2013-2014

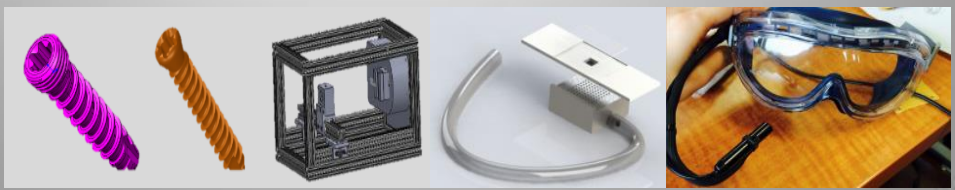
Discover Design Develop Deliver

Senior Design Projects

Biomedical Engineering Technology Expo and Competition

Friday, April 18th, 2014
8:00 a.m. – 2:30 p.m.
FIU Engineering Center

FIU | Biomedical Engineering
Florida International University



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Senior Design Project AGENDA

8:00am	Breakfast
8:40am	Welcome by Dr. Ranu Jung, BME Chair and Professor
8:50am	Introduction and Orientation by Dr. Anthony McGoron, BME Undergraduate Program Director
9:00am	Team 1: Design of Securing Components and Testing Rig for Olecranon Plate Application *Sponsor: Skeletal Dynamics Inc.*
9:30am	Team 2: Orthogonal Specimen Radiography Plate *Sponsor: MacBrud Corp.*
10:00am	Team 3: Development of a Bioreactor System for the Conditioning of Tissue – Engineered Heart Valves *Sponsor: TEMIM Laboratory, Florida International University*
10:30am	Team 4: Enhancement of an Auto-Injecting Pen Trainer *Sponsor: SHL Group*
11:00am	Team 5: Endo tracheal Intubation Visual Aid (EIVA) *Sponsor: FIU Simulation Teaching and Research Center*
11:30pm	Team 6: Percutaneous Driveline Adaptor *Sponsor: HeartWare*
12:00pm	Team 7: Circulating Tumor Cell (CTC) Microfilter Slide *Sponsor: University of Miami Pathology Laboratory*
12:30pm	Judges Deliberations and Lunch (BME Conference Room)
1:30pm	Senior Design Award Ceremony and Reception

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Message from the Chair

Congratulations Seniors!

This book of Senior Design Projects reflects your Capstone undergraduate experience in Biomedical Engineering at Florida International University. You have come to the end of one journey only to begin another.

It is heartening to see the culmination of the yearlong effort. Your projects indicate that you have not only had the opportunity to work on the design and development of an engineering solution for a practical problem, but that you have effectively utilized the strength and value of collaboration and partnership that allow us to embody our ideas and deliver innovative solutions.

As you embark on the next stage of your education and careers keep the confidence that comes from having enhanced your knowledge, remain inquisitive and have the courage to achieve your dreams.

Ranu Jung
April 2014

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Florida International University

Spring 2014
Senior Design Projects

Design of Securing Components and Testing Rig for Olecranon Plate Application

Team #1: Bader Aloufi, Laura Anderson, Roosvelt Delius, Winnie Medina, Gabrielle Roman
Dr. Sharan Ramaswamy
Company Sponsor: Skeletal Dynamics Inc.

Bader Aloufi

Laura Anderson

Roosevelt Delius

Gabrielle Roman

Winnie Medina

Abstract

Internal fixation plates are a class of implants designed to aid in the repairing of bone fractures. Screws in internal fixators can be "locked" within the plate and are subjected to axial as well as bending loads during insertion. Bone screw loosening and breakage presents a major clinical problem, leading to implant failure and inadequate fracture healing. Mechanical factors influencing the behavior of the bone, screw, and plate interfaces were analyzed to design an optimal bone screw for an olecranon fixation plate that would provide maximum pull-out strength and torsional strength during insertion. Torsion and pull-out mechanical testing following ASTM standards were performed; in addition, to accomplish the torsional tests a custom made aluminum testing rig was designed. Two types of bone screws , a locking and non-locking design, exhibited the following maximum torque and pull-out strengths respectively, 3.8N-m and 143N . Additionally the screws provided optimal plate fixation based on the thread profile and head of the screw.

skeletal™ dynamics

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Orthogonal Specimen Radiography Plate

Team #2: Luis Briceno, Kenneth Riggott, Yuneidy Lopez, Racquel Aking
Faculty Advisor: Dr. Shuliang Jiao
Company Sponsor: MacBrud Corp.


