2017

BUMECHE

SENIOR CAPSTONE

MAY 4TH - 5TH

PHOTONICS CENTER | 8 MARY'S ST | RMS 210 & 211

DAY 1 Schedule & Table of Contents

All presentations will be available as a live stream. To view live event, go to the links provided below for each room:

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Live Stream Room 211: http://bu.adobeconnect.com/me_capstone_2017_rm211

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WELCOME
to the
Mechanical Engineering 2017 Senior Conference!

On May 4th and 5th, our graduating class will share details of their senior capstone projects. You will hear about devices designed to enhance teaching and learning in grade schools and in university classrooms, to save time and to reduce variability in surgical procedures, to facilitate communication for patients with severe neurological impairments, to advance the forensic investigation of human remains, to turn trumpets into pianos, and that is just the beginning.

The capstone is a collaborative experience that connects mechanical engineering students to colleagues in the department, across the university and even in the greater Boston industrial ecosystem. Sixty percent of the MechE students work on projects whose focus lies outside the College of Engineering. Customers and mentors include faculty in the School of Public Health, the BU Medical School, the BU College of Fine Arts, as well as industry practitioners outside the university. Interdisciplinary teams are led by biomedical engineering majors or by mechanical engineering majors. Connections occur because faculty reach out in search of projects, because students reach out in search of partners, and because, as we engage more and more with the outside world, organizations and individuals perceive there is benefit in approaching us.

Not only are we proud of the diversity of our projects, but we also celebrate the talent and diversity of our students. As they introduce themselves in their talks, note their names, listen to their accents, and recognize the range of cultures they represent. We thank the parents around the world who have entrusted their sons and daughters, for a short time, to our guidance. Those of us who mentor them are fortunate to have that opportunity.

Enjoy the presentations!

Alice E. White

Alice E White
Professor and Chair
Department of Mechanical Engineering

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SAINT-GOBAIN ABRASIVES

Group Members:
Meadow Lakin
Alex Backus
Andrei Kentlier
Ashley Reischman

Company Contact:
Michael Pettit

Faculty Advisor:
William Hauser

Saint-Gobain Abrasives is a world leader in manufacturing abrasive materials. Founded in 1885 as Norton Emory Wheel Co, and acquired by Saint-Gobain in 1990, they are one of the largest abrasive manufacturers in the world and are headquartered in Worcester, MA.

One of the high volume products for the Worcester manufacturing facility is abrasive grinding wheels. These wheels come in several diameters (3 – 20"). Each wheel is comprised of an inner region, primarily made from steel, and a small outer region that is coated with abrasive diamond; the diamond on the outer edge of the wheel is what allows the wheel to effectively cut through hard materials. There is a small step height between the inner steel and outer abrasive diamond regions. In order for any wheel to be within specification, the step height on one side of the wheel must be within a one-thousandth of the step height on the other side. The capstone team was tasked with automating the current step height inspection system used by Saint-Gobain Abrasives to improve inspection efficiency, accuracy, and speed while working within a corporate environment.

The capstone team has designed, built and tested subsystems to be integrated into the Saint-Gobain Abrasive wheel manufacturing line following the conclusion of this project.

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Elena Flynn

Research Advisor: Professor J. Bird

Faculty Advisor: Professor W. Hauser

fluidlab
UNCOVERING INTERFACIAL DYNAMICS

When a bubble bursts on the surface of a liquid bath, it frequently produces an upward-moving jet which can break up into a series of droplets, referred to as jet drops. These droplets are known sources of particulates and contaminants that enter the atmosphere, such as bacteria from water towers or salts from the ocean. Thus, a model to predict the number and volume of droplets ejected from bursting bubbles is useful. It is known that smaller bubbles produce more jet drops, but when a bubble is sufficiently small, its burst will not release any droplets due to viscous forces. This transition to producing no droplets is unknown. Furthermore, the relationship between the size of a parent bubble and the size of the first droplet it produces is uncertain.

To address these unknowns, we use high-speed photography to observe bursting bubbles and count and measure the droplets ejected, then compare the results to those predicted from numerical simulations and microfluidic experiments. However, the smallest bubbles produce droplets that are too small and too fast-moving to be seen even with high-speed equipment. Therefore, we use dimensional analysis to understand how to vary the liquid properties to examine the same effect of changing bubble size. Increasing the viscosity of the liquid simulates decreasing the size of the bubble. Using different glycerol-water solutions, we vary the viscosity to observe how viscous forces influence droplet production from small bubbles. We find that there is a non-monotonic relationship between the size of the bubble and the number of droplets produced, as well as between the bubble size and the first droplet size.

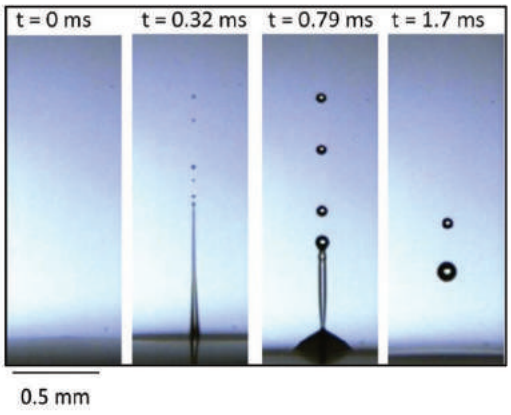
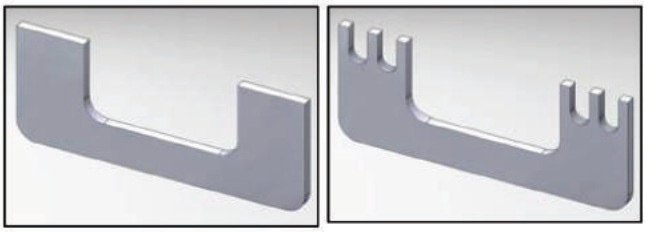


Figure 1: A bubble of radius ≈ 240 µm and viscosity ≈ 3 cP bursts, producing many micron-sized jet drops.

Figure 2: A drop of water rests on a hydrophobic leaf. A bubble pops, inducing several jet drops.

Low Frequency Vibration Sensor



Background

TMC AMETEK is a global leader in both electromechanical devices and electronic instruments. A large part of what they do is manufacture and sell a wide variety of vibration isolation systems. Their current vibration sensor that is in a vast majority of their systems is a geophone sensor, which fails to detect frequencies lower than 3 Hz. Our goal is to either improve upon the geophone design or research new sensor technologies and develop our own sensor to solve this problem and allow their systems to detect frequencies as low as 1Hz.

Solution

The geophone currently used by TMC can be seen to the right. In order to increase the frequency range detected by these sensors, we found that by changing the design of the interacting magnet and coil faces, we could achieve a stronger output signal. We integrated our optimal magnet design into a prototype vibration sensor, testing both of our face designs to compare the results.

TMC VIBRATION CONTROL
AMETEK ULTRA PRECISION TECHNOLOGIES

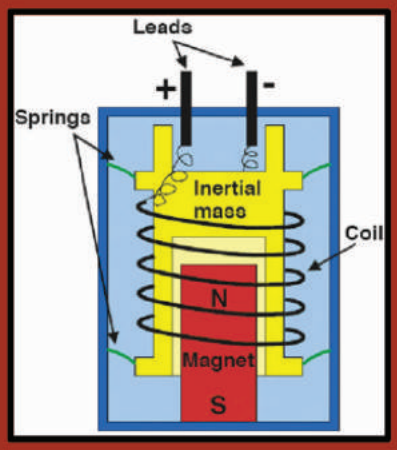
Client: TMC AMETEK

Team Members:

Lucas Encarnacao
Jaryd Hobbs
Alejandro Rivera
Mark Steranka
Aaron Slamowitz

Faculty Advisor:

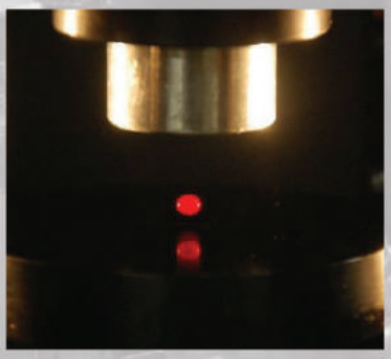
Enrique Gutierrez Wing



BUMECHE

Acoustic Tweezing Tensiometer | Physical Acoustics Lab

Background

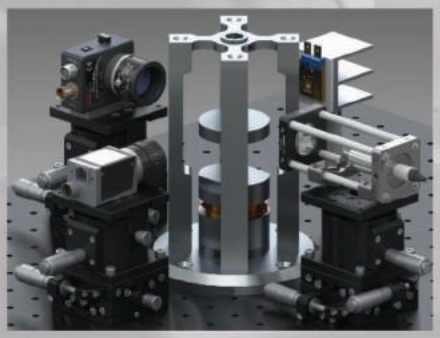


Clotting studies of blood are currently conducted using mechanical rheometers, devices which requires a relatively large sample of blood. In addition, these rheometers have several drawbacks namely poor repeatability, a requirement for direct contact with the sample, and a qualitative "time to clot" as opposed to a quantitative test result.

In collaboration with his graduate students, Dr. R. Glynn Holt has devised a non-contact free-decay method that utilizes acoustic levitation to analyze the sample. In addition to resolving the contact contamination issue, the levitation-based technique is faster, requires a smaller volume of blood (approximately 0.01 mL) and yields quantitative results – such as viscosity – allowing for easy comparisons between samples.

Objective

In order to obtain the quantitative data from measurements, Dr. Holt's technique requires knowing the surface tension of the sample. While this quantity can be inferred for Newtonian fluids such as water, blood is non-Newtonian in nature; in order to obtain the surface tension of a blood sample, it must be measured statically and independently. The goal of this project has been to develop an independent method to find the surface tension of a blood sample in the same apparatus that performs the free-decay analysis. Currently, the independent method is able to produce a dataset that is ready for external post-processing; real-time processing of the data is expected to be within reach.



