better option in construction in terms of reduced long-term average square footage cost.

Research stage – Early Stage
STEM

P.2

Productivity, Cost, and Safety Benefits of Utilizing Concrete 3D Printing in the Construction Industry

Jesse Odom

Major in Construction Management

Co-authors: **Mario Cisneros** and **Hoah McGallion**

Mentors: **Dr. Zhe Luo** and **Minkyum Kim**

Reese Construction Management Program

This senior paper is aimed at determining the productivity, cost, and safety benefits of utilizing concrete 3D printing in the construction industry. We performed a systematic comparison between 3D printing of concrete structures and traditional methods of erecting concrete structures.

Research approach: By extensive literature review, the historical and theoretical data related to concrete 3D printing were collected from previously performed testing by liable and credible sources. The data of material cost were determined using current industry averages. The hourly labor rates are calculated using averages from the Bureau of Labor Statistics. The hour, labor and material cost of both methods are quantified and itemized in a case study, and the benefits of concrete 3D printing are thus demonstrated.

Findings: Our case study of constructing a reinforced concrete wall shows that utilizing a concrete 3D printer produces approximately 7 times of production factor compared to traditional methods. The productivity benefits of utilizing concrete 3D printing in the construction industry is the uniform quality, repeatability, and faster production rates.

Concrete 3D printing is found to save money for companies over the long term due the reduction of unnecessary reoccurring costs. The average cost of items can potentially be reduced or eliminated from a project with the use of a concrete 3D printer.

Due to the decrease of manpower needed, the concrete 3D printing has the benefit of reducing injuries and fatalities on the construction site, promoting the safety in construction.

Research stage – Early Stage
STEM

P.3

High Frequency Radar for Sabine-Neches Waterway and Galveston Bay

Rubi Garcia

Major in Civil Engineering

Co-authors: **Nayana Muppavarapu**

Mentor: **Dr. Liv Haselbach**

Civil and Environmental Engineering

High Frequency Radar (HFR) networks provide near real-time surface current data that is applicable to coastal hydrodynamic characterizations and enables more accurate modeling and assessment of pollutant fate and transport and water quality mechanisms. The project involves installation of the HFR equipment in the Sabines-Neches Waterway and Galveston Bay area and collecting and researching the data from the HFR equipment. The HFR data helps create a real time surface currant map. This data enables the researchers to track the fate of non-point source pollutants, oil spills and storm movement and develop better mitigation techniques for pollution control and oil spills and storm management.

Research stage – Early Stage
HASBSEB

P.4

Attitudes and Misconceptions of the Black Lives Matter Movement

Kyra Rost

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Mentor: **Dr. Stuart Wright**

Department of Sociology, Social Work, and Criminal Justice

In 2014, after the murder of 17-year-old Trayvon Martin, outrage among Civil Rights groups, minority leaders, and inspired individuals across the nation erupted, bringing attention and accountability to the senseless murders of Black men and women. This led to the formation of the Black Lives Matter movement (BLM), which aims to eliminate white supremacy and systematic oppression against the Black community. The movement has gained global attention and awareness, however there is significant controversy over the movement. Opponents argue that the BLM movement is working against its own interest, has terroristic intentions, and that the message of the movement is often unclear. Though, these critiques are commonly voiced by conservative leaders and right-wing news media, we actually know very little about what the public thinks of the BLM movement. In this presentation, I will clarify the goals of the Black Lives Matter movement/organization. Furthermore, I will be addressing how Dr. Wright and I will be conducting a campus-based survey of college students to measure attitudes about the BLM movement. The questionnaire will have replicas of posed questions from Gallup polls in the 1960s. Which allows for a comparison of current attitudes towards the Black Live Matter movement to attitudes in national polls towards the Civil Rights movement in the 50s and 60s. Furthermore, allowing us to test the assertion that significant progress has been made in racial equality and understanding. This study will also measure perceived effectiveness, awareness, and support for the Black Lives Matter movement.

