

LSU

Department of
Biological & Agricultural
Engineering

FALL 2018 NEWSLETTER





DEPARTMENT HIGHLIGHTS

Biological and Agricultural Engineering Introduction

State of the Department: The Department of Biological and Agricultural Engineering has had a very successful and active year of growth during 2017-2018. Research and extension funding has continued to develop, with an average of about \$120,000 (\$136,000 this year) awarded per faculty member over the last six years. Total awards, on an annual basis, were \$1,358,000 with the majority being from Dr. Boldor's NSF EPSCoR award and Dr. Reichel's DHH funding, both AgCenter projects. These two awards add up to more than \$4.4 million in total grant amounts. In the last six years, BAE faculty has obtained, on average, approximately \$2 million per year in research funds. Total refereed journal publications for 2017 were 17 (being a net number), only counting publications by more than one departmental faculty member once.

Enrollment and graduation numbers continue to increase in the undergraduate program, and positive changes have occurred in the graduate programs. The new PhD in Biological Engineering was approved by the Board of Regents on Dec. 11, 2017, after a long reviewing process at many levels. The independent BE PhD is a

major accomplishment that has been proposed a number of times in the past. This new degree is linked to the Fast Path Program, established early in 2015, coupling LSU's BS and PhD in BE with the MD at the Health Sciences Center – New Orleans. This program has generated significant interest since 2015, with 12 students now enrolled in the BS part of the program, and one student starting the MD part in Fall 2018.

Graduate enrollment has declined somewhat in 2017, with seven MS and six PhD students currently enrolled. We expect this drop from the typical 20 students to increase rapidly as three new faculty have startup funds for GAs, and faculty are pursuing additional grants. We saw more than 110 freshmen arrive in August 2017, with total undergraduate enrollment increasing to 326 in Fall 2017.

Three excellent hires were made in 2017-18. Dr. Yongchan Kwon has joined us from Northwestern University. His area includes synthetic biology, an exciting new area of molecular modeling and construction. In addition, two full-time TAs were added to the

department to assist with multiple labs and sections. BAE Instructor Nick Totaro guides the TAs within his role to including development, undergraduate program leadership, recruiting, and IT/lab support.

In May 2018, an offer was made to Dr. Kevin Hoffseth at UC Santa Barbara, who will join us in August.

Dr. Monroe was awarded an Alumni Professorship, and Dr. Theegala received an Outstanding Faculty Award from LSU Campus. Dr. Constant received the Zaki Bassiouni Distinguished Professorship in the College of Engineering. In December 2017, several of our faculty received the Tipton Team Award from the AgCenter. At present, all of our teaching/research tenured faculty hold one or more professorships, and while we are a relatively small department, faculty hold three Alumni Professorships.

Based on our student exit surveys, the BAE Department has now taken a very active role to engage LSU resources, BAE alumni, and the local industry to enhance our students' experiences both before and after graduation. In partnership with the Olinde Career Center, activities such as career discovery, resume building, Handshake (previously Careers2Geaux) account creation, personality test and SWOT analysis, and a mock interview have been incorporated into the curriculum. The student organization BESO remains very active and should become a BioMedical Engineering Society (BMES) member in 2018.

The BAE Advisory Council has established officer positions and an enrichment fund to be used for council directives. With the council's influence, more outside companies and partnerships with LSU-HSC have been established. With the support of BE alumni, many classroom visits and some video conferences occurred in several upper level design electives. We believe that with recent changes to a more independent Advisory Council, with their own charter and agenda, that these interactions will produce more development results and increased contacts. The target for growth of this fund is \$135,000, to be on par with a couple of the other similar funds in the College of Engineering departments.

We expect 2018-2019 to be an exciting year in BAE, with new faculty, students, and projects at both the graduate and undergraduate levels. Feel free to contact us and visit the BAE Department in E.B. Doran Hall.

Meet Some of the Faculty & Staff Members



Faculty Member

Claudette Reichel

Non-Faculty Members

Donna Elisar
 Angela Singleton
 Ashley Flynn
 Sumit Libi
 Thomas McClure
 Sara Navarro
 Charles Malveaux
 Haley Moore
 Debra Langlois
 Bobbie Shaffett
 Shandy Heil
 Paul LaGrange
 Glenn Ray
 Bill Robinson
 Pranjali Muley

Student Highlights

Summary of Senior Design Projects



Vacuum-Operated Modular Microfluidic Device for Analysis of Sperm (VOMMDAS)

Faiz Alam, Christian Lemoine, Mykola Sereda, Mitchell St. Pierre, Evan Wilson
Faculty Advisor: W. Todd Monroe, PhD
Department of Biological and Agricultural Engineering

Introduction

Zebrafish (*Danio rerio*) are a primary model organism in developmental biology due to the optical clarity of their embryos and the ability to use them as vertebrate-specific genetic problems. The wide use of zebrafish has resulted in thousands of zebrafish lines, but since it is inefficient and difficult to maintain all lines as live fish, researchers have turned to genetic cryopreservation as a means of effective storage and preservation of the genetic resource. To address post-hawk analysis of the zebrafish sperm, this sensor design team seeks to produce a microfluidic device that:

- Accommodates small (< 5 μ L) volumes of aquatic species sperm
- Contains a chamber that is optically transparent for live video microscopy
- Enable the study of effects of electrical fields on sperm cells
- Has a portion of the microchannel depth of less than 25 microns and an optically clear viewing chamber to ensure accurate analysis by CASA (Computer Assisted Sperm Analysis) Systems
- Drives flow via negative pressure (vacuum) to prevent leaking and reduce footprint
- Stops flow quickly enough (~1-2s) for proper motility analysis
- Is modularly fabricated for ease of maintenance for the non-engineer user

Results

Figure 9: Mean Performance Comparing Pressure Drop of each microfluidic device against its respective flow rate. Mixing Efficiency is not directly related to the Pressure Drop.

Figure 10: Excludes all 100% negotiation, electrode leads due to spattering process.

Figure 11: Top view of 'Characterized' microfluidic device showing resolution in the flow.

Methods

Figure 1: 3D schematic of the device showing the inlet and outlet ports.

Figure 2: Modular device setup for flow rate measurement.

Figure 3: Device used to generate 10 μ m channels.

Conclusions

- CNC machining:**
 - Promising results for the hemirhombic geometry
 - Multi-layer process would likely exceed the costs of photolithography
 - Rough surface finish be worked around by having greater channel depth
- Fluid flow via vacuum generation:**
 - Cessation rates were within the acceptable range for the 1-channel
 - Microchannels had backflow when the vacuum was released due to increased pressure drop
 - More robust way to restore atmospheric pressure within the device will be required
 - Vacuum flow requires much less sample to be used, reducing costs
- CONCLUS:**
 - The Hemirhombic Speedbump mixer has the highest mixing efficiency while achieving an acceptable pressure drop. At lower velocities (< 2000 m/s) the SeLMA has an acceptable pressure drop but does not scale as well due to the geometry
 - If future 50% mixing is acceptable, the Hemirhombic Pushover mixer will be an optimal mixer

Acknowledgements

We would like to thank the Department of Biological and Agricultural Engineering for funding our project. Additionally, Dr. Todd Monroe, Mr. Tom McClure, Jorge Bergolden, Dr. Doris Bador, LSU Shrimp Production Facility, Jacob Beckham, Angie Singsper, and Dorina Elmer.