Team: Jarrod Risley | Client: Dr. R. Glynn Holt | Advisor: William Hauser

PORTABLE WEATHER STATION FOR NASA GLOBE

TEAM:

MICHELLE YE

DAVID MARTINEZ

CHITANYA GOPU

HAYLEY WALKER

CUSTOMER:

CALEB FARNY

COLLABORATORS:

PETER GARIK

BENADETTE MANNING

KEITH MAGNI

VICTOR MANNING

RUSSEL THOMPSON

FACULTY ADVISOR:

ENRIQUE GUTIERREZ-WING

The Earth's atmosphere is changing rapidly. To accurately track weather patterns over time and to meaningfully understand the environment, NASA's Global Learning and Observations to Benefit the Environment (GLOBE) program collects weather data worldwide. Not only do scientists contribute data to NASA GLOBE's program, but average citizens and students can participate as well to encourage "citizen science", educating the public while accomplishing GLOBE's main mission.

Our role in GLOBE's mission is to provide high schools with an affordable, accessible and portable weather station kit for the students to build and then implement in their schools, contributing to real climate science data collection. This engages the students in environmental education, while teaching fundamental mechanical and electrical engineering skills to encourage STEM education.

Our weather station is relatively cheap, solar powered, and wirelessly plots data in real-time on an online data analytics platform with the Arduino IDE. The system measures temperature, humidity, pressure and wind speed using a breakout board and anemometer, with a custom designed electronics housing and a roof mount. A prototype of the weather station and educational material has been successfully tested and approved by Fenway High School students.

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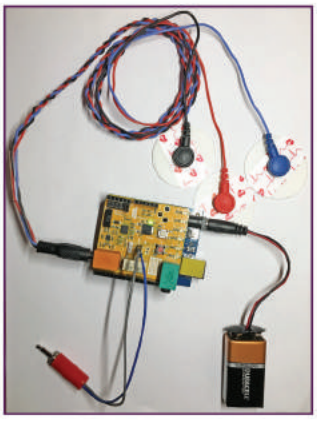
DESIGN OF AN ELECTROMYOGRAPHIC SWITCH FOR COMMUNICATION SYSTEMS

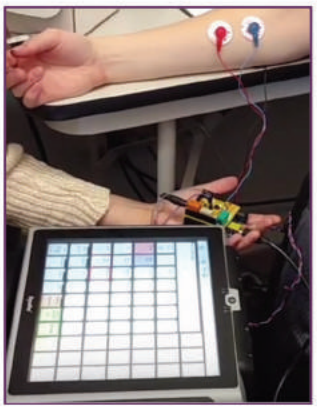
BOSTON UNIVERSITY: COLLEGE OF ENGINEERING

CLIENTS
- Madonna Rehabilitation Hospital
- Boston University STEPP Lab for Sensorimotor Rehabilitation Engineering

TEAM
- Katherine Girouard
- Victoria Frick
- Evi Shiakolas

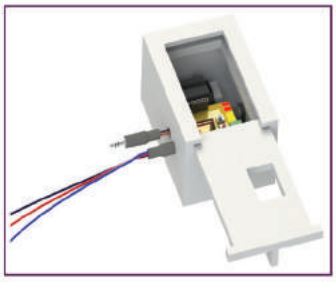
ADVISORS & COLLABORATORS
- Dr. Cara Stepp
- Dr. William Hauser
- Meredith Cler, PhC
- Dr. Susan Fager





Augmentative and alternative communication (AAC) systems provide patients with specialized methods to communicate when oral communication is not possible. However, some patients have insufficient motor control to access current AAC systems, or the cost of current systems is too high (e.g., via head-tracker, eye-tracker, button-style mechanical switch). There is a subcategory of patients who possess volitional control over one or more muscle groups but lack the strength or coordination to activate a mechanical switch, leaving these patients with no way to communicate.

This project delivers a device that directly replaces a mechanical switch for AAC operation by capturing muscle activity via surface electromyography (sEMG). The device uses the signal processing capabilities of an Arduino UNO equipped with sEMG-capable hardware to amplify, filter, and smooth the signal from a patient's voluntary muscle activity. A patient-specific threshold is used to determine the state of the switch and produce a binary output that matches that of an existing mechanical switch. This complete sEMG-based switch is provided with full documentation detailing instructions for sensor placement over any volitionally-controlled muscle group, calibration, operation, and maintenance procedures. The device design is modular and replicable with commercially-available parts and open-source software for use by any hospital or caregiver serving the target population.



MADONNA Rehabilitation Hospital

STEPP LAB Sensorimotor Rehabilitation Engineering

GLOBE Educational Weather Station Platform

Background

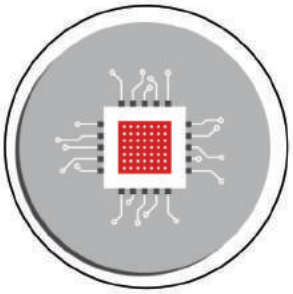
The Global Learning and Observations to Benefit the Environment (GLOBE) program is a NASA and NSF sponsored science and education program. Their goal is to promote science and engineering to K-12 students across the country. Our team has worked with Professor Caleb Farny to deliver a working prototype that adheres to GLOBE standards to be tested in schools in Massachusetts before expanding to the rest of the country.

Project Goals

Our team's goal is to create a weather station that students can use to gain insight on science and engineering applications. By providing K-12 students and teachers with a detailed manual, we hope they will be able to recreate weather stations across the country. In addition to the manual, we have also developed ways to incorporate the data from the weather stations into existing curriculums to allow students to receive hands-on experience with weather data, programming and engineering basics. The weather station is designed for roof installations and can run completely off-the-grid.

Programming

Structural Engineering



Electrical Engineering

Team:
Hester van der Laan
Walid El Kara
Michael Ward
Abdullah Babgi
David Oluwadara

Client:
Caleb Farny

Advisor:
Peter Zink

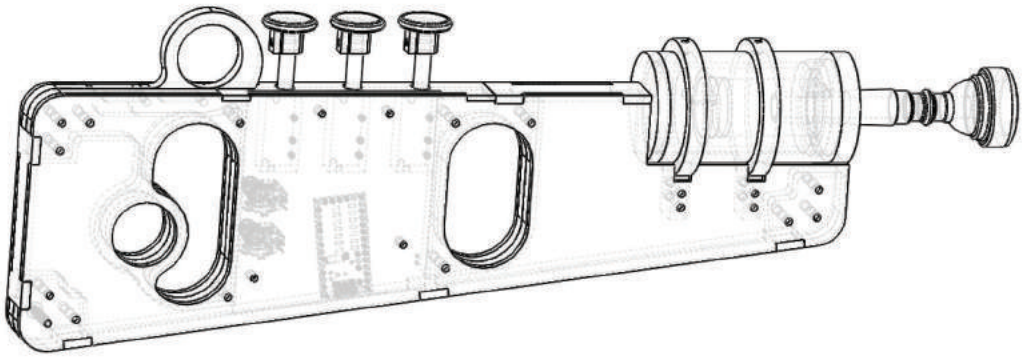
Stella

a novel electronic trumpet synthesizer controller

David Baylies, Waleed Snobar, (James) Huicheng Wang

Faculty Advisors: ***Prof. Glynn Holt, Prof. William Hauser***
Other Advisors: ***Prof. Paul Lehrman (Tufts Univ), Prof. Ted Werth***

Synthesizers have been a major force in music over the past 50 years, and have enabled substantial artistic creativity by enabling musicians to create and explore novel sounds that are not achievable using natural instruments. Synthesizers have traditionally been played using keyboards, which makes them very accessible for piano players. There are also woodwind synthesizer controllers that allow woodwind players to play synthesizers. However, there does not exist a synthesizer controller that allows trumpet players to use their hard-earned technique to play a synthesizer, which denies them a whole world of artistic possibility. The goal of the Stella project is to design and build a functional prototype of a MIDI synthesizer controller that can be played and controlled just like an acoustic trumpet. The player buzzes a pitch into a trumpet mouthpiece that is installed in Stella, and controls the resulting note using three linear position sensors, similar to the valves of a trumpet. The inputs are analyzed and converted into a MIDI signal, which is then sent to a synthesizer, opening a world of new musical possibilities for any trumpet player.



VITA NEEDLE
Stainless Steel NEEDLES & TUBING
SINCE 1932

Semi-Automation of Hub Drilling Process

Background:

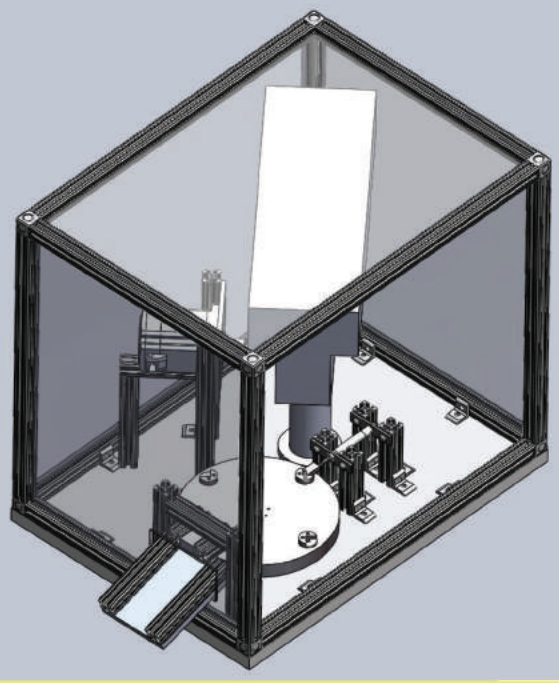
Vita Needle is a small, family-owned business that manufactures a variety of stainless steel tubing, needle hubs, and other fabricated parts. One of their most popular parts, a nickel-plated brass hub for hypodermic needles, is currently produced by several operators. This process consists of securing each hub individually in a pneumatic collet and drilling the proper diameter hole to a desired depth on a manual drill press.