Research stage – In-progress
STEM

P.5

Highly Selective Sensor based on Molecular Rotational Resonance Technique for Fast Monitoring Sulfur Dioxide in Ambient Air

Md Abrar Jamil

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As part of efforts to determine the utilities for Molecular Rotational Resonance (MRR) Technology to air quality control, a K-Band MRR gas analyzer has been examined for SO_2 monitoring in ambient air. Preliminary analysis of the observed features reveals a rich, but interpretable, pattern, due to MRR's sensitivity to detect multiple polar analytes in environmental matrices. The capability for K-band MRR to monitor SO_2 in environment matrices has been evaluated by measuring MRR signals over a wide range SO_2 concentration balanced in N_2 and by spiking the observed signal of SO_2 with air moistures. Work to determine the producibility and limit of detection based on the current data is underway and will be reported in the future.

Research stage – In-progress
STEM

P.6

Beta-Amyloid's Antibacterial Effects on Alzheimer's Disease

Caroline LeBlanc

Major in Chemical Engineering

Co-authors: **Paityn Warwick**

Mentor: **Dr. Maryam Vasefi**

[#]*Department Biology*

Alzheimer's disease has become a significant health concern as the number of diagnoses continues to increase worldwide. Alzheimer's disease is a multifactorial disease-causing propagation of neurofibrillary tangles and beta-amyloid plaques. The propagation of beta-amyloid plaques leads to the destruction of brain cells. Beta-amyloid accumulation could be a normal response to an infection by stimulation the innate immune system. In particular, certain bacteria may display the ability to elicit the human immune response, triggering the release and agglutination of the beta-amyloid peptide leading to the release of inflammatory mediators. The goal of this study is to broaden the research of Alzheimer's disease through acquiring experimental evidence and analyzing data. The antibacterial effect of Aβ peptide was measured by using colony-forming units (CFU). Gram stain was used to measure agglutination of bacteria in presence of beta-amyloid. In addition, bacteria/beta-amyloid aggregation and neurotoxicity are measured in presence of antibiotics: ampicillin, streptomycin, and penicillin G. Results shown from the experiment suggest that the secretion of beta-amyloid may contribute to immunity by agglutination of pathogens and prevention of bacterial distribution. This research will allow a better understanding of the pathology of Alzheimer's disease and the contribution of chronic infection in the progression of the disease. Ultimately, this research provides information that may lead to the development of a new strategy for treatments of Alzheimer's disease.

Research stage – In-progress
STEM

P.7

Fifty Year temporal and Spatial Trends in Water Quality of Sabine Lake Estuary

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Major in Biology

Co-authors: **Jared Brottem**

Mentor: **Dr. Matt Hoch**

Department Biology

Sabine Lake is a shallow and well mixed estuary along the Gulf Coast of Texas and Louisiana, which supports important fisheries and vital national infrastructure. During the past five decades population growth, freshwater demands in watersheds, and climate have changed and can affect water quality. The Texas Commission of Environmental Quality (TCEQ) has monitored water quality at 8 sites on a monthly basis for fifty years for assessment of compliance to national standards. This study analyzes important water quality parameters from the TCEQ data archive for long-term trends and spatial variability within the estuary. Linear regressions were performed to calculate 5-decade changes in temperature, salinity, phosphate, and ammonium. Long-term means (± 95%CI) were also calculated per site to assess variation from rivers to Gulf of Mexico (GOM). Over 50 years temperature increased by about 2 °C in Sabine Pass and GOM, but not other stations. Salinity increased in 50 years by 2-3 ppt in rivers to 9 ppt in Sabine Pass and GOM. Throughout the estuary phosphate increased slightly and ammonium decreased slightly over 50 years with site mean ranges of 0.086-0.226 mg NH_4-N/L and 0.045-0.130 mg PO_4/L. The increase in temperature may be indicative of rising sea surface temperatures in the GOM due to climate change. Salinity measures are influenced by changes in freshwater use in the watershed that impacts river flow in addition to precipitation patterns. The fluctuations and increases of nutrient levels are due to population growth and development of the land surrounding the estuary.