Design and Fabrication of a Continuous Column Still for Baton Rouge Distilling

Elaf Ezzir, Kristy Hebert, Benjamin Ray, Katie Render, Gene Salam
Sponsor: Ricci Hull; Advisor: Nicholas Totaro
Department of Biological and Agricultural Engineering
Louisiana State University; Baton Rouge, LA

Problem Statement

Design and fabricate a low cost suspended continuous column still fitted with food grade equipment for ethanol distillation at Baton Rouge Distilling.

Measurable Objectives

- Process 250 gallons of 20 proof (10% ABV) beer/wine in 7 days to produce 24 gallons of 140 proof (28% ABV) ethanol
- Maintain a constant pressure and variable temperature based on 3 separate product streams to maintain steady state equilibrium
- Produce five product streams of varying alcohol composition

Constraints

Budget

Total Budget: \$2,000.00
Amount Spent: \$1,841.35

A) Pressure tests on each fabricated still component must be done to insure no leakage on welds

Still must fit in a 4' by 4' space

Design

Conceptual Design

Ladder S&B

Final Design

Calculations and Diagrams

Theoretical Plates (TP) and Still Height

Condenser Calculations

$Q = \dot{m} C_p \Delta T$

$Q = U A \Delta T_{lm}$

$A = \frac{Q}{U \Delta T_{lm}}$

P&ID Diagram

Stream Results

Gas Chromatography

Conclusions

- Additional work may be done to maintain a consistent flow throughout the condensers, which would aid in reducing temperature variations during the run.
- Further optimization may be required to aid in the consistency of separation.

Acknowledgements

Ricci Hull, PE; Nicholas Totaro; Jorge Belgodere; Nicholas Dinecola; Mark Lee; Dr. Chandra Theegala; Dr. Adam Melvic; Tin Roof Brewing Co LLC

LSU Rapidly Deployable Flood Protection Mechanism for Small Structures

Aaron Holub, Olivia Derise, Jeanne Steyer, Cameron Larks, Grace Rozanski
Advisor: Dr. Dorin Boldor
Department of Biological and Agricultural Engineering

INTRODUCTION

Flooding is the overflow of various depths of water onto the land that is ordinarily dry. Aside from wildfires, flooding is the most widespread and destructive natural disaster. The Federal Emergency Management Agency offers flood map services to determine flood risks. The residents in those flood zones need an inexpensive, flood protection device that can be set up quickly. Inowing this need, a small-scale prototype was designed to withstand the hydrostatic force of three feet of water. A pump was used within the device to expel the water seepage entering the device.

OBJECTIVES

- The main focus of the design is to construct a framework that will remain upright even with the high hydrostatic force created by rising water without debris.
- The device will withstand 3ft of water without the braces breaking or the fabric collapsing.
- Two people will be able to have the device set up within 90 minutes.
- The device will handle a maximum seepage of 50 gal/hr.

STAKE DESIGN

According to the Federal Highway Administration, the minimum factor of safety of 1.5 against sliding should be used for footings.

$$F_s = \frac{\sum W \cos(\alpha) + c \sum \sec(\alpha)}{\sum W \sin(\alpha)}$$

$$F_s = \frac{1000 \text{ lb} \cos(30^\circ) + 100 \text{ lb}}{1000 \text{ lb} \sin(30^\circ)}$$

$$F_s = 1.33$$

In order to have multiple stakes, they must be far enough apart to be out of the failure surface. A common assumption for the friction angle of silty loam is 30°.

BRACE DESIGN

- Fabricated from two 4 ft ASTM A36 steel rectangular channels and one 4 ft ASTM A36 steel U-channel.
- The two rectangular channels are welded together to form a 90° angle.
- The U-channel is welded to the two rectangular channels so that it forms two 45° angles.
- Designed to a factor of safety of 2.6.

Calculations:

$$M_{max} = \frac{wL^2}{2} = 4361.19 \text{ lb} \cdot \text{in}$$

$$I_{min} = \frac{M_{max}}{S} = 13,899.24 \text{ in}^4$$

$$I = \frac{b^3 h^3}{12} = 20(\frac{b^3}{12} + \frac{h^3}{12}) = 6043 \text{ in}^4$$

$$I = \frac{b^3 h^3}{12} = 6314 \text{ in}^4$$

$$b = 1.14 \text{ in}$$

R_{max} and T_{max} equations come from Superposition. Simple Supports: Intermediate Load.

DESIGN & CONSTRUCTION

- Pool noodles were duct taped to the vertical side of the brace to prevent the tarp from rubbing against the steel and tearing.
- The tarp was connected to the braces by attaching grommets on the tarp to carabiners on the braces.
- One layer of sand bags were placed on the tarp skirt.
- One pump with an attached float switch was placed inside the device.
- It took 43 minutes for two people to set up the device.

TESTING

- Due to testing constraints (well dysfunction, pool failure), the braces and tarp were turned in to form an eight foot diameter circle that was then filled with water using two hoses (The second hose was added an hour into testing).
- Hose 1 Flow Rate: 4.03 gal/min
- Hose 2 Flow Rate: 5 gal/min
- Tested for eight hours

RESULTS & OBSERVATIONS

- Due to the high rate of seepage, the water level was not able to reach 3 ft.
- The water reached a maximum height of 25.5 inches (Figure 12). At this height the braces did not move at all and none of the carabiners bent.
- However, the tarp ripped away from a few of the grommets after being subjected to the force from the 25.5 inch water for 1 hour.
- There was also a much higher rate of seepage than what was anticipated as shown in Figure 13. The seepage came from under the tarp and through the zipper.

CONCLUSION

- Through testing it was determined that the device can be set up by 2 people within an hour and a half.
- While testing the device inside out, creases in the tarp had to be made in order to have the tarp sit correctly on the ground. These creases allowed water to flow under the tarp at a higher rate than anticipated.
- The device was not able to be tested at 3 ft of water. At the maximum water height, the braces and stakes did not slide or bend under the pressure. The tarp began to stretch at the grommets and ripped at one grommet.

FUTURE TESTING

- A thicker tarp and stronger grommets
- Test the device with the correct side facing out
- Observations from testing showed that seepage came from under the tarp and through the zipper. Ways to address this problem include:
 - A zipper that is better protected from the water. This could be tackled by using the same design as a kayak dry bag zipper.
 - Another layer of sand bags around the bottom of the device.

ACKNOWLEDGEMENTS

We would like to thank Dr. Dorin Boldor, Mr. Tom McClure, Dr. Navid Jafari, Dr. Clinton Wilson, Mr. Jeff Ortega, Dr. Chandra Theegala, Mrs. Donna Elour, Mrs. Angie Singleton, and Mrs. Donna Sapp. Additionally, we would like to thank the Department of Biological and Agricultural Engineering for funding this project.