Problem:

In order to improve the repeatability of the drilling process and decrease the cycle time for each hub, our customer requests a semi-automated drilling machine that will be manually loaded by an operator and automatically drill and eject each hub.

Solution:

The final design features an aluminum rotary table mounted to actuator that allows the table to index precisely between four different stations. The stations include one where an operator loads a hub, a second where the hub is secured with a piston and drilled, a third spare station, and the fourth station where each finished hub is ejected using compressed air. The linear motion of the drill spindle was automated through use of a servo motor and custom attachments. The system is enclosed in an 80/20 aluminum frame with acrylic windows, and features an Andon light, emergency stop button, and a dual-handed safety switch to initiate the indexing of the table. The various components of the system are controlled using a programmable logic controller, or PLC.



Team Members:

Anthony Damigella
Movarney Maraney
David Chittenden
Lance Nakano
Jason Yung

Faculty Advisor:

Peter Zink

Customers:

Michael LaRosa
Frederick Hartman

Vita Needle Company
919 Great Plain Ave.
Needham, MA 02492

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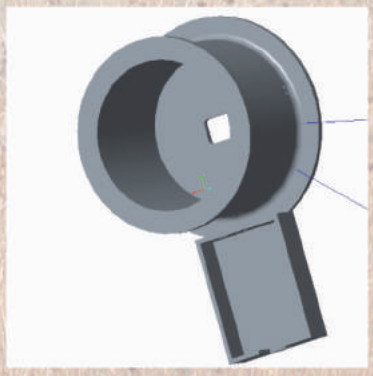
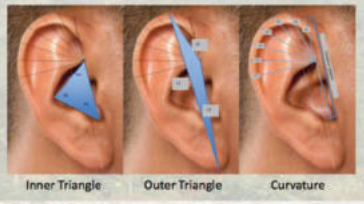
EAR BIOMETRIC SCANNER FOR IMPROVED PATIENT IDENTIFICATION IN ZAMBIA

Project Team: Rachael Campion, David Martinez and Lauren Etter
Project Advisor: Dr. Christopher Gill (BU School of Public Health)
Technical Advisor: Professor Hauser (BU College of Engineering)

Under the current healthcare system in Zambia, patient identification to ensure linkage to health records is a major obstacle for the continuity of healthcare. This problem leads to repeat vaccinations, unnecessary or incomplete antibiotic regimens and potential misdiagnosis due to unknown medical history. In absence of unique identifiers such as social security numbers, presence of high rates of illiteracy, and an aversion to finger printing, a different solution is needed to track patients across time and space. Under the scope of Project SEARCH at BU's School of Public Health, our project aims to provide an efficient platform and procedure for ear biometric identification. We have developed a device which improves image capture of the patient's ear, allowing for more accurate identification rates.



We pursued this objective by designing and testing a device which standardizes the image capture procedure to improve patient identification rates. After developing this device, our team completed an experimental trial with 220 participants in order to test that the device improved the function of the identification algorithm.



We found that our device and procedure, in conjunction with a previously developed identification algorithm, improved the accuracy of patient identification by more than 10%. This improvement confirms the necessity of our device and procedure in order to accurately identify and link patients with their medical records.

Grip Strength Measurement Device to Track Post-Stroke Recovery

Background

Boston University's Laboratory of Cognitive Neurobiology is conducting research on the effect that various interventions have on the post-stroke recovery process of human beings using a primate model. Current research focuses on fine motor function and dexterity.

Objective

There is no current apparatus to track the hand grip strength recovery of the primate subjects. It is the goal of the team to provide the research staff with a mechanical system that is able to quantify this grip strength recovery.

Solution

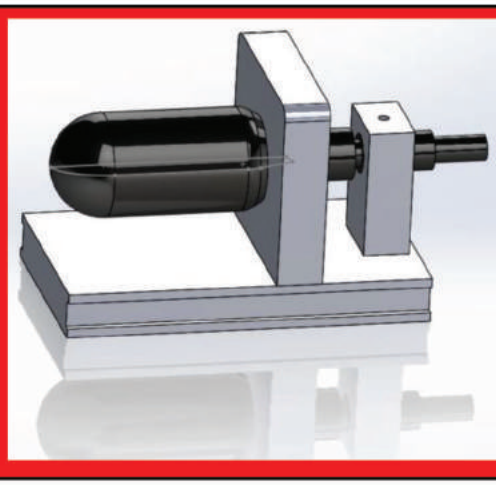
The team has developed a pneumatic system that is retrofitted into the current testing apparatus used in studies. This system has an adjustable pressure that the test subject must overcome by squeezing a bulb. If the subject overcomes the system pressure, indicated by a pressure gauge, the system pressure is then manually increased and testing continues.

Team Members
Casey Flynn, Kristof Fogarasi, Alex Ortiz, Connor Sheehan

Faculty Advisor
Professor Peter Zink

Client
Associate Professor Tara Moore, Ph.D.
Laboratory of Cognitive Neurobiology
Boston University School of Medicine

Special Thanks
Joe Estano, Bob Sjostrom, Heitor Mourato, Eric Hazen



BUMECHE

Rolling Ball Viscometer for High-Temperature Applications

Researcher:

Matthew Mirek

Faculty Advisor:

Professor William Hauser

Principle Investigator:

Professor Uday Pal

Special Thanks:

Professor Greg Blonder

Tomás Villalón Jr.

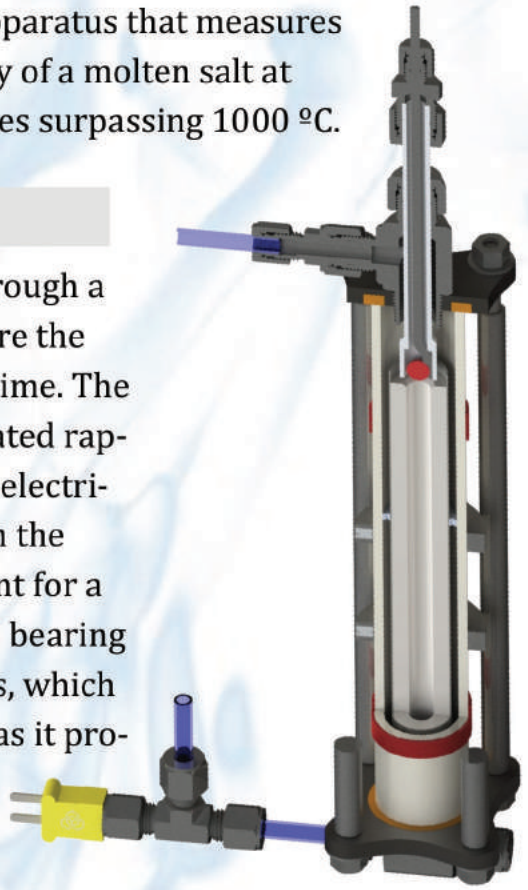
Abhishek Patna

Background:

Professor Uday Pal's Energy and Sustainability Lab at Boston University focuses on high-temperature chemical and electrochemical processes. The viscosity of the molten salts used in these processes can be a rate limiting step, reducing overall electrochemical efficiency.

Objective:

The goal of the project is to design, fabricate, and prove an apparatus that measures the viscosity of a molten salt at temperatures surpassing 1000 ºC.



Solution:

A ball is released and is allowed to fall through a fixed distance through a molten salt, where the viscosity can be inferred from the travel time. The apparatus was designed to produce repeated rapid measurements with small samples. An electrical resistance furnace is integrated within the housing, which eliminates the requirement for a separate tube furnace. Velocity of the ball bearing is detected via two inductive sensing coils, which tracks the movement of the ball bearing as it progresses through a boron nitride tube.

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Hacking Trauma Test Apparatus

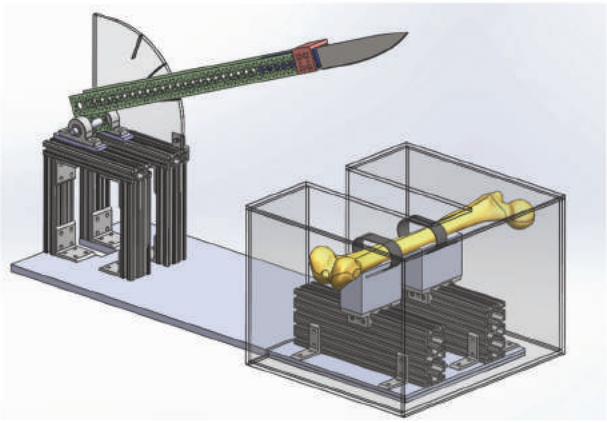
BACKGROUND

Hacking is a form of physical trauma that is used in manslaughters to disfigure and dispose the victim's body. The motion is carried out by the swing of the arm with force. Within the study of hacking trauma, the cut marks are observed on a macroscopic level in order to identify the weapon of assault. Our customer, Jasmine Mansz, is a BU graduate student conducting research in forensic anthropology. She would like to reproduce these cuts in a standard manner on deer bone using a chef's knife, cleaver, axe, and machete. She aims to identify the hacking trauma characteristics on the bones at three different forces representing weak, medium, and hard blows.

TEAM MEMBERS
Regina Czech
Carolyn Nguyen
Madeline Zhang

CLIENT
Jasmine Mansz

COLLABORATORS
Enrique Gutierrez-Wing
William Hauser

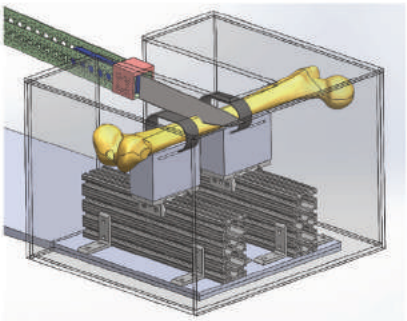


OBJECTIVE

Design and construct a device that hacks deer bones at three distinct forces with four different tools: a chef's knife, cleaver, axe and machete.