Research stage – In-progress
STEM

P.8

Quantifying Aquatic Bacteria and Algae by Flow Cytometry using a BD FACS Melody

Nyah Sciarrilla

Major in Biology

Mentor: **Dr. Matt Hoch**

Department Biology

In aquatic microbiology, flow cytometry (FCM) has become a more efficient alternative to direct microscopy for quantifying bacterioplankton, critical in cycling nutrients, and phytoplankton, predominant primary producers, in natural waters. These communities can be differentiated by cell size and fluorescence of stains or natural photopigments. Reported here is first-time use of the BD FACS Melody instrument to quantify planktonic bacteria and algae. FCM was performed on pure cultures and combinations of bacteria and algae of varied sizes to determine flow rate detector voltage settings, and gates to distinguish populations by light scatter and fluorescence. Heterotrophic bacteria, *Bacillus megaterium* and *Staphylococcus epidermidis*, required DNA staining with SYBR Green-I (SYBR) to fluoresce. The eukaryotic algae, *Chlorella vulgaris*, contains chlorophyll *a* (chl*a*) which auto fluoresces. Cultures and natural water samples were preserved with 0.5% paraformaldehyde, centrifuged, and resuspended in phosphate buffered saline before FCM. The 488 nm laser was used to excite SYBR and chl*a*, and emissions detection used 527/32 nm and 700/54 nm range filters, respectively. Fluorescent beads were added to samples to assist quantification. Epifluorescence microscopy was performed to confirm culture cell size and fluorescence. Establishing FCM protocols for plankton community quantification on the BD FACS Melody allows use of the instrument's cell sorting function for further analyses of specific cell types in a sample. In addition to studies of natural aquatic ecosystem productivity and biogeochemical function, the ability to quantify bacteria and algae with the BD FACS Melody can also benefit research in bioengineered applications, microbial-medical research, and ecotoxicology

Research stage – In-progress
HASBSEB

P.9

Knowledge and Awareness about Hearing Health and Conservation among College Students: The Use of Technological Devices

Sierra Hunnicutt

Major in Speech and Hearing Sciences

Mentor: **Dr. Lilian Felipe**

Department of Speech and Hearing Sciences

As technology grows and advances, so does our need for new, leisurely activities. With the emergence of new devices, comes the dwindling awareness of how they can affect an individual's ability to hear (Diviani, et al., 2019; Marron et. al, 2014; Reddy & Thenmozhi, 2018). Within the last decade, music listening has become a leading cause regarding hearing loss (Himanshi, Muninarayanappa, Natha, Nageshwar, & Sridhar, 2018; Imam & Hannan, 2017). OSHA (Occupational Health and Safety Administration) recommends listening to sounds that are 90 dB for 8 hours, and anything over is considered damaging to one's hearing (UNITED STATES DEPARTMENT OF LABOR, 2020). Due to the neglect of safety protocols used when listening to music (Balanay & Kearney, 2015; Diviani, et al., 2019), an estimate of 1.1 billion young adults are at risk of acquiring noise induced hearing loss (World Health Organization, 2015). Whether the youth of today knows it or not, inappropriate and unmonitored volume of sound directed through a listening device, can cause permanent hearing loss (Destriza, Castro, & Enriquez, 2015; Reddy & Thenmozhi, 2018). Anatomical structures of the ear may become damaged due to the intensity of a sound coming through a device during entertainment activities, and thus cause music induced hearing loss (Imam & Hannan, 2017). Young adults seem less likely to understand that they are neglecting safety protocols and recommendations, if they don't see hearing loss as a safety concern (Diviani, et al., 2019; Rabinowitz, 2012). Understanding why recommendations are set for listening to technological devices, is a major part of being aware of hearing health and hearing conservation.

Objective

The objective of this study is to verify the level of knowledge and awareness about hearing health among college students from Lamar University.

Methodology

An online survey composed of 25-questions, using Qualtrics, was conducted. The questionnaire was based on the harmful impacts that technological devices can have on hearing, the student's individual listening practices, as well as student's overall knowledge over noise exposure hearing loss and their own hearing health.

Results

A total of one hundred and one Lamar students answered the questionnaire (75% were female; 65% were 18-21 years of age; 85% undergraduate and 40% from the college of Arts and Sciences). Related to aspects of knowledge / awareness and use of devices: 80% of students agreed that exposure to excessive sound can be associated with hearing loss; 30% believe they may have normal hearing thresholds (Figure 1), although 40% of them have never had a hearing evaluation (Figure 1); 50% held knowledge of noise exposure hearing loss (Figure 1), and all participants responded that they use some sort of technological device (Figure 1). Use of devices were as follows: 85% used the device in both ears, the average amount of days participants spends listening to their devices is five or more days per week, the average time devices were from 6 to 8 hours per day and the main activity on the listening devices was entertainment (movies, tv, music). About the properties of the equipment, 75% of the participants reported that they set their device to a medium volume; 52% agreed that is moderately important to evaluate the quality of headphones and just 20% of them used noise cancelling headphones.