Biorelevant *In Vitro* Metastatic Model: BrIMM

Grace C. Bingham, Jonathan Cuccia, Aaron Hargrove, Calvin Rome, McKenzie Windham
Faculty Advisor: Dr. Elizabeth Martin
Graduate Advisors: Jorge Belgodere, Ethan Byrne, Connor King

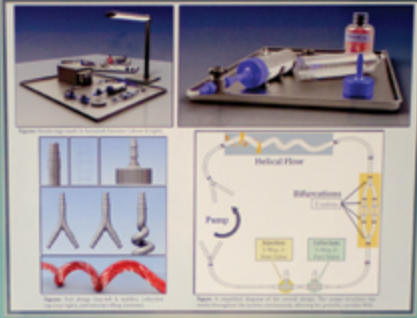
Introduction

Biorelevant *In Vitro* Metastatic Model (BrIMM) is a novel *in vitro* metastatic model designed to simulate the complex interactions between primary and secondary tumors, including mechanical, chemical, and biological factors. This model is designed to provide a more realistic and comprehensive view of tumor progression and metastasis, allowing for the study of tumor biology and the development of novel therapeutic strategies.

Objectives & Methodology

- To establish a minimum cell viability and stability of 40% following one hour of mechanical stimulation.
- To reduce fluctuating mechanical wall shear stress (WSS) with magnitudes of 100-1000 dyne/cm² throughout the system using a 3D printed design.
- To design a circulation system that can hold and circulate 0.5L of cell suspension.
- To incorporate semi-modular and reusable components into the design.
- To enhance quality of retained cellular media for further culture studies.

Design & Modeling



Computational Fluid Dynamics

- Primarily modeled by the 3-in-100 turbulence model and k- ω 2 advection scheme.
- Models were generated in and imported from Autodesk InRoads.
- Simulations were run in SimScale CFD 2020 virtual convergence was met.
- Results were used to verify preliminary calculations as well as provide flow visualization of helical pathways and the helical component.
- Simulations were used in determining the effects of geometry and part design on shear stress profiles in helical pathways.



Preliminary Calculations

Determination of Governing Helical Flow Equations

$$W = \frac{1}{2} \rho \omega^2 r^2$$

$$\tau = \mu \frac{dv}{dr}$$

$$\tau = \mu \frac{d}{dr} \left(\frac{\omega r}{2} \right)$$

$$\tau = \frac{\mu \omega}{2}$$

Governing Parametric Equations for the Helical Component

Prepared using: SolidWorks, MATLAB, Excel, etc.

Printing & Assembly



Testing & Validation

Stability Testing & Evaluation

Fig 1

Fig 2

Cell Cycle Debris

Fig 3

Cell Retention & Viability

The bar chart shows the number of retained cells for different conditions. The y-axis is 'Number of Retained Cells' and the x-axis is 'Condition'. The bars show that the device successfully retains cells, with a significant number of cells remaining after one hour of mechanical stimulation.

Conclusion & Considerations

The BrIMM device was successfully designed, modeled, printed, and assembled. It provides a biorelevant *in vitro* metastatic model that can be used to study tumor biology and the development of novel therapeutic strategies. The device is designed to be semi-modular and reusable, making it a cost-effective and practical tool for research.

Acknowledgments

We would like to thank our faculty advisors, Dr. Elizabeth Martin, Jorge Belgodere, Ethan Byrne, and Connor King, for their guidance and support throughout the project. We also thank our fellow students and friends for their assistance and encouragement.

DEVICE FOR IMPROVING ULTRASOUND-ASSISTED, COAXIAL CANNULATION OF THE SUBCLAVIAN VEIN: CONTROLLED PLUNGE DEPTH AND VELOCITY

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ADVISORS: DR. PHILIP JUNG, MR. JEFFREY ORTEGO
BIOLOGICAL AND AGRICULTURAL ENGINEERING DEPARTMENT, LSU

BACKGROUND

- Central Venous Cannulation (CVC): Over 5 million insertions annually in the U.S. performed on ~8% of all hospitalized patients.¹
- Ultrasound-guided cannulation combined with the Seldinger wire technique is a recent development but studies have not shown that complications are reduced.
- Up to 33% of catheters are not placed correctly², resulting in a multitude of complications, including death.
- An improved method for placing catheters correctly inside central veins could save thousands of lives, annually.

PROBLEM STATEMENT

Design of a device that can be used for ultrasound-guided central line cannulation coupled with the Seldinger wire technique which reduces the amount of human error involved in the procedure.

RESULTS

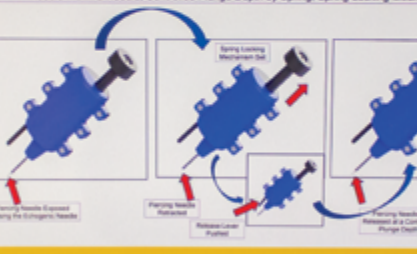
- Device design allows for use of full Seldinger wire technique without any physical obstruction theoretically allowing for minimal or no extended prep time.
- Plunge depth: 3.49 ± 0.02 mm; minimum tested spring load of 4.87 lbs. found for successful piercing event.
- Velocity measurements were unobtainable due to limited frame rates per second of camera available.

MEASURABLE OBJECTIVES

- Desired Functionality:** Consistently performs a single-wall puncture of a central vein and allows for the full implementation of the Seldinger wire technique without creating any mechanical or physical obstructions.
- Precision:** Repeatable piercing needle extension of 3.50 mm ± 5% over 15 events; repeatable velocity (±5%) over 15 events.
- Practicality:** Prep time for device should not extend procedure time by more than 2 minutes.

DEVICE INSTRUCTIONAL

Main Components of the Design:
Needle, Controlled Plunge Depth by Spring, Spring Locking Mechanism



CONCLUSION

A single-use design was chosen and fabrication was done via 3-D printing. Using simulated vein grafts models, the device repeatedly succeeded in performing a single-wall puncture. Total prototyping cost was under \$100, less than 1/10th of the total budget.

The prototype was designed to showcase the functionality of the design and, although not tested on actual patients, it has all the necessary features to allow a medical practitioner to perform an ultrasound-guided CVC coupled with the Seldinger wire technique with a reduction of complications attributed to human error involved in manual puncturing of the vein.

Optimization including a quick unlocking mechanism for easy needle loading of device is not packaged with needles already in place; the retention of the release lever to more ergonomic location, and general ergonomics of the device casing should be implemented in future prototypes designed for actual medical use.

CONSTRAINTS


- Cost:** Prototyping under \$1000; device design can not increase costs of procedure significantly.
- Equipment:** Must be compatible with generic needles and ultrasound transducers.
- Size:** Ergonomically designed and handheld.
- Autoclavable:** For multi-use design only.

FINAL DESIGN OF PROTOTYPE AND TESTING MODEL



REFERENCES


1. Smith, J., Wilson, D., & Taylor, R. (2010). Complications of central venous catheters: internal jugular versus subclavian access in pediatric intensive care unit patients. *ICU*, 4(4), 402-407.
2. Mitchell, D. C., & Daulton, M. L. (2005). Preparing complications of central venous catheterization. *New England Journal of Medicine*, 353(12), 1120-1126.
3. Egan, L. A., Rosenman, M., Berger, J. S., May, P. H., Rosen, J. A., & Schmalzer, K. T. (2006). Benchmarking complications of central venous catheters. *Journal of Intensive Care Medicine*, 21(2), 80-85.