Luis Briceno

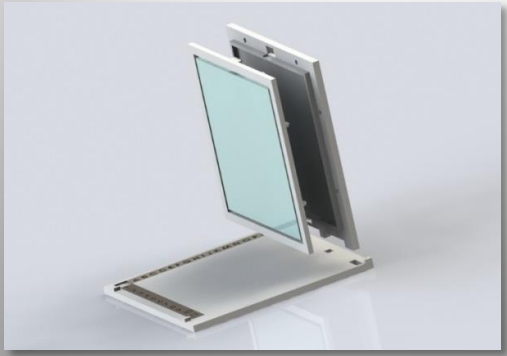

Kenneth Riggott


Yuneidy Lopez


Racquel Aking

Abstract

As a result of increased mammography screenings, breast tumors are being detected at much smaller sizes, resulting in an increase in breast conservation therapies such as lumpectomy procedures. One of the key aspects of a lumpectomy procedure is the determination of non-cancerous margins around the excised tumor. A mobile x-ray specimen radiography system can be used in the operating room to provide a real-time determination of non-cancerous margins before being sent for frozen sectional analysis. To perform margin determination of an excised breast tumor using a specimen radiography system at least two different orthogonal images must be taken. MacBrud Corp. currently produces two disposable radiography plates that do not provide an orthogonal orientation. The final output of this project will be a prototype of a disposable radiography plate that will have the capability of fixating and rotating a breast tumor to an orthogonal position while maintaining a coordinate system.



MACBRUD

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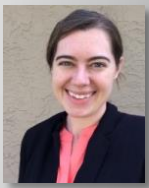
Development of a Bioreactor System for the Conditioning of Tissue-Engineered Heart Valves

Team #3: Gina Brignola, Daniel Guyton, Diego Ramirez, Daria Tarighy
Faculty Advisor: Dr. Sharan Ramaswamy
Company Sponsor: TEMIM Laboratory, Florida International University

Daniel Guyton

Diego Ramirez

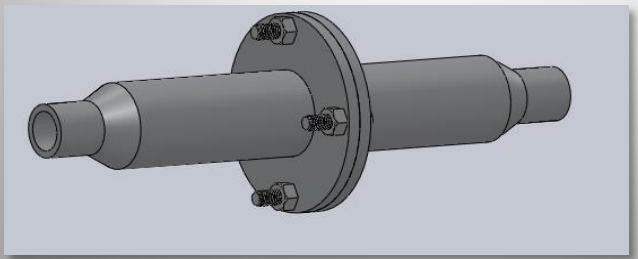


Gina Brignola

Daria Tarighy

Abstract

There is a demand for tissue-engineered heart valve (TEHV) replacements in clinical medicine. During development, TEHV must be exposed to the appropriate in-vivo pressures and conditions, which is done via the use of in-vivo simulators called bioreactors. The majority of bioreactors on the market today are capable of conditioning tissue, however they are extremely complex and costly devices and often cannot accommodate the full-organ structure. This project focuses on the development of a bioreactor system capable of conditioning a full valve structure at a low cost. The system consists of a valve-containing unit, a blood pump that simulates the action of the left ventricle, and integrated pressure transducers capable of assessing the transvalvular pressure during conditioning.