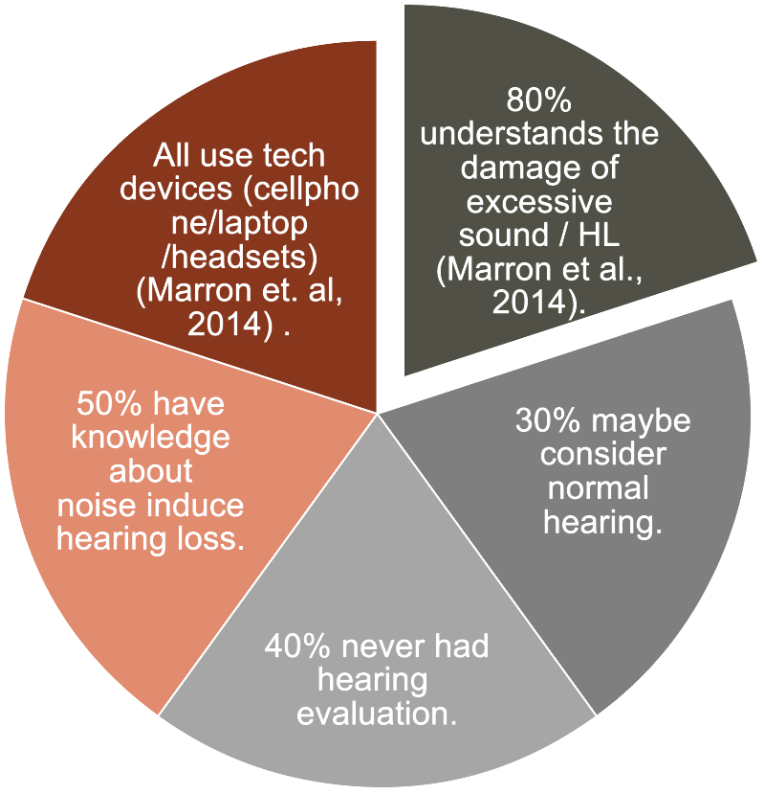

Figure 1

For the symptoms associated with the use of the device: 20% related to have tinnitus after using their devices (Figure 2), with 52% experienced ringing in both ears. Difficulties in understanding speech after using their device were related in 30% of the participants (Figure 2), with 6% experiencing dizziness too (Figure 2). Regarding desire to be educated and be given information, 75% of students responded that they have not received information properly and 70% would be interested in receiving information and learning about Noise Exposure Hearing Loss.

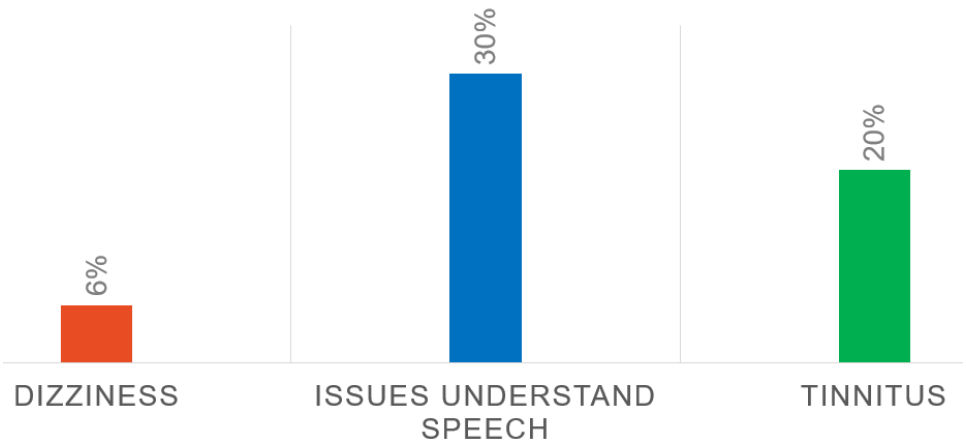

Figure 2

Conclusion

Participants' knowledge and awareness of their hearing health while using their devices is based on their perception of loudness, use of listening equipment, and their exposure to safety of hearing knowledge. Lamar's students' level of knowledge of hearing health is not appropriate to standards shown in literature, and their level of awareness is average. Intervention with education and prevention are necessary to obtain and increase information about hearing health and conservation while using technological devices.