OUR DESIGN

Our design allows for hacking tools to be easily interchanged, while providing safe and accurate cuts each time. Because deer bone sizes vary depending on the part, our design adjusts to this variability. Our device applies three distinct varying forces from which Mansz can record data.



BUMECHE

Mechanisms Collection

Faculty Advisor: Professor William Hauser

Team Members: Sebastian Arias Malca and Nicholas Cerini

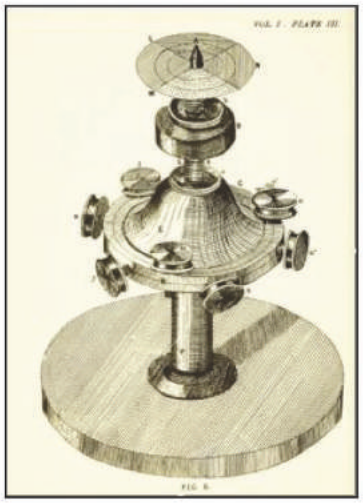
Project Objective:

Work with professors in the Mechanical Engineering department to identify the class concepts that their students have the most difficulty understanding due to their complexity and hard-to-visualize nature. In order to illustrate these concepts, mechanisms will be developed which the students can interact with and therefore improve their comprehension.

Customer: Dr. Ray Nagem

Mechanism: Fully Mechanical Gyroscope

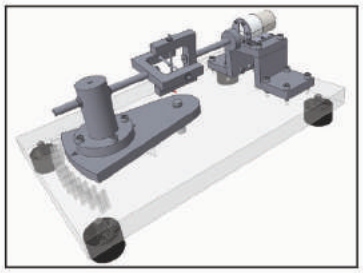
The objective of this apparatus is to illustrate two theories: color perception and 3D rigid body dynamics. Its design is largely based on the model built and presented by James Clerk Maxwell before the Royal Society of Edinburgh.



Customer: Professor Enrique Gutierrez-Wing

Mechanism: Universal Joint

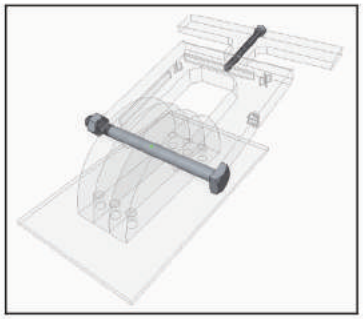
The objective of this mechanism is to clarify the purpose of a universal joint and to explore its advantages and disadvantages.



Customer: Professor Caleb Farny

Mechanisms: Pin, Roller, and Ball & Socket Joints

The objective of these mechanisms is to demonstrate the ability of pin and roller joints as well as ball and socket joints to provide reaction forces and/or moments.



Portable Surface Impact-Tester

Boston University College of Engineering

Client
New Balance
Mr. Pedro Rodrigues

Advisor
Professor Enrique Gutierrez Wing

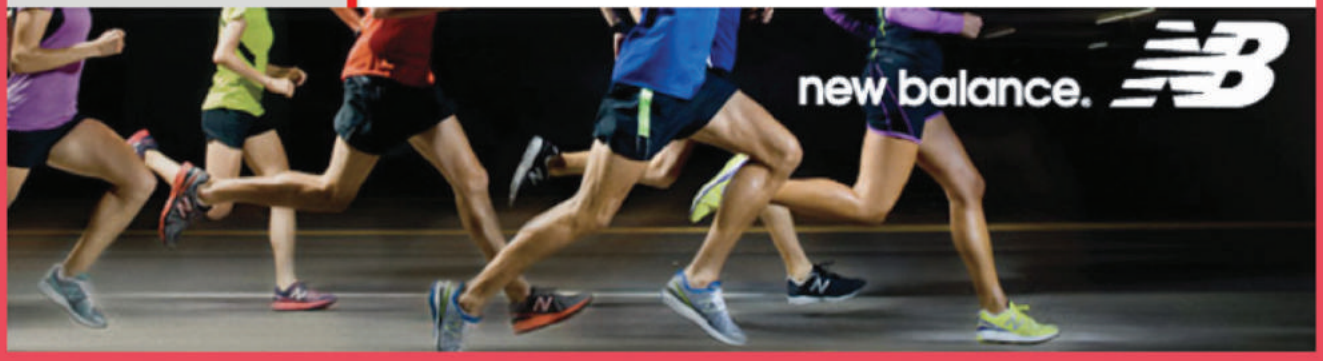
Team
Zwe Lynn Ngwe
Anant Sultania
Garrison Norton
Henry Hwang

Background

The "Sports Research Lab" at New Balance was established as a research and development facility that is used in the design process of footwear across the entire company. The lab uses a controlled-drop impact tester to characterize materials that are used in different types of footwear.

Objective

New Balance desires the ability to characterize the surfaces that their various shoes will be used on. This design project seeks to take the technology in the current apparatus and make it portable for field-use. The goal of the new apparatus is to be able to characterize various playing surfaces such as turf, tracks, or standard grass. By coupling data from shoe's soles and inserts with the data from various surfaces, the Sports Research Lab will be able to better apply their research and development to optimize the shoes that they design and manufacture.



BUMECHE

Hydropac®
WASTE DISPOSAL SYSTEM

The Client:

The ***Animal Science Center (ASC)*** at BU's Medical Campus is a team of staff members who are committed to the advancement of science through research. Each day, the Center's staff promotes the humane use of animals for biomedical research and testing by caring for rats, mice and guinea pigs.

The Problem:

In caring for the animals at the ASC, the Center's staff is responsible for disposing of 800 Hydropac® water nutrition bags daily. The current disposal method employed is labor intensive.

Our Objective:

Provide the Animal Science Center with an improved means for disposing of the waste nutrition bags. Successful completion of this task includes the design of a new, manually-powered disposal machine that is capable of puncturing and collecting the waste pouches, while simultaneously draining the excess water that remains following animal use.

Team Members

Sid KC
Sierra Lanfranco
Leticia Lopes
Katherine Schwartz

Faculty Advisor

Professor William Hauser

Customer Representatives

Patrick Gagnon
Larry Vintinner

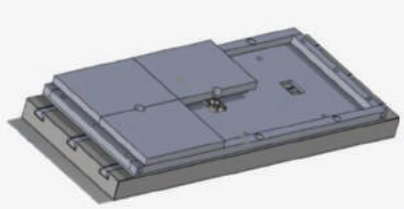
BUMECHE

Modular Fixture System

Engineering Team:
Omar Ab Aziz
Abdikhalaq Bade
Stephanie Kwok
Isabella Olivares
Nicholas Renzi

Team Advisor:
Professor Peter Zink

Customer:
Robert Sjostrom
Boston University Engineering Product Innovation Center



Computer numerical control machines (CNC) are common in machine shops. Although automation has helped increase the precision and consistency of tool motions, work-pieces still need to be manually secured and aligned onto the machine table prior to each machine operation. Long setup times delay projects and prove costly to both the machine shop and the customer. One way to improve setup times is to use a modular fixture system. Modular fixtures allow for quick interchange between parts, using a series of holes and bolt fixtures to secure materials within the CNC machine.

The project team was tasked with designing and building a custom modular fixture system for BU's machine shop, the Engineering Product and Innovation Center (EPIC). The fixture will be used in the Haas VF-2 CNC mill and will increase efficiency and reduce machining cost by decreasing setup and breakdown times for high-volume, high-mixed parts.

The fixture manufactured by the team consists of a system of six interchangeable modules, each customizable by EPIC machinists to fit their needs. It is highly precise and can withstand machining forces typical of operations run in the Haas VF-2. The modules fit within a frame, which secures them along with double edge clamps, ensuring location repeatability. This modular fixture system will reduce total machining time, and improve EPIC's efficiency, without reducing the quality of the final product.

Boston University College of Engineering, MechE Department

NUD POB

TEAM: REDA BELMAACHI, SHAN HAIDER FARUQUE AND JUAN LOPEZ

Background:

Partnership with Nud Pob Thai Cuisine restaurant gives BU Mechanical Engineering undergraduate students the opportunity to work with a client and get hands-on experience with product goals and application of basic engineering skills. .