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Adhesive, Sensor-Based Hydrogel to Dynamically Monitor Joint Angle

Student Investigators: Caroline Copeland, Sean Guilbeau, Matthew Herrera, Michael Nguyen
Advisors: Dr. Yongchun Kwon, Dr. Mandi Lopez, Nicholas Totaro
Department of Biological and Agricultural Engineering | Louisiana State University



Introduction

Physical therapy involves the treatment of a bodily injury through the use of movements designed to remediate impairments and increase mobility and function. Certain tools used in physical therapy measure and track the progression of joint range of motion through the use of handheld and strapped-on measuring devices; however, the market for adhesive, hands-free sensing devices is often unexplored and potentially saturatable.

The adhesive, sensor-based hydrogel developed in this project can be attached to the skin to monitor the range of motion of the knee and elbow. The sensor involved in angle measurement, an inertial measurement unit, can capture angular displacement of a moving body and transmit this information to an interface for user interaction.

Design and Creation of a Graphical User Interface (GUI)

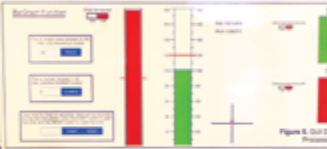
In order to translate the data from the IMU into meaningful angle values, programs were written using Arduino IDE and Processing IDE. In Arduino, the incoming values from the sensor, measured as quaternions, were converted into Euler angles (roll, pitch, and yaw) using the equation in Figure 4.

$$\text{Roll} = \alpha = \arcsin\left(\frac{2(q_0q_1 + q_2q_3)}{1 - q_4^2}\right)$$

$$\text{Pitch} = \beta = \arcsin\left(\frac{2(q_0q_2 - q_1q_3)}{1 - q_4^2}\right)$$

$$\text{Yaw} = \psi = \arcsin\left(\frac{2(q_0q_3 + q_1q_2)}{1 - q_4^2}\right)$$

A graphical user interface (GUI) was programmed with Processing IDE to convert the angles from Arduino into visible and audible cues (Figure 5). The user can interact with this GUI to perform therapy while wearing the device, with respect to the parameters of the given exercise.



Testing and Results

Visual Mechanical Testing

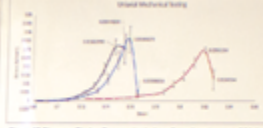


Figure 10 Stress vs. Strain. Compression tests performed over the span of 14 days show the changes in mechanical properties over time. Samples were stored in sterile conditions and tested in sets of three per week to determine storage life.

Figure 11. Inset: Machine performing compression test.

Figure 12. Plotting Strength




Figure 14 Resistance of Adhesive. Under standard ASTM D2262, a 50 Degree Peeling test shows an average minimum load of 0.077 Newtons per average displacement of approximately 0.7 mm.

Figure 16. MC Degree Peeling Test using Hydrogel Adhesive

Mechanical tests were carried out using a tension and compression-type apparatus as shown in Figures 12 and 13.

Testing procedures for mechanical compression follows the standards as outlined in ASTM D2262 and D1327 for strength properties of viscoelastic solids and storage testing. Impact tests conducted over the span of two weeks were used to generate a graph depicting the change in mechanical properties of the hydrogel.

Results from Day 0 show the highest loading by displacement ratio. Each consecutive week thereafter shows a decrease in mechanical properties.

Soaking Test/soak in PBS




Figure 18. Soaking Test Graph. The soaking test was used to verify the gel after it was made and the results show that over time it soaks in PBS.

Accuracy of Sensor

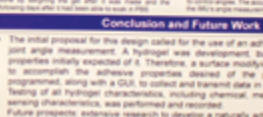


Figure 19. Accuracy of motion angle measurements using hydrogel. The accuracy was done to compare the IMU's angle measurements to the goniometer.

Design Approach – Sensor

Metal measurement units (IMUs) are often used to monitor joint angles and range of motion detection. These types of sensors use an accelerometer, a gyroscope, and a magnetometer to measure acceleration, angular velocity, and magnetic field vector in the respective axial joint coordinate system. In general, they can compute the motion of an object in space relative to an inertial frame and can then translate this motion data to be measured. For this design, SparkFun's MPU-9250 Razor IMU was used, which houses the MPU-9250 and the on-board microcontroller (Atmel SAM3U), which together aid to capture and process motion data.




Figure 3: IMU used to gather motion data

Design Approach – Hydrogel

Progression of the Double- Network Polyacrylamide/Alginate Hydrogel

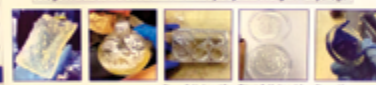
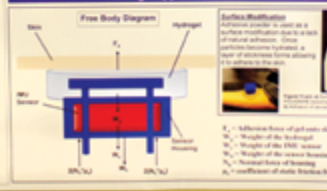


Figure 4: Hydrogel 1: crosslinked hydrogel
Figure 5: Hydrogel 2: crosslinked hydrogel
Figure 6: Hydrogel 3: crosslinked hydrogel
Figure 7: Hydrogel 4: crosslinked hydrogel
Figure 8: Hydrogel 5: crosslinked hydrogel
Figure 9: Hydrogel 6: crosslinked hydrogel

Design Approach – Combined

Free Body Diagram



Surface Modification

Adhesive polymer is used as a surface modification for the IMU. The adhesive polymer is used to adhere the IMU to the skin. The adhesive polymer is used to adhere the IMU to the skin. The adhesive polymer is used to adhere the IMU to the skin.

Acknowledgements


Lakshapathy De Mel, LSU Chemistry Department
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Dr. Carlos E. Astete, LSU Biological & Agricultural Engineering

LSU Engineering


Department of Biological & Agricultural Engineering



LSU Health New Orleans
HEALTH SCIENCES CENTER

Lower Extremity Automated Power Evaluation Device (L.E.A.P.E.D.)

Leila Chowdery, Christopher Dodson, Caitlin Lawrence Justin Martin, Brandon Noble, Michael Politz
Advisors: Jeffrey Ortega; Noelle Moreau, PhD, DPT; Mattie Pontiff, DPT



Background

This study aims to create a portable, inexpensive, and easily-operated device that quantifies power output following the completion of a leg press and may be used in a variety of research and clinical settings. An accurate device quantifying power output for comparison over time is needed. This device will be utilized at LSU Health Science Center to research adolescents with cerebral palsy. In addition, this device can be implemented in PT clinics for analyzing patients' post-injury or surgery.

Design and Testing

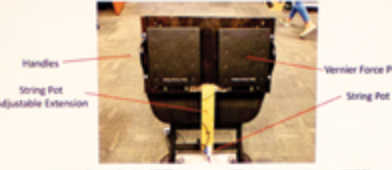


Figure 2: Typical pre-test starting position. (90°/90)


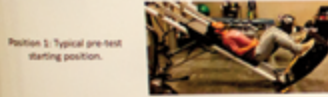



Figure 3: Adjustable Legs and J-hook supports

Methods

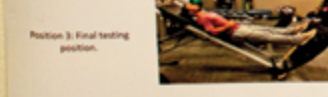
Position 1: Typical pre-test starting position.