References

Balanay, J. A., & Kearney, G. D. (2015). Attitudes toward noise, perceived hearing symptoms, and reported use of hearing protection among college students: Influence of youth culture. *Noise & health*, *17*(79), 394–405.

Destriza, W.-N. C., Castro, R. B. D., & Enriquez, H. M. (2015). An Experimental Study on Maximum Sound Output Capabilities and Preferred Listening Levels Using Different Earphone Types. *Philippine Journal of Otolaryngology-Head and Neck Surgery*, *30*(1), 6–13.

Diviani, N., Zanini, C., Amann, J., Chadha, S., Cieza, A., & Rubinelli, S. (2019). Awareness, attitudes, and beliefs about music-induced hearing loss: Towards the development of a health communication strategy to promote safe listening. *Patient Education and Counseling*, *102*(8), 1506–1512.

Himanshi, Muninarayanappa, N., Natha, H., Nageshwar, V., & Sridhar, K. (2018). Is Long Term Use of Headphones Affect the Hearing Health? A Narrative Review Based on Literature. *International Journal of Nursing Education*, *10*(2), 55.

Hodgetts W.E., Rieger J.M., Szarko R.A. (2007). The effects of listening environment and earphone style on preferred listening levels of normal hearing adults using an MP3 player. *Ear Hear*, *28*(3),290-297.

Imam L., Hannan S.A. (2017).Noise-induced hearing loss: a modern epidemic?. *Br J Hosp Med (Lond)*, *78(*5), 286-290.

Rabinowitz, P. M. (2012). The Public Health Significance of Noise-Induced Hearing Loss. *Noise-Induced Hearing Loss Springer Handbook of Auditory Research*, 13–25.

Reddy, B. A., & Thenmozhi, M. S. (2018). Excessive usage of headphones among college students and their effects. *Drug Invention Today*, *10*(11), 2296–2299.

Marron K.H., Sproat B., Ross D., Wagner S., Alessio H. (2014). Music listening behavior, health, hearing and otoacoustic emission levels. *Int J Environ Res Public Health*. *11*(8), 7592-7607.

UNITED STATES DEPARTMENT OF LABOR. (n.d.). Retrieved August 13, 2020, from https://www.osha.gov/SLTC/noisehearingconservation/standards.html

World Health Organization (2015). 1.1 billion people at risk of hearing loss. Retrieved August 11, 2020, from https://www.who.int/mediacentre/news/releases/2015/ear-care/en/

Research stage – Advanced
STEM

P.10

Investigating Traffic Crashes Involving Autonomous Vehicles

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Director of Driving Simulation Lab
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Department of Industrial and System Engineering

Deaths due to road traffic accidents are one of the leading causes of death in the United States. Furthermore, the economic impact of road traffic accidents accounts for about 3% of the United States' annual gross domestic product (GDP). In the past decade, extensive research has focused on autonomous vehicles (AVs). This technology is said to help prevent traffic accidents while promoting road traffic safety. This study aims to investigate the safety performance of AVs and identify the significant risk factors associated with the AV collisions. The study considers more than 200 crashes involving AVs and includes vehicle factors, environmental factors, collision type and crash severity. Multinomial logistic regression was conducted with collision type. The results showed no statistically significant risk factors to crash severity. However, movement preceding to collision contributes significantly to collision type. When both vehicles are moving, there's a higher likelihood of an angled collision, 47% to be exact. The other scenario which demonstrates a high probability of an angled collision is when the AV vehicle is not moving while the other is moving. The highest probability for a rear-end collision to occur is when the AV vehicle is not moving while the other is moving. This scenario makes up 55% of the entire rear-end collisions. As for the second-highest proportion, both vehicles moving, it consists of 42%. The research shall help reduce AV involved collisions and increase driving safety.