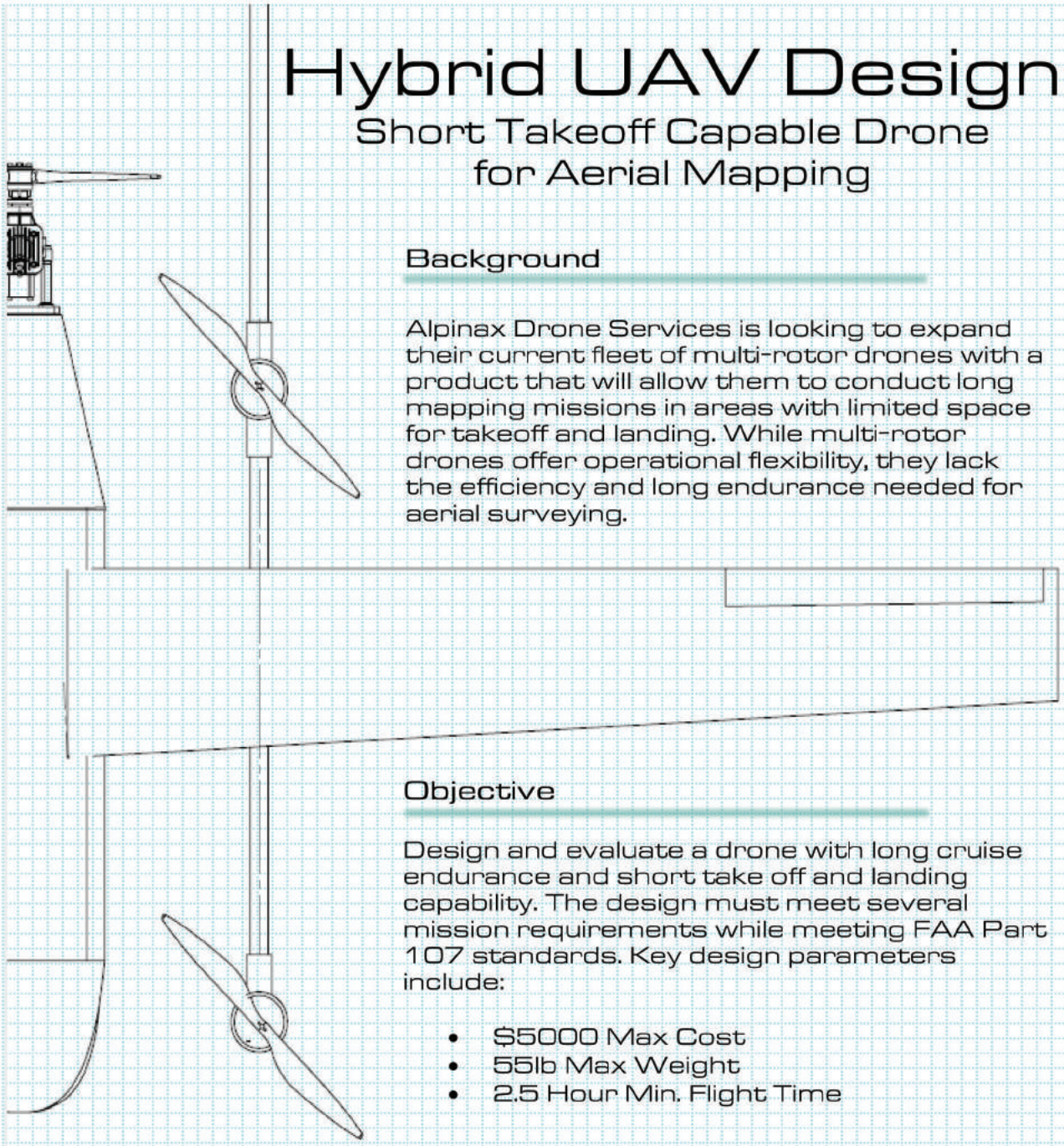
Collaborators: Dr. William Hauser, Faculty Advisor; Dr. Greg Blonder, Consultant; Mr. Eddie Chen, Nud Pob Owner

PROJECT DESCRIPTION

The desire for better sliced onions and jalapeños drove the team to improve a commercially available vegetable slicer to fit the needs of our client. With emphasis on better quality onion slices and a desire for orientation control, we developed a functional product with innovative ideas to meet our client's needs.

Hybrid UAV Design

Short Takeoff Capable Drone for Aerial Mapping



Background

Alpinax Drone Services is looking to expand their current fleet of multi-rotor drones with a product that will allow them to conduct long mapping missions in areas with limited space for takeoff and landing. While multi-rotor drones offer operational flexibility, they lack the efficiency and long endurance needed for aerial surveying.

Objective

Design and evaluate a drone with long cruise endurance and short take off and landing capability. The design must meet several mission requirements while meeting FAA Part 107 standards. Key design parameters include:

- $5000 Max Cost
- 55lb Max Weight
- 2.5 Hour Min. Flight Time

Team Alpinax

Tomas Amadeo
Evan Mislick
Calvin Earp
Scott Nickelsberg

Faculty Advisor

Prof. James Geiger

Primary Contact

Juha Turalba

ALPINAX

BUMECHE

REPURPOSING CARDBOARD AS SCULPTURAL MATERIAL

TEAM

Bryan Calci
Valerie Koch
Christopher Sek
Ameen Zahid

CLIENT

Hugh O'Donnell
Professor, CFA

ADVISOR

William Hauser, Ph.D

Vision

To many, the recycling process ends with throwing the bottle in the bin, the cardboard in the right receptacle. People who recycle are usually not involved with the process nor directly benefit from the product. We set out to create a process where the consumer would recycle waste material in their own space into something that would be useful for themselves. Our first challenge was to find a product, a process, and a customer where we could realize this vision.

Development

Our team took a two pronged approach where we researched possible repurposable waste materials as well as investigating clients on campus who could find use for any of our various ideas. After researching several possibilities, we connected with professor Hugh O'Donnell of the College of Fine Arts as our customer.

Status

After meeting with our customer, we decided we would develop a system to repurpose cardboard into a sculptable material and shape useful to artists. We have developed a low cost shredding method and explored the properties of various mixtures of cardboard and binder. Our project will be considered successful if artists use our method to create sculptures after we graduate.

BU Glider Challenge

"That's not flying, that's just falling with style." – Woody (Toy Story, 1996)

Background

The objective of the glider design projects is for students to apply fundamental aircraft design concepts:

- Airfoil Selection
-Drag Prediction
-Stability & Control
-Configuration Design
-Material Selection

that allow the students to employ system-engineering techniques to a product design.

Team Members

Zachary Gruskin, Daniyal Hannan, Jesse Batson, Geoffrey Mei, Richard Avila

Faculty Advisor / Customer

James Geiger

Project Description

The gliders are built out of foam and/or balsa wood only and launched from a catapult system. The catapult design must be completely horizontal (with no incline), must be within 1-3 feet off the ground, and have a pullback distance between 1-3 feet.
As part of the design, a number of candidate airfoils were selected, built using a foam cutter, and tested in a wind tunnel to examine their capabilities for lift and drag.

Goals

The main goal of the balsa-foam glider is to maximize its range by performing crucial stability and control analyses during the design process. The glider should also be stable in all dimensions (roll, pitch, yaw) to ensure that the glider does not deviate more than 15% of the original trajectory. At least two designs will be constructed to prove that the results can be replicated. The final design should

COLORS OF THE WIND

BUMECHE

Prehensile Test Measurement Apparatus

Client:
Dr. Tara L. Moore
Laboratory of Cognitive Neurobiology

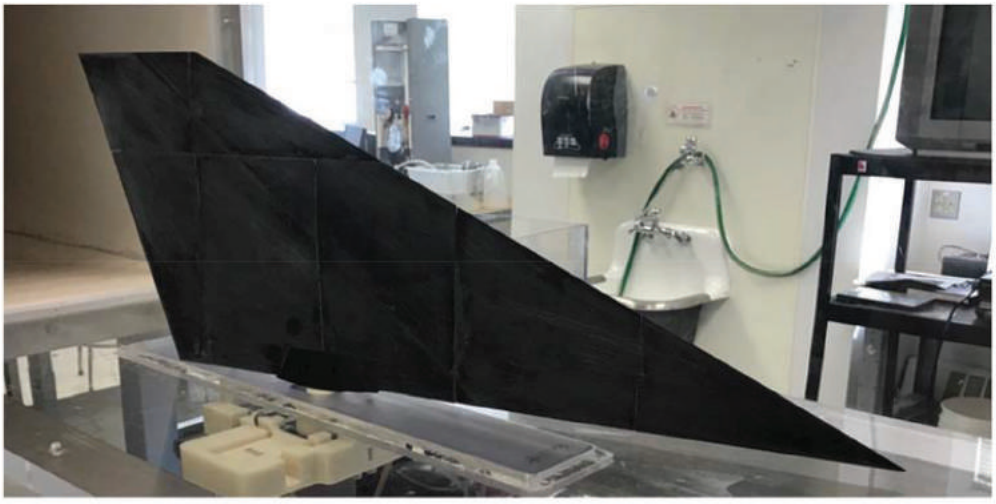
The Laboratory of Cognitive Neurobiology and lab director, Dr. Tara L. Moore, investigate the effects of inosine on the recovery of fine motor functions in rhesus monkeys following cortical injuries to model stroke recovery. The current prehensile effort testing system records monkeys grasping a small treat during various stages of recovery. The prehensile effort is then categorized using a grasp assessment scale that determines how successfully the treat is retrieved using fine motor skills. The current categorization process is time consuming and requires each video of the test to be reviewed by an individual in the lab. Dr. Moore tasked the team to create an apparatus that can eliminate this long process and classify the recovery of the monkey's fine motor skills for them.

The solution concept utilizes support vector machines (SVM) to classify video based on approximately 100 distinguishing parameters and determine the prehensile effort on the grasp assessment scale. Video files will be generated from three cameras that are strategically placed such that they view the entire testing board for greatest accuracy. The testing apparatus emphasizes customer and design requirements such as durability, ease of cleaning, and ease of software integration in mind.
At the end of this process, the team presented Dr. Moore with the testing apparatus and an easy to use video capture process. Due to regulatory and time constraints, a future team in the ECE department will be presented with documents containing information needed to complete the classification algorithm.

Team:
Alexa Beach
Monica Chung
Hannah Polster

Faculty Advisor:
Professor Frank DiBella

Collaborators:
Professor Janusz Konrad



BURPG

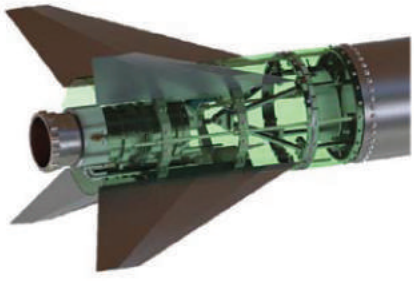
BU ROCKET PROPULSION GROUP
SUPERSONIC FIN DESIGN

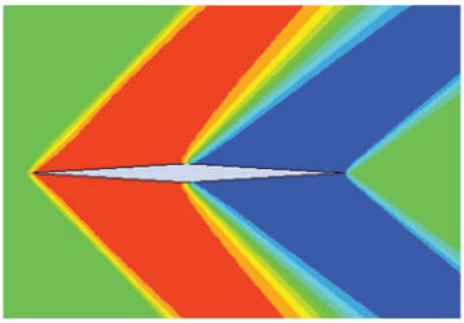
Jeremy Pedro - Robert Palladino - Sean Kyne - Vincent Lee

The BU Rocket Propulsion Group designs, builds, and tests advanced propulsion and rocket flight technologies. BURPG's flagship rocket, Starscraper, is a suborbital launch vehicle capable of carrying 100 lbs of payload to 100 km.