Position 2: Mid-press position.



Position 3: Final testing position.



The subject being tested will be instructed to press as hard and as fast as possible beginning from position 1 and ending in position 3. Data will be collected during a single press with additional weight added depending on a patient's limitations.

Results

Sample Data Set



Conclusion

This device acquires two simple sets of data: force and distance over time, which can easily be transferred over to an excel template with preset equations that calculates out an ample amount of data into tables and graphs to be interpreted by the physician or therapist. Analysis of the patient's results can show if there has been improvement over multiple visits, left vs. right leg dominance, and maximum power produced.

Future Testing

The use of L.E.A.P.E.D. has been verified under six healthy individuals of differing sizes and physical capabilities. The next steps will be use in a clinical setting. The system will be used to monitor patient progress over the course of a physical therapy training regimen. Primarily, L.E.A.P.E.D. will be used in the research of improving the lives of adolescents with cerebral palsy.

Acknowledgements

We would like to thank Mr. Jeffrey Ortega for his guidance, supervision, and support over the last two semesters. We would also like to thank Dr. Moreau and Dr. Pontiff for the project proposal and counsel. Also, a special thank you to Dr. Monroe and Traction Elite Physical Therapy.

Pre-formulated Excel Template




Figure 4: Pre-formulated Excel Template to which raw data is exported.

Designing a Tree-Coring Tool Assessing Volatile Organic Compound's (VOC) Contamination



Design Team: Anndia Donahue, James Hebert, Asia Johnson, Laura Martin, Marcus Simon
Advisors: Dr. Theegala, Mr. Scott Bergeron, Dr. David Constant
Department of Biological & Agricultural Engineering Louisiana State University

Introduction

An increment borer is a specialized tool that removes a cylindrical section of wood tissue, extending from the bark to the pith of a living tree. This conventional method provides important information about tree-ring chronology. Handling a manual increment borer can be a tedious process. Therefore, our primary goal is to develop a more efficient procedure to core a tree.

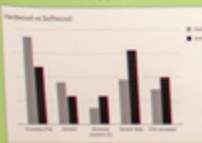
Objectives

1. Create an 15-in borer bit
2. Design and manufacture functioning drill attachment
3. Significantly reduce the amount of physical strain on the user
4. Attain a quality tree sample

VOC's

The Enviro Depot LLC is interested in this project for the use of assessing the timeline of VOC's

Softwood vs Hardwood Tree Factors



Design



A. Parts included in drill attachment:

- Manufactured Borer Bit
- Keyless Chuck
- Gearbox with 10:1 gear ratio
- Thermoplastic Extractor
- Adapters
- Support Handle

Figure 2 (A-C) Drawings and Components used for Full Assembly



B. Inventor Drawing for Borer Bit



C. Complete Drill Attachment

Test trials & Results Table

Trial	Results
Trial 1	Attained ~1.5 inch sample after using the borer bit and drill
Trial 2	Made edits to the borer bit and was first time testing with full assembly
Trial 3	Bit attained ~2 in sample Attachment malfunction



Figure 3. Testing Full Assembly

Full Assembly



Figure 4. Full Assembly with Drill Attachment

Alternative Testing Method and Improvements

- Increase gear ratio to provide higher torque output
 - Test another, simpler drill bit design
 - Replace rear adapter component
- Total Redesign: Create "Steady State" process. This would involve an automated drilling mechanism set to core very small increments over a period of time.

Conclusion

Though our design fell short in delivering a complete high quality tree core sample, we were able to create a functioning drill attachment. With the data collected from testing we were able to locate the points of failure and propose design modifications to further product development in the future.

Acknowledgments

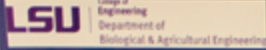
Thanks to Mr. Scott Bergeron at EnviroDepot, LLC, Dr. Theegala, Dr. Cao at RRRI-LSU, Mr. Nicholas Director at ME Shop-LSU and the BE Department for all help and support.

Vacuum-Operated Modular Microfluidic Device for Analysis of Sperm (VOMMDAS)

Faiz Alam, Christian Lemoine, Mykola Sereda, Mitchell St. Pierre, Evan Wilson

Faculty Advisor: W. Todd Monroe, PhD

Department of Biological and Agricultural Engineering



Introduction

Zebrafish (Danio sp.) are a primary model organism in developmental biology due to the optical clarity of their embryos and the ability to use them as invertebrates to explore vertebrate-specific genetic problems. The wide use of zebrafish has resulted in thousands of zebrafish lines, but since it is inefficient and difficult to maintain all lines as live fish, researchers have turned to gamete cryopreservation as a means of effective storage and preservation of the genetic resource. To address post-thaw analysis of the zebrafish sperm, this sensor design team seeks to produce a microfluidic device that:

- Accommodates small (< 5 μ L) volumes of aquatic species sperm
- Contains a chamber that is optically transparent for live video microscopy
- Enable the study of effects of electrical fields on sperm cells
- Has a portion of the microchannel depth of less than 20 microns and an optically clear viewing chamber to enable accurate analysis by CASA (Computer Assisted Sperm Analysis) software
- Shows flow via negative pressure (vacuum) to prevent leaking and reduce footprint
- Shows flow quickly enough (<1s) for proper motility analysis
- Is modularly fabricated for ease of maintenance for the non-engineer user

Methods

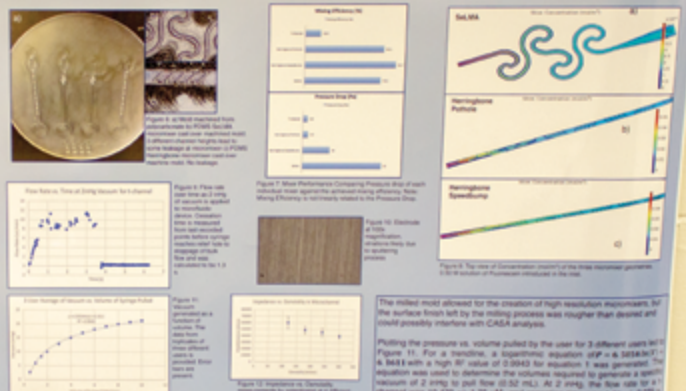


Photolithography has been the default method of fabricating microchannel molds through complex microchannel geometry makes this method difficult. Initial mold fabrication was 20 printed with Peltex technology and while successful channels were produced, the microchannel geometry resolution was low. The most recent mold was fabricated through CNC machining of a polypropylene, yielding better resolution. Traditionally, microfluidic devices were permanently adhered to a glass slide via a plasma coating. This creates adherence issues with collection of sperm in channels and the ability to be collapsed channels. A modular device assembly has been used to make the device easier to use and to give it a longer life.