Research stage – Advanced
STEM

P.11

Stabilization of Dredged Material

Zachariah Payne

Major in Civil Engineering

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Mentors: **Dr. Mien Jao**

Dr. Paul Bernazzani, Dr. T.Thuy-Minh Nguyen, and **Jasmin Harmon**

Department of Civil and Environmental Engineering

There is a high capacity of dredged material (DM) being pumped from the Sabine-Neches Waterway (SNWW) and most of the material is placed in landfills. In 2010, approximately 8 million cubic yards of DM was pumped from the SNWW (US Army Corps of Eng., 2010). This number has increased since then due to the deepening and widening of the navigation channel. It is becoming a big problem for near-by counties such as Orange and Jefferson counties where the landfills are close to full capacity (Rabbanifar et. al, 2020). Our project will investigate three different methods for sustaining this DM in order to provide a beneficial alternative to placing the DM in landfills. The alternative to this will be using the sustained DM to manufacture compressed earth blocks (CEBs). In this work, a traditional method for stabilizing the DM will be used as well as a bio-enzyme and bacterial method (bio cementation). A number of laboratory experiments will be performed for each method. The analyzed data will be used to determine which method produces the most effective and cost-efficient design. The research performed will ultimately lead to a beneficial alternative for using the DM from the SNWW.

Research stage – Advanced
HASBSEB

P.12

Impact of Dizziness on the Quality of Life and Prevalence of Falls in the Elderly Population of Beaumont

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Mentor: **Dr. Lilian Felipe**

Department of Speech and Hearing Sciences

Introduction

Adults aged 65 years or older make up 14 percent of the population in Beaumont, Texas and the number is continuing to grow each year. (US Census, 2018). With the elderly population growing, so do the risks of them experiencing a fall related to dizziness or other vestibular complaints. Once an older adult experience a fall their chances of experiencing other increases dramatically (Al-Aama, 2011). Falls are not an inevitable part of aging and can be easily avoided with the proper educational awareness and early intervention.

Objective

The objective of this study is to describe the demographic variables related to risk factors for falls in the elderly population from Beaumont, Texas.

Methodology

Participants answered a thirteen-question demographic analysis composed by areas such as age, gender, ethnicity, race, marital status, living situation, medications. The second part was related to dizziness. If they have dizziness complains, they are then prompted to answer a 25-questionnaire Dizziness Handicap Inventory (DHI), that is a scientific tool used to rate the participants on a functional, physical or emotional scale for their dizziness complaint.

Results

A total of 85 participants completed the surveys. About the characteristics of this population, most participants were female (76%). From the total, 62 % were Caucasian, 29% African American and 9% selected other for their ethnicity. The prevalent age group was between 75-79 years old (39 %). When assessing the subjects on falls they had experienced in 2019-2020, 33% had fallen 1 time and 17% had fallen 2 times. The main cause for the falls were related to dizziness (35 %), followed by medications or underlying illness (15%). About the consequences following a fall were bruising (45 %), followed by pain (41%). The subjects who experienced a fall, just 14 % had to visit a hospital following the event. Results from the DHI concluded the main aspect rate was the Functional (46%) as the main reason for falls. The Emotional and Physical made up the same percentage (27%) each one.

Conclusion

Most falls that happened due to dizziness and were experienced in their own homes or in nursing homes where external factors played a primary role such as loose flooring, slippery floors or poor lighting. It is crucial to increase the educational awareness to the elderly community and their families along with early intervention to help in the prevention of falls.

References

1. Al-Aama, Tareef. NCBI., US National Library of Medicine National Institutes of Health. “Falls in the Elderly: Spectrum and Prevention. 2011. 57(7): 771–776.

2. Fuller, George F. (2000) American Family Physician. “Falls in the Elderly” White House Medical Clinic Washington, DC. 61(7):2159-2168

3. United States Census Bureau. “Quick Facts, Beaumont City Texas” 2019. Retrieved August 9, 2020, from https://www.census.gov/quickfacts/beaumontcitytexas

4. World Health Organization (2018) Falls. Retrieved August 10, 2020, from https://www.who.int/news-room/fact-sheets/detail/falls

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