A critical feature in achieving suborbital space flight is the active stabilization of the rocket via thrust vector control. Downsides of active stabilization are its added complexities and high costs. BURPG has requested an alternate vehicle design for a low altitude flight which will allow Starscraper to be passively stabilized throughout its entire flight regime using aerodynamic forces generated through supersonic optimized fins.

After analyzing the vehicle's structural, thermal, and flight profile, our team developed a modified passively stabilized launch vehicle. A full assembly CAD model has been delivered to the customer along with an analysis summary package.





BOSTON UNIVERSITY racing

Accumulator Container System

Team Members

Aidan Rose

Hannah Jean Zengerle

Joshua Zins

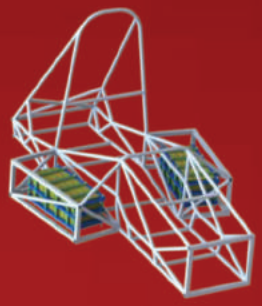
Faculty Advisor

Frank Di Bella

Acknowledgements

Calvin Lin

James Wang



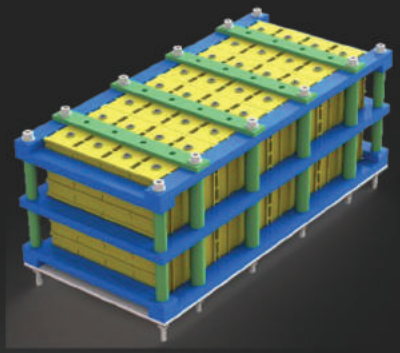
FORMULA HYBRID 10

Background

Formula Hybrid is an interdisciplinary design and engineering competition where university students from around the world compete in a multitude of events using hybrid and electric vehicles they designed and built. The rigor of the competition requires students to innovate across all engineering disciplines. In this high-performance application, drivetrain innovation and fuel efficiency are the key aspects of a winning vehicle.

Objectives

Our team has been tasked with the design and fabrication of an accumulator system for Boston University's Racing Team. Due to safety and cost requirements, it is extremely difficult to perform maintenance on the current accumulator system. These difficulties are significantly associated with the use of lithium-ion pouch cells which require many custom components and intricate connections to meet the Formula Hybrid racing requirements. The newly improved accumulator system designed by our team will utilize lithium-ion iron phosphate ($LiFeYPO_4$) prismatic cells as the energy source. The goal of this project is to ensure that all parts of the system are easily accessible for maintenance while maintaining high-performance functionality and meeting all competition regulations.



A NEW KIND OF LUXURY,
AHEAD OF ITS TIME.
INTRODUCING THE SILENT STINGRAY

Silent Stingray

Team Members
Hieu Tran
Purity Dele-Oni
Rahat Khan
Jiohnnie Diaz

Faculty Advisor
James Geiger

Company Supervisor
Dr. Elizabeth Ward

Drama

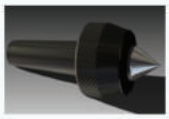
NASA

CHALLENGE The increase in demand for air transportation calls for significant progress to be made in reducing noise levels, harmful emissions and fuel burn. Objectives in this design project include proposing vehicle or propulsion concepts and technologies that will meet NASA midterm goals for a 200+ passenger commercial transport.

SOLUTION The blended wing body concept brings an all-new design to the industry focused on improving effiency over the classical fuselage and wing. The BWB concept shows substancial reductions in fuel burn and takeoff weight. A decrease in the plane's overall size helps reduce noise during takeoff and landing.

BUMECHE

Automatic Tube Flaring Machine



Team Members

Tania Nauman
Carolina Amaral
Nicolas Robles

Client Organization

Boston University Rocket Propulsion Group

Faculty Advisor

Frank DiBella

Background and Challenge

The Boston University Rocket Propulsion Group (BURPG) is working on an exciting space age project to launch their first rocket. Tube flaring is a critical process in rocket launcher fuel systems that mechanically expands the end of a tube to form a pressure tight seal. When done properly, it eliminates the risk of catastrophic leaks in AN fluids connections. BURPG currently flares its tubes manually, but faces significant issues due to the tube diameter size and thickness.

Solution

The project team put forward various methods of tube flaring and for each method presented the financial needs, machining capabilities, and necessary workforce requirements. The decision was made to flare the tubes on the lathe machine in EPIC by designing an Automatic Tube Flaring Machine (ATFM). The aim is to provide BURPG with an automated process capable of flaring stainless steel tubes to exacting requirements. It includes manufacturing all the needed tools, collets, and fixtures.

Results and Status

A fully automated tool will be presented to the BURPG providing a simple and fast. solution to flare their tubes to the necessary angle using the lathe machine. The system can easily be adopted to similar needs in other industries.

BURPG
Boston University Rocket Propulsion Group

Preliminary design of an automated tube flaring machine

Giovanni Coral

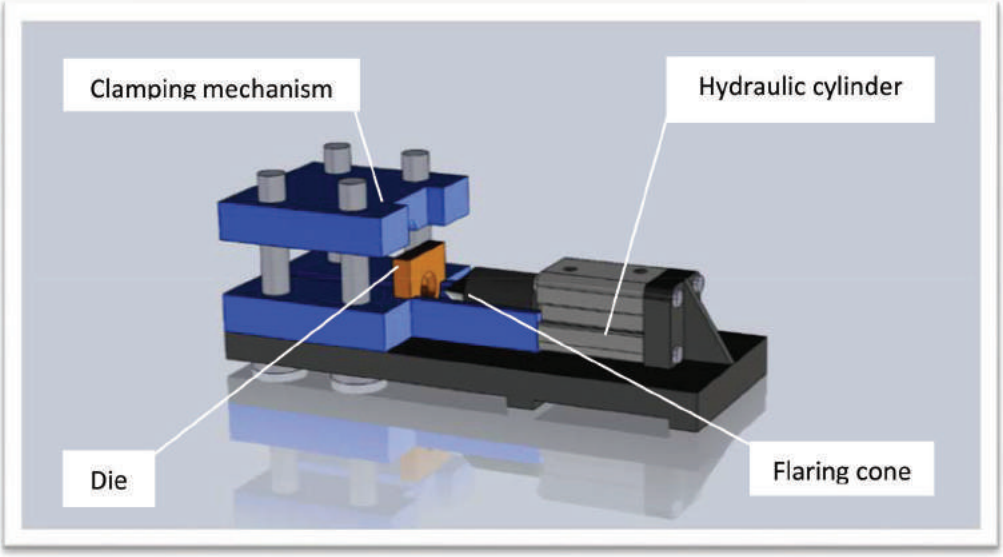
Faculty advisor: Prof. Frank Di Bella

Customer: Boston University Rocket Propulsion Group

The process of tube flaring is a metal forming process that consists in the mechanical expansion of the end of a tube. This process is the fundamental step to perform a flare fitting, a faster and substitutive way respect to welding to hermetically connect two tubes with a threaded joint.

The Boston University Rocket Propulsion Group makes daily use of this kind of connection on stainless steel tubes, performing the flare with a manual flaring tool. However this kind of tool has low reliability, producing low quality flares, and requires great physical effort.

The goal of this capstone project is to present the fundamental calculation and tests carried out in order to propose a reasonable design for an automated tube flaring machine.



Gliding Glory

BU Glider Challenge

Background

The BU glider challenge is an annual senior design project for mechanical engineering students with an aerospace concentration. It challenges seniors to apply knowledge acquired from their previous courses to build a glider with significant range and stability capabilities

Problem Statement

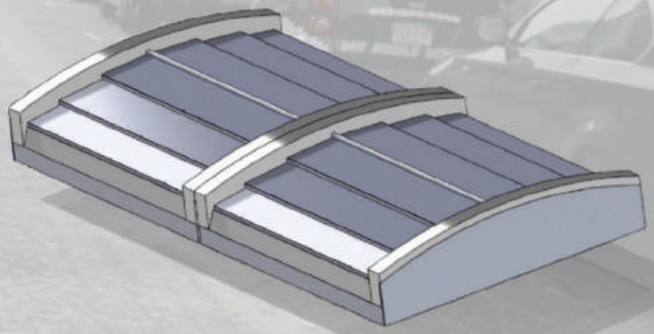
Design, build, and test a durable glider made of balsa wood and foam to be launched from a level rubber band catapult 3ft off the ground with a maximum pull-back distance of 3ft. The glider is expected to fly a range of 50-100ft with at most 10% lateral deviation from the center launch line of the flight distance. Additionally, the flights should be consistent and predictable.

Sponsor
BU Mechanical Engineering Department

Consultants
Professor Geiger
Professor Grace
Dorien Villafranco

Team Gliding Glory
Matthew Waldman
Kyungsik Shin

SALT SPREADER COVER



Background

During the heavy snow winter of 2015, the City of Boston used over 55,000 tons of road salt and spent about $35 million on snow removal. Road salt negatively affects both the city's budget and the natural environment surrounding the city.

The Problem

When drivers are salting their routes during a snowstorm, snow accumulates in the salt bed and starts to freeze large clumps of salt together. As a result, the distribution mechanism jams and the driver must return to the loading facility to wash out the frozen load. This results in wasted salt, wasted fuel, and wasted time.

The Challenge

To design a cover that keeps snow out of the salt bed in order to prevent frozen loads. The cover cannot use electronics or introduce extra steps to the drivers' current routine. The design must withstand an impact from a ton of salt and prevent snow from entering the salt bed.