Vacuum was generated with a 10 mL syringe. To reduce the footprint of the system, it became more practical to generate specific pressures generated by a syringe pulled by the user, non-dependent on the rate at which the syringe plunger. Vacuum was released by pushing the plunger past a hole cut in the syringe body to reduce atmospheric pressure. Flow rates and fluid retention times were measured using litmus. Mixing efficiencies at various constant vacuum pressures were determined in COMSOL for three different microchannel geometries: SetaMA, Hemingway Speedflow, and Hemingway Pulse. The velocity field is solved using a momentum based in a shear model with 0.1 mPa pressure and 0.001 m/s initial outflow velocity. Experimental results: The wall boundary condition is the velocity of fluid normal to wall is zero. Mixing is measured by comparing concentration variation of the inlet reservoir and the outlet.

Microfluidics are created by making a cut out with a Silhouette Cameo 3 sticker cutter on a vinyl sheet to use as an overlay of the glass slides. Three covered slides are put in an EMS 550K splicer coating machine which lays down 200 nm of plasma at a time which acts as the electrode. Once complete, the vinyl is removed from the glass and all that is left is a strip of polydimethylsiloxane that can be used to attach wires using an electrical conductivity wire spacer connecting microfluidic geometry. This was used to measure various electrical properties of the electrodes, such as capacitance and resistance.

Results



Conclusions

CNC machining

- Preliminary results for the hemingway geometry
- Multi-layer process would likely exceed the cost of photolithography
- Rough surface finish be worked around by having greater channel depth

Fluid flow via vacuum generation

- Constant rates were within the acceptable range for the volumetric
- Microfluidics had backflow when the vacuum was released due to increased pressure drop
- More robust way to restore atmospheric pressure within the device will be required
- Vacuum flow requires much less sample to be used, reducing costs

COMSOL

- The Hemingway Speedflow mixer has the highest mixing efficiency while achieving an acceptable pressure drop. At lower velocities (1000 m/s) the SetaMA has an acceptable pressure drop but does not scale as well due to the geometry.
- If future 80% mixing is acceptable, the Hemingway Pulse mixer will be an optimal mixer.

Electrodes

- Platinum electrodes are a viable option for future modular devices
- Preliminary results need a detailed experimental design incorporating conductivity, an impedance

Acknowledgements

We would like to thank the Department of Biological and Agricultural Engineering for funding our project. Additionally, Dr. Todd Monroe, St. Tom McCune, Jergel Bagdasarian, Dr. Doris Bostick, LSU Shared Instrument Facility, Sarah Neuharth, Anna Singleton, and Divina Echeverri.

2017–2018 Graduation



BAE Advisory Council

MISSION:

The mission of the Advisory Council is to advise and counsel the chairperson and the faculty of the Department of Biological and Agricultural Engineering (BAE) on matters pertaining to academic quality and stature of the Department. The Council will provide counsel on how the Department and the College can improve relationships and meet the needs of students, industry, commerce, government, and the society through best utilization of available resources. This includes actively supporting the Department's Development efforts in securing additional resources through individuals and industry.

Chairperson—Nick Gerbo

Vice-Chairperson—Richard Nelson

Secretary—Scott Bergeron

Meetings occur three times a year—summer, fall, and spring.

GOALS STARTING IN SUMMER 2017

1-Year Goals

- 15 active members on Advisory Council
- 30 networks of alumni for internships
 - Partnership with the Olinde Career Center

2-Year Goals

- Industry partners with senior design projects
- Progressively advance funds

5-Year Goals

- Meaningful financial contribution to the department

The Community Playground Project Celebrates 20 Years

For the past 20 years, LSU Biological and Agricultural Engineering Professor Marybeth Lima has made it her mission to build safe, accessible playgrounds—and bright futures—for local public school students.

With the help of her BE students and volunteers, she has spearheaded more than 30 playground builds through the LSU Community Playground Project. To commemorate the CPP's 20th anniversary, Lima and her design students recently hosted a celebration at University Presbyterian Church, where there was plenty of food, laughs and stories shared among students, volunteers and community members who have worked together over the years.



Founded in 1998, the LSU CPP has first-year BE students work together with local schools and community partners to

co-design and build playgrounds in an effort to ensure all children have access to play. Elementary and college students collaborate to create a playground design, which is finalized by children's votes and input from teachers, administrators,

ects, many of whom were at the celebration gathering.

"Everyone you see here works for me or is an alum who graduated and came back for the party," Lima said.



and community members. The team then works together to fundraise and write proposals to pay for the playground and its installation.

The playgrounds, which can be constructed in 2-3 days, are usually built by volunteers to promote learning and community spirit and to minimize construction costs. In all, the CPP teams have designed playgrounds that serve approximately 12,000 children every school day.

"I try to do as many as I can, as fast as I can," Lima said. "Finding volunteers is easy because we've been doing it for a while and most people love to come out and build. It's the money that's hard."

For this reason, the CPP team fundraises and writes grant proposals to obtain funding. If the funding goes through, the team then organizes volunteers and helps facilitate the build. Lima has a list of 550 volunteers to call on for help with proj-

"She's great," says Beatriz Garcia, a BE senior from Brusly, La., who has been a part of Lima's CPP team since her freshman year. "I still plan on helping with playground builds after I graduate."

After the students presented her with a tiara and trophy to show their appreciation, Lima smiled and quickly shifted everyone's attention back to the celebration. After all, this is a woman whose motto is "Service is the rent you pay for living on this earth."

To learn more about LSU CPP, visit

<https://sucommunityplaygroundproject.weebly.com>.

BESO

BESO Activities

- Currently American Society of Agricultural and Biological Engineers members
- The annual BESO Crawfish Boil was a great success!

BESO 2017-2018 Blurbs

From Anthony Nguyen:

“I think, because of BESO, as well as the faculty and staff, we are able to grow a form of community compared to the other engineering departments at LSU. The fact that we have a BESO lounge makes it a good place to chat with other colleagues about interests and struggles, and it’s a great way to relax without having to worry as much. The crawfish boil and sweet potato/rice sale are great ways of engaging with colleagues of different years or of the same year as you. I’ve noticed that freshmen tend to avoid the BESO lounge because of how ‘intimidating’ the higher-year undergraduates might seem to be. So, if there’s a way to fix that problem, then perhaps members of the BE department can form a stronger relationship with each other.”

From Aimee Turner:

“BESO is a great organization! Everyone is super friendly, and the events are really fun. By joining BESO, I have really been able to connect with many students and faculty in the BE department. In addition to the great people, the monthly meetings are very informative and many of the guest speakers have really helped me get a better idea of what I want to do when I graduate from LSU.”

From Christian Lemoine:

“I enjoyed BESO so much because it gave me a chance to interact with other students in the major outside of the classroom, and it allowed me to make friends within the department. More importantly, as a student who didn’t always know what he wanted to do after graduation, BESO exposed me to a lot of options and helped me form a good idea of what choices I had following graduation. It is a good place to get the information you need from friendly and helpful faculty and students in the department.”