TEMIM lab
Tissue Engineered Mechanics, Imaging & Materials

FIU Biomedical Engineering
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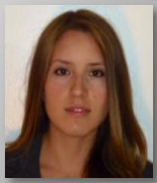
Enhancement of an Auto-Injecting Pen Trainer

Team # 4: Pablo Cordoba, Lashawnta Goss, Carlos Vallecilla, Saide Ketelsen
Faculty Advisor: Dr. Shuliang Jiao
Company Sponsor: SHL Group

Pablo Cordoba

Lashawnta Goss

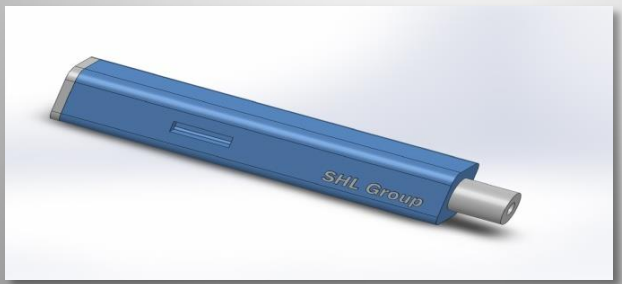
Carlos Vallecilla



Saide Ketelsen

Abstract

With the increasing number of severe allergies around the world, the auto-injecting pen has become an effective and widely used medical product. Studies demonstrate that both doctors and patients may be using auto-injectors improperly but studies have also shown that usage skills are improved by training. To effectively educate users to properly use auto-injectors, an auto-injecting pen trainer is provided. Part of the problem that affects the correct use of auto-injectors may be related to the design of the auto-injector pen trainer itself. The purpose of this project is to enhance the experience of users with auto-injectors by improving the design mechanism of the auto-injecting pen trainer therefore providing a more realistic device that can resemble the true medical device. We hope that by improving the design of the auto-injecting pen trainer provided to us by SHL Group we will decrease the amount of injuries caused by improper use of auto-injectors.



SHL GROUP

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Endotracheal Intubation Visual Aid (EIVA)

Team #5: Hanna Kaliada, Andres Medina, Emmanuel Soto, Angela Zaza
Faculty Advisor: Dr. Wei-Chiang Lin
Company Sponsor: FIU Simulation Teaching and Research Center


Hanna Kaliada


Andres Medina


Emmanuel Soto


Angela Zaza

Abstract

According to the International Journal Annals of Emergency Medicine, during endotracheal intubation in hospitals up to 25% of endotracheal tubes are misplaced, with 66% of misplaced tubes being inserted into the esophagus. Students of FIU College of Nursing and Health Sciences are undergoing meticulous training to perform this emergency procedure correctly. Currently, trainers lack the ability to provide real time instructive feedback to the trainee about the most critical steps of the procedure.

Endotracheal Intubation Visual Aid is a device that will provide a method of viewing the trainee's perspective through real time streaming. It is going to include two CMOS cameras, one that will track the eye of the trainee and the other - provides the point of view. A 940 nm IR LED coupled with Infrared Filter will be used for dark pupil contrast. The software being implemented is Open CV library and Microsoft Visual Studio C++.

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College of Nursing & Health Sciences

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Florida International University

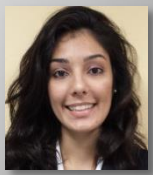
Percutaneous Driveline Adaptor

Team # 6: Federico Garces, Vahid Majidi, Andreea Meyer, Sofia Schlossman
Faculty Advisor: Dr. Michael Brown
Company Sponsor: HeartWare


Federico Garces


Vahid Majidi


Andreea Meyer

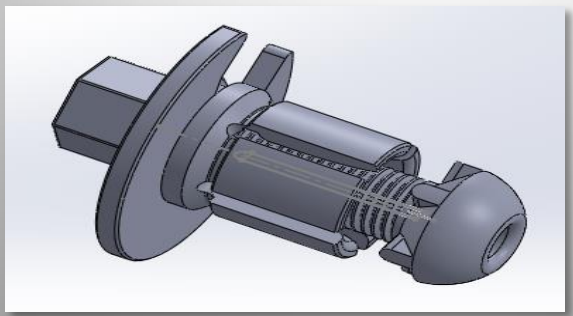

Sofia Schlossman

Abstract

The project aims to deliver an adaptor that will keep the driveline of the HeartWare Ventricular Assist Device (HVAD) in place, preventing it from moving in and out of the skin. Through root cause analysis, computer simulations, and experimental testing, our team will design and fabricate the adaptor in such a way that will:

- Functionally complement the HVAD system.
- Adapt to the current protocol for the implantation of the HVAD.
- Disperse forces applied to the driveline at the skin interface.