Client
City of Boston Public Works Department

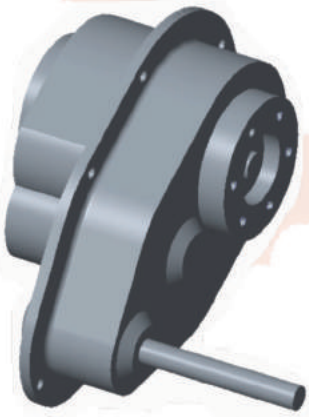
Faculty Advisor
Professor Frank Di Bella

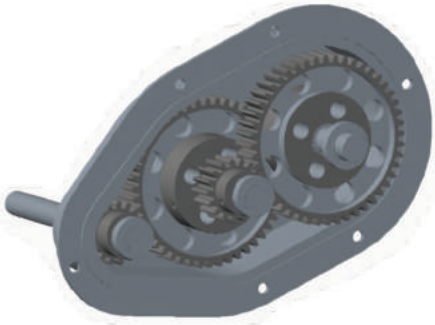
Team Members
Brendan Butler
Gabriella Henkels
C. Brad Miller
Cameron Pizzo
Abigail Rendos

BUMECHE

Boston University Baja SAE Gearbox

Team Members: Michael Lybass, Alexandre Gutierrez, Brian Gelblat, John Maguire, Matt Ramirez
Customer: Jaryd Hobbs **Faculty Advisor:** Professor William Hauser





Background:

Baja Society of Automotive Engineers (SAE) is an international competition in which universities from around the world design and build all-terrain vehicles (ATV) and compete in several events. These competitions include an endurance test, maneuverability, tractor pull, acceleration, and suspension. There are rules and regulations that all teams must follow such as using an engine with the same specifications. For teams to succeed they need to design their ATV's to be lightweight and durable. In addition, Baja's scoring relies heavily on student designed components, meaning that the more pieces built from the ground up the better the chances of success.

Problem:

The BU Baja team has reached out to BU's Mechanical Engineering department to have a team design, construct and test a new gearbox to improve performance of their ATV. The goal for this project is to fully implement a student designed and constructed gearbox that reduces weight, performs better than their current gearbox, and helps the team further understand the design process for future components of the ATV.

Team Members

George Bill

Lucas Bombonatti

Reo Hara

Hadi Sarieddine

Faculty Advisor

Frank DiBella

VitaNeedle Contacts

Fredrick Hartman

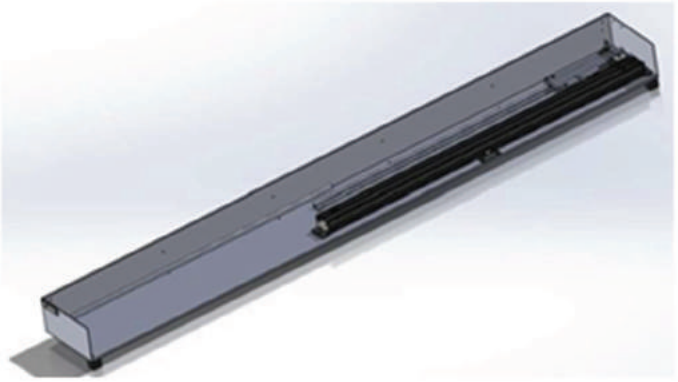
Josh Lowell

VITA NEEDLE
Stainless Steel NEEDLES & TUBING
SINCE 1932

Tube Measurement

Background:
Vita Needle is a manufacturer of stainless steel tubings, wires, and fabricated parts located in Needham, Massachusetts. The company was founded in 1932 and has since been supplying their products to the medical, industrial, and commercial industries. Currently, a traditional tape measurement is used at their shop for the length evaluation of their samples. To further improve their quality assurance, a more accurate and easy-to-use measurement system is required.

Mission:
The goal of this project is to develop an easy to use and durable quality control measurement device that can accurately measure tubing and wire with lengths ranging from 3-72" and diameters ranging from 0.010-0.500". Vita Needle had the following requirements for the device:



- Accuracy of 0.002"
- Contact and non-contact systems (To preserve fragile wires)
- No motors
- Budget of $5,000

Our Design:
The measurement device functions by using a linear encoder to measure displacements in both a contact and non-contact system. An L-shaped channel supports all the equipment; and the channel is tilted in order to keep the sample in place by gravity during the operation. The accuracy requirements led to evaluation of various measurement tools. Designing and ordering processes were successful, and the total mass of the device is about 35lbs.

BUMECHE

The Boston University SAE Baja Club

BACKGROUND

The Society of Automotive Engineers (SAE) Baja Team, is a Boston University club that aims at designing and building a Baja car to compete in a competition that hosts 100 different teams. A Baja car is an off-road vehicle that strongly resembles a dune buggy. At these competitions, teams bring their Baja vehicles to test them against tough terrain. The vehicles have to perform rock crawls, hill climbs, and maneuverability tests.

Dynamometer

TEAM

Brian Shaeffer
Ryan Peters
Jacqueline Farnsworth
Saul Silverberg
Torben Umeda
Duc Nguyen
Jim Chen
Francois Bassil

CUSTOMER

The BU Baja Club

ADVISOR

Prof. W. Hauser
Boston University

PROJECT

In order to keep improve design iterations and to remain competitive, our customer, the Baja Club, has requested a dynamometer to measure the power output of their car. The main goal is to design and build a functional device with a budget of about $1,500 (compared to about $15,000 if bought on the market). Additionally, it needs to be easily transportable and compatible with the specifications of the car. We will also provide our customer with instructions and recommendations for improvement and use of the product.

APRO: Air-Propelled Remote Operator

Team Members:
Sungwon Hong
Jake Kapoosuzian
Joey Khoury El Aramouni
Fiona Moran
Marianne Walters

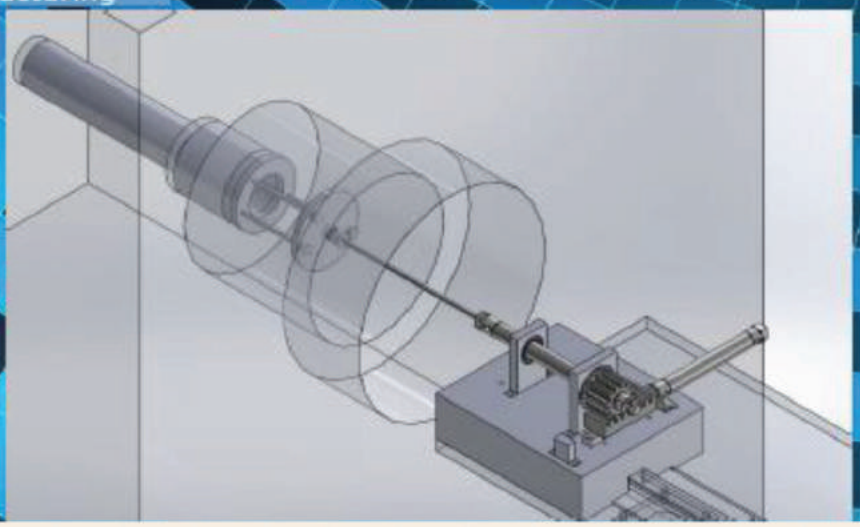
Client:
Dr. Bang-Bon Koo
John McCall

Advisors:
Professor Frank DiBella
Professor William Hauser
Bob Sjostrom
Joe Estano
David Campbell
Bimba Manufacturing

The NEIDL facility is a biosafety laboratory dedicated to the development of diagnostics, vaccines, and treatments to combat emerging and re-emerging infectious diseases.

The aim of this capstone project is to engineer a device for the NEIDL that provides them with an automated means to adjust the position of an animal chamber, with a sedated animal inside, within the imaging field of an MRI. The critical requirements for this project are to develop two degrees of freedom (axial and rotational) with the provided range and accuracy, operation of the device within the imaging field of an MRI machine, compatibility with the existing animal test chamber, and remote operation. The existing process requires a technician to manually reposition the animal chamber according to instructions from a scientist outside of the room of containment, which is a time consuming process due to safety protocols that must be followed. The automated system should permit the scientist to directly adjust the animal chamber without assistance from the technician.

The group ultimately chose pneumatic actuators in order to achieve axial and rotational motion. The APRO device will increase the efficiency of the laboratory by producing quicker scans of animals, and it's a cost-effective solution that has the potential to reduce the operating costs the laboratory performs at.



BIMBA

nheuser-Busch

Team:

Eric Sun
Andrew Suri
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William Hauser

When brewing beer ingredients are added at various points in the process to improve flavor, quality and appearance. One such ingredient is tannic acid; it is used to filter out the large yeast molecules from the beer. The tannic acid is premixed in a large vertical mixing tank. The tank's top hatch is manually accessible via a raised platform elevated 15 feet from the floor. The design problem is to develop a safe, efficient and reliable way of moving five 55 pound barrels of tannic acid to the platform and their contents into the mixing tank.

The current procedure involves loading a rack with three barrels, lifting it to the platform by a chain hoist, followed by a manual unloading process on the platform floor and into the tank. This method puts a dangerous level of physical strain on the technician and is inefficient as it requires two cycles to transport all five barrels. The design challenge is to redesign the current system in place at the Anheuser-Busch brewery to address these problems. Critical considerations include spatial clearance of the platform, worker safety, and cycle time.

The proposed design alters the capacity of the tannic acid movement system from three to five barrels. It eliminates the strain experienced by the brewer via ergonomic improvements, such as conveyor rollers, elevated unloading height, and an unloading mechanism.

SAINT-GOBAIN

PERFORMANCE PLASTICS

Piston Ring Fixture and Tool Path Redesign

Background

Saint-Gobain Performance Plastics has customers from a variety of markets that range from the aerospace and automotive industries to electronics and industrial uses. The company produces materials that are used around the world with high quality, high-performance polymer products. This particular project took place at the Saint-Gobain Performance Plastics Plant in Bristol, Rhode Island and one of its main projects is to machine piston rings for off-highway vehicles for one of its customers. Currently, the company manufactures one ring every thirty seconds in a CNC vertical mill and there is a need of around 3,000 parts per month. The procedure involves one fixture and one machinist working eight hour shifts for two weeks straight.