BESO 2018–2019 Officers:

President

Thaksin Kongchum; *Fun Fact*—played violin

Vice President

Brandon Tramontana; *Fun Fact*—robotics minor

Secretary

Angelle Leger; *Fun Fact*—plays in Tigerband

Treasurer

Kaitlin Dinh

Fundraising Chairs

Athena Lindsay; *Fun Fact*—kept her baby teeth even after learning the truth about the tooth fairy

Daniel Augustin; *Fun Fact*—business minor, part-time ninja

Fundraising Sub-chairs

Jackie Begue; *Fun Fact*—double-jointed

Chris Bolonga

Social Chair

Christina Dang; *Fun Fact*—Met singing group Fifth Harmony

BESO Outreach Representative

Gabrielle Kerkow

BAE BANQUET



Award recipient's group photo

Master of Ceremonies

Dr. Marybeth Lima, professor

Awards & Recognitions

Harold T. Barr Memorial Scholarship

Presenter: Dr. Cristina Sabliov

Recipient: Jordan Remont

Richard L. Bengtson Endowed Scholarship

Presenters: Dr. Richard Bengtson and
Mrs. Rhonda Bengtson Courville

Recipients: Alison Carrier
Jonathan Cuccia
Christina Dang
Jeanne Steyer

William H. and Barbara A. Brown Scholarship

Presenters: Dr. & Mrs. Bill Brown
Recipients: Dominique Angibeau
Thaksin Kongchum

Albert P. Halluin Memorial Scholarship

Presenter: Mr. Tracy Jones

Recipients: Jacob Bursavich
Nicholas Moss
McKenzie Windham

Mansel M. Mayeux Honorary Scholarship

Presenters: Mr. Mike Mayeux and
Mr. Steven Mayeux
Recipients: Logan Daigle

Wiley D. Poole Memorial Scholarship

Presenter: Mr. Nick Totaro
Recipients: Amber Jarrell
Drake Melancon
Emily Patterson

Scott-Windham Scholarship

Presenter: Dr. Cristina Sabliov

Recipients: Jeremy Acosta
Anuradha Das
Darshil Patel

Carl H. and Christine F. Thomas Family Scholarship

Presenter: Mr. Mike Thomas

Recipient: Olivia Derise

Charles E. Severance Endowed Fellowship

Presenters: Mr. Charles Severance,
Ms. Ann Severance and
Ms. Susan Severance

Recipients: Jorge Belgodere
Ethan Byrne

Biological Engineering Student Organization**BESO Michael Mailander Memorial Scholarship**

Presenter: Aaron Hargrove,
President 2017-2018

Recipient: Nathaly Ysaccis Betancourt

Louisiana Section of ASABE Student Scholarship

Presenter: Mr. Scott Bergeron

Recipient: Amari Baker
Meggie Lam

Introduction of the Outstanding Alumni

Presenter: *Award recipient Dr. Alex Thomasson*

Dr. Richard Bengtson

Distinguished Alumni:

Dr. Alex Thomasson, MSAE 1989

Biography:

Professor

Undergraduate Education:

B.S., Texas Tech University, Agricultural Engineering, 1987

Graduate Education:

M.S., Louisiana State University, Agricultural Engineering, 1989

Ph.D., University of Kentucky, Agricultural Engineering, 1997

Research Interests

Cotton engineering, precision agriculture, remote sensing, sensor development, bioenergy, identity preservation

Rising Star Award



Parents of Lacey Simon accepting the award on her behalf with Presenter Dr. Cristina Sabliov

Lacey Simon, BSBE 2012, MSBAE 2014

My career began in 2008, when I walked in the doors of EB Doran. The colleagues and professors I encountered were shaping my future more than I expected. In 2011, LSU BE alumna Emily Hodges came to Dr. Sabilov's Process Design class to present her work as a process engineer at Procter & Gamble. That was my first exposure to P&G, and I remember thinking I'd never measure up to get a job at a place like that.

Seven years later, I am promoted to a Band Two Manager at P&G with a role as Site Environmental Manager at the Sacramento Chemicals Plant. My resume/CV highlights some notable achievements during my tenure at P&G, but I will showcase my progression following my graduation from LSU in 2014, with an MS in BAE.

Process Engineer at P&G Alexandria Fabric Care (2014)

This was my first assignment at P&G, and until this point, my most difficult. I was placed in the most volatile operation in the company (Tide PODs), which had a reliability of less than 50 percent. I was responsible for eliminating equipment losses on the most critical piece of equipment in the operation (the machine that actually makes the pods). With collaboration from individuals in operations, I was able to bring the equipment from more than 10 stops per day to less than two stops per day over the first year.

During this role, I became a global expert and resource for cost savings and forecasting, serving as team leader of a group of engineers from Louisiana, Ohio, France, and Japan.

Site Equipment Owner (2016)

This was my second assignment at P&G. I was responsible for more than 30 technicians' training, results, and career progression. I was also responsible for all equipment changes and upgrades on the equipment I owned. Some of the big projects I oversaw included child safety improvements to make the pods less soluble when ingested, and equipment throughput increase of more than 30 percent.

Start-up Leader (2017)

This was my third assignment at P&G. I oversaw the launch (start-up and validations) of a bundle of new products, leading a project team of all functions.

Site Environmental Manager (2018)

This was my fourth and current role at P&G, that I was promoted to on March 1, 2018. I will be managing the Site Environmental Program at the P&G Chemicals site in Sacramento, where the main products are glycerin, methyl esters, fatty acids, alcohols, and fatty acids. I will be fully on-boarded to work within the site operation to ensure we have the proper programs—including new projects—to meet government imposed criteria, which is elevated in California.

Research Highlights

LSU Discover Day

Jacob Bursavich

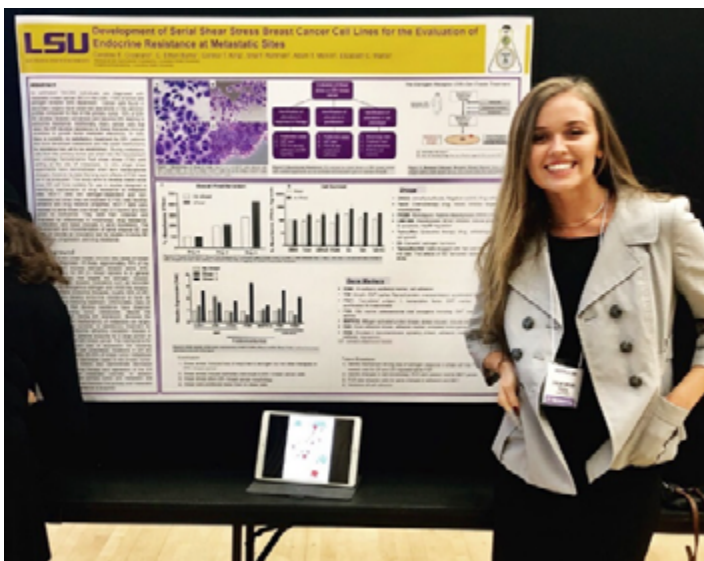
Biological Engineering major Jacob Bursavich was named a [2018 LSU Discover Scholar awardee](#). These awards are given to the top 10 undergraduate researchers at LSU each year. They were celebrated at a ceremony on March 6, 2018, with their faculty mentors, family, and friends. Each awardee received a \$1,500 travel stipend and will be highlighted at the annual LSU undergraduate research symposium LSU Discover Day.

<https://www.youtube.com/watch?v=xP7NDhUWnAs&feature=youtu.be>

Grace Rozanski—May 2018 Graduate

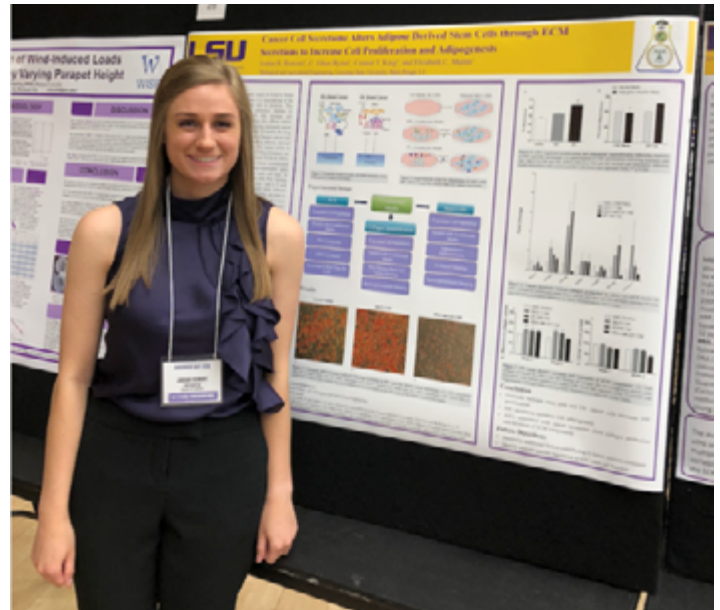
Grace Rozanski has worked on the culture and gene expression of aged and young human adipose derived stem cells over the past year. She presented her work, titled “The Extracellular Matrix: A Target for Rejuvenating Aged Human Adipose-derived Stem Cells,” at LSU Discover Day. Her project focused on age-dependent changes in the extracellular matrix and their role in the decline in hASC regenerative capacity.

Caroline Copeland—May 2018 Graduate



“At Discover Day, I presented the research I had been working on in Dr. Martin’s lab on the effect serial stress of metastatic breast cancer cells has on their endocrine therapy resistance. There were so many innovated projects in one room at Discover Day. I really enjoyed being a part of the program so I could exhibit our progress in breast cancer research.”

Jordan Remont—Junior



“Cancer Cell Secretome Alters Adipose Derived Stem Cells through ECM Secretions to Increase Cell Proliferation and Adipogenesis”

ABSTRACT

In 2018, it is estimated that 226,100 new cases of invasive breast cancer will be diagnosed in women in the U.S. Remodeling of the extracellular matrix (ECM) plays a key role in invasion. This remodeling changes integrin binding pathways, leading to upregulated AKT and MAPK pathways that increase cell proliferation and survival. Matrix remodeling also affects matrix stiffness based on collagen concentration, causing increased cancer progression and poor patient outcome. Current 2D models for drug studies are not ideal due to the heterogeneity of breast cancer and contributing stromal cell populations, including adipose derived stem cells (ASCs). To better identify how the tumor ECM is remodeled and how these changes contribute to drug resistance, we aim to develop and characterize tumor-stimulated ECM in ASCs. Here, we demonstrated that breast cancer secretome (conditioned media) stimulated ASCs. Changes in matrix-associated gene expression were evaluated with qRT-PCR for each cell type. In addition, total collagen stains were performed with Pico Serious Red Stain Kit. Conditioned media from both ER+ (MCF-7) and triple negative (MDA-MB-231 and BT549) cell lines induced increases in collagen deposition by ASCs. In the future, we plan to target these matrix-associated genes to test drug response in a more realistic microenvironment by making a better 3D tumor model that is sub-type specific. This model will allow a better understanding of how cancer cells function and, potentially, make prognosis and patient-precision therapy more effective in increasing patient survivability through targeting of the ECM.

Gracie Miller—Junior

“Evaluation of Extracellular Matrix Gene Expression as Predictive Markers of Breast Cancer Survival”

ABSTRACT

The ability to identify the subtypes of breast cancer is important in predicting therapy used to treat patients. Estrogen-receptor positive (ER+) and estrogen-receptor negative (ER-) can both develop drug resistance. Despite the current understanding of the different subtypes, there is still a lack in knowledge governing cell survival and proliferation, indicating a need for better prognostic indicators. The extracellular matrix (ECM) creates a unique microenvironment that supports cellular function and plays a key role in cancer progression. Due to their ability to induce cellular survival and mediate response to therapy, ECM related components may provide novel insight to patient response to therapy and outcome. This research aims to correlate tumor ECM composition to prognosis by identifying key matrix genes associated with patient survival for ER+ and ER- breast cancer tumor samples. Based on the expression of genes, Kaplan Meier plots estimate the survivability of cancer patients. With data from thousands of cancer patients over monthly follow-ups, graphs are made to measure the probability of survival over time based on whether a certain gene has high or low expression. Seventy-one different ECM genes including collagen, integrin, laminin, and elastin were looked at in ER+ and ER- cells. If there was significance in the Kaplan Meier plots, then the gene was important to survival, and is thus important to the ECM and ECM specific therapies. This correlation has the potential of bringing physicians one step closer to customizable patient precision medicine by providing additional prognostic markers.

Layah Kahlif—Senior

“Identification of Breast Cancer Subtype Specific Response to Extracellular Matrix”

ABSTRACT

Ninety percent of all cancer-related deaths are attributed to tumor burden at sites of metastatic lesions. Metastatic cancer cells, often correlating to stage IV (four) cancer, are characterized by their (1) rapid and uncontrolled growth, (2) ability to invade surrounding tissues, and (3) ability to spread to distant sites (metastasis). There is currently no satisfactory treatment for metastatic cancer. Prior research connects specialized intracellular structures, invadopodia, to cancer invasion and metastasis. These small finger-like projections, found selectively in invasive cancer cells, extend from the cell into the extracellular matrix via integrins. These integrins facilitate cell-to-extracellular matrix adhesion and attachment and the activation of these integrin binding pathways result in an increase in cell survival and proliferation, promoting

tumor formation. The purpose of this research is to quantify the morphological differences of metastatic cancer cells on differing extracellular matrices in order to analyze how morphology correlates to adhesion and proliferation. Cell lines representing different breast cancer cell types are grown on various extracellular matrix substrates (fibronectin, collagen, and laminin) and visualized after undergoing fluorescent staining (Phalloidain, DAPI and Ki67 stains colorize actin ECM filaments, nucleic acid and nuclear proliferative protein respectively). This research aims to identify how characteristic matrix components induce a more aggressive phenotype for each breast cancer subtype to better understand how tumor environment differentially affects cancer proliferation. This research is currently in the preliminary stages of imaging and will evolve into quantitative differentiation through analysis of parameters such as cell length, diameter, height, projection area and volume.

Akbar Zamin—Junior

In my Discovery Day presentation, I shared my work on the synthesis and characterization of new collagen-lignin composites. These novel biomaterials exhibit robust mechanical properties, minimal cytotoxicity and immunogenicity, three desirable qualities for regenerative medicine applications.

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