Problem

The piston ring's manufacturing process has proven to be inefficient, untimely, and physically taxing on the operators. The system is designed to process a single ring per run, which results in a high processing time and low work efficiency. Additionally, the door on the CNC machine requires sufficient force to move manually and this poses safety and ergonomic risks. Notably, the operators make complaints about their muscle pains from the repetitive motion of opening the doors every thirty seconds continuously for eight hours. The machining of multiple rings per run was determined to be the priority, which directly increases efficiency and reduces processing time and subsequently will reduce the physical demands of the operator.

Design

This project lead to the redesign and installation of a system of pneumatic clamps that will be able to machine six rings at a time. In addition to providing the client with the developmental fixture designs, the team also researched alternatives and provided a recommendation to automate the doors of the Haas CNC mill. Implementing this new design will decrease physical labor to a fraction of the initial demands and will produce six times more rings per run, making the system 362% more efficient.

Team Members

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Professor de Winter

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MASSACHUSETTS GENERAL HOSPITAL

PCNL SURGICAL POSITIONER

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CUSTOMER

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MGH, Department of Urology

ADVISOR

Professor William Hauser,
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BACKGROUND

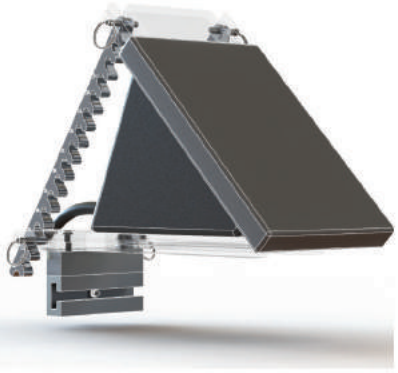
Percutaneous Nephrolithotomy (PCNL) is the most common procedure to remove large sized kidney stones that cannot pass through the urethral tract. In the U.S. alone, approximately 17,500 procedures are performed annually. The patient is placed on his/her back and general anesthesia is administered. The patient is centered by aligning the flank to the center of the table. The patient is then tilted to one side, while two supports (saline bags, gel rolls) are placed underneath the pelvis and rib cage/chest to stabilize and expose the flank.

PROBLEM DEFINITION

The process of positioning the patient is flawed and non-standard. Miscellaneous items, such as gel rolls, are arduously inserted between the patient and the table to achieve proper supine position. The process is lengthy and laborious, taking five to ten minutes of valuable OR time ($150 / min) as well numerous staff members.

SOLUTION

The team designed two independently operated devices, one supporting the chest area and one supporting the pelvic area, which attach to any OR table. Each apparatus consists of two polycarbonate plates with foam padding on the top plate for the patient's comfort. By pressurizing an inflatable air bladder with a barbed nipple in its back side between the plates, the patient is tilted to the side. In case of air bladder failure during surgery, aluminum racks are pinned to the top plate, while quick release pins secure them to the bottom plate and lock them into position upon inflation.



GE Aviation

CT7 T89 Engine Sump Remanufacturing

GE Aviation in specifically is a world leader in design and manufacturing of both commercial and military aircraft engines. GE aviation currently employs 40,000 employees, manufactures and repairs avionic parts worldwide with a total of more than 25,000 jet engines currently in service.

In order to minimize cost, our team has been asked to provide an innovative way to redesign the manufacturing process of the engine oil sump for GE's iconic CT7 T89 jet engine which is currently in operation on more than 25 types of helicopters and fixed wing aircrafts.

The team managed to redesign the process by introducing additive manufacturing and automation. In addition, the team devised a new floor plan suitable for Lean manufacturing and a full financial justification for the proposed solution.

May 05
2:30PM

INSTRUCTOR
Theo A. de Winter

COMPANY REPRESENTATIVE
John Cappadona

PRESENTER
Xiayu Zhang
Yiyuan Wang
Yuk Yu Chan
Yue Guo
Cheng en Yeh

BUMECHE

FRACTYL®

Catheter Manufacturing Process

Fractyl is a biomedical company currently focused on the treatment of Type II Diabetes and Insulin Resistance by remodeling the wall of the small intestine. The device being developed is the Revita Catheter, which is inserted orally to administer the non-invasive therapy.

The project consisted of developing a new manufacturing process to enable a new dual-flexibility catheter. This process thermally welds two separate polymer catheter shafts to create a composite shaft to improve the device ease-of-use and patient safety during the procedure.

The development of this thermal process consisted in the selection of machinery, development of inspection processes, documentation updates, the design and development of manufacturing process itself, and its turnkey implementation. The project was successful and will be integrated into the Revita Catheter's manufacturing process in the coming generation of the product.

Team Members
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Fractyl Engineering Team
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Brendan Zarechian
Kyle Dalbel

We would like to thank Ryan Cahill, John Fitzgerald, Sara, Brendan, Kyle and everyone involved with putting together this project.

Rolls-Royce®

Parts Washing Operation Improvements

Client

Rolls Royce Naval Marine

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The Rolls Royce Marine Assembly and Test department refurbishes propeller hubs and oil distribution (OD) boxes for large naval vessels. These hubs and OD boxes are disassembled, thoroughly washed and polished, and inspected to ensure they meet required dimensions and tolerances to be recommissioned. The current parts washing process that Rolls Royce uses is fully manual, which is time consuming, ergonomically unsound, and uses a chemical which is potentially hazardous to both the user and the environment. Analysis and improvement of the current parts washing operation is necessary in order to save time and money as well as increase worker safety and efficiency.

After thorough research of parts washing operations, it was determined that the most effective solution was for Rolls Royce to replace their current parts washers with newer automated, aqueous-based parts washers capable of batch-washing parts. After collecting pricing from multiple vendors as well as proof of concept of the new parts washing operation, a formal recommendation was made for a new parts washer along with a full financial justification.

BUMECHE

Rolls-Royce®

Process Improvement of Propeller Machining Setup

Team

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Consultants

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Alessandro Cellai
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Frank Lanni

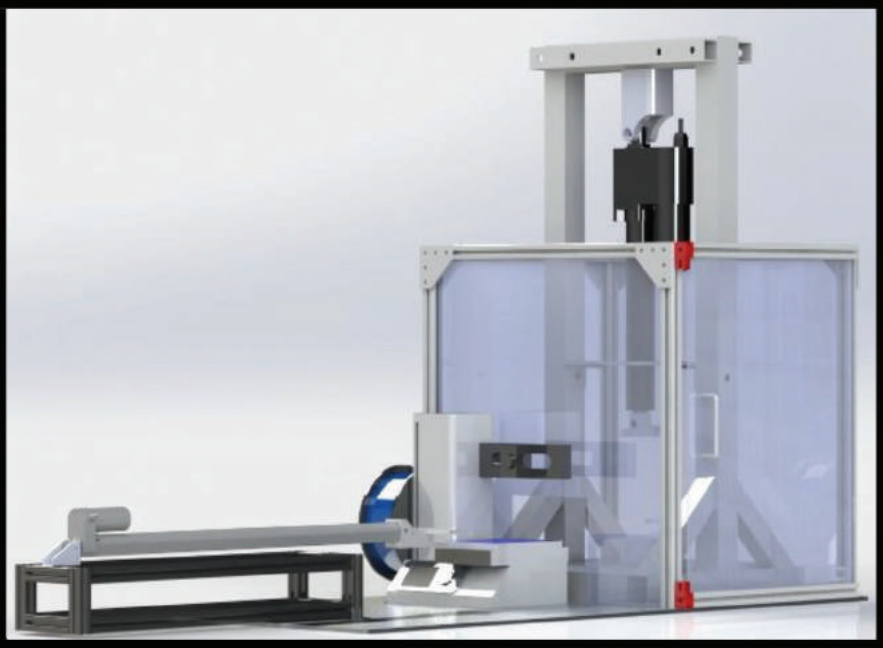
Background:

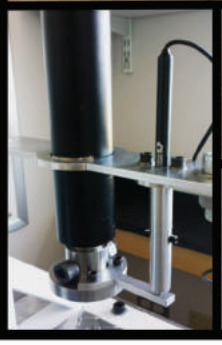
Rolls-Royce Marine, located in Walpole, MA, manufactures propeller blades for ships. The blades are first sand casted which yields inconsistent geometries. The castings must be measured before machining to find an orientation that optimally positions the finished blade geometry within the casting. This process is timely, does not identify defects early in the manufacturing pipeline, and requires careful attention to procedures to avoid a Health Safety & Environmental (HS&E) risk.

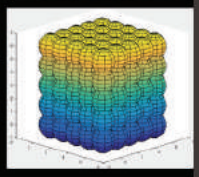
Process Design:

Our team aimed to improve the overall process time, cost and safety without sacrificing measurement accuracy. We provided a business case for implementing modern measurement technology and SMED fixturing methods. In conjunction, we designed a process to establish early QA and automate the recording and analysis of measurements. Our design will immediately reduce HS&E risk, reduce measurement time and improve employee satisfaction. In the long term, our design will improve the consistency of castings, reduce setup time, and reduce time spent on repair welds.

METAMATERIAL AUTOCRUSHER







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Faculty Advisor:
Prof. Theo DeWinter

Client:
Prof. Keith Brown

Presentation:
May 5th, 3:30pm
Photonics 211

The Metamaterial Autocrusher is a fully automated system built around a filament deposition 3D printer and crusher that can acquire and store structural data from a wide array of complex, self-generated, 3D printed structures. Using various Matlab scripts and functions, the system generates 3D structures, prints them, and transports the structures to a crusher where the samples are then compressed. Following each crush, the results are used to optimize the subsequent prints by designing the next structure within the automated cycle. This automated assembly presents a novel and improved method for quick, hands free exploration of vast geometric parameter spaces, and eventual optimization of certain classes of 3D printed metamaterials. Once implemented, the results this system will produce could range from the discoveries of new geometry based metamaterials with unforeseen properties, to lightweight, cost efficient structures that exceed the strength of heavier and more costly conventional materials.

BUMECHE


CONGRATULATIONS
SENIORS!
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