The percutaneous driveline adaptor will minimize potential trauma to the exit site of the driveline in the skin caused by excessive loading. Therefore, it will help to relieve possible patient discomfort at the skin interface.



HeartWare

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Circulating Tumor Cell (CTC) Microfilter Slide

Team # 7: Angelica Arias, Eric Benk, Maximiliano Velez Mejia, Daniel Sanchez
Faculty Advisor: Dr. Nikolaos Tsoukias
Company Sponsor: University of Miami Pathology Laboratory

Angelica Arias

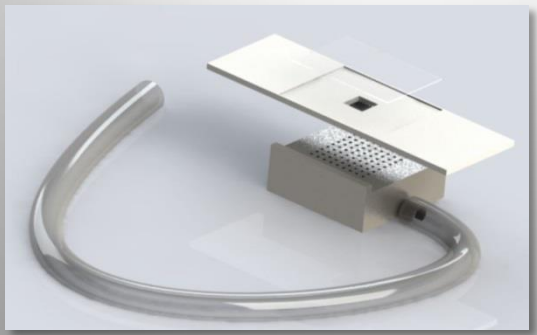
Eric Benk

Max Velez Mejia

Daniel Sanchez

Abstract

Cancer is a leading cause of death in the US and >90% of cancer-related mortality is due to metastatic disease, which occurs through tumor invasion into the bloodstream. Thus, circulating tumor cells (CTCs) play a critical role in tumor dissemination, and new applications for basic research and clinical use of CTCs are improving diagnosis, treatment evaluation, and our understanding of metastasis. University of Miami (UM) has developed an automated microfiltration system (AMFS) for the enrichment of CTCs, and we propose to expand the efficacy of the AMFS through the development of a Microfilter-Slide: a new assembly method and microfilter-housing slide, where the microfilter (used for CTC enrichment) and glass specimen slide (used for post-enrichment analysis), are integrated to form a singular unit. The final product will be a critical component of the AFMS that permits simple, efficient CTC capture and analysis by multiple users, allowing uniform characterization of CTCs.



UHealth University of Miami Health System | University of Miami Miller School of Medicine

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Summer 2013
Senior Design Projects

Discover Design Develop Deliver

Senior Design Project AGENDA

8:00am	Breakfast
8:40am	Welcome by Dr. Ranu Jung, BME Chair and Professor
8:50am	Introduction and Orientation by Dr. Anthony McGoron, BME Undergraduate Program Director
9:00am	Team 1: Non-Invasive Animal Mounting and Positioning System *Sponsor: FIU Biomedical Engineering*
9:30am	Team 2: Bone Particulate Drug Delivery Device for Spinal Fusion through the Posterior Approach *Sponsor: University of Miami Tissue Bank*
10:00am	Team 3: Modified 1.5mm Plate for Hand Fracture System *Sponsor: Biomet, Inc.*
10:30am	Team 4: Fully Automated Device for Viable Circulating Tumor Cell Capture and Recovery *Sponsor: University of Miami Pathology Research Center*
11:30pm	Judges Deliberations (BME Conference Room)
12:30pm	Senior Design Award Ceremony and Reception

Non-Invasive Animal Mounting and Positioning System

Team # 1: Bria Hitt, John O'Mara, Sarah Shah, William Williamson
Faculty Advisor: Dr. Shuliang Jiao
Company Sponsor: FIU Biomedical Engineering


Bria Hitt


John O'Mara


Sarah Shah


William Williamson

Abstract

Age-related macular degeneration, diabetic retinopathy, and glaucoma are a list of the major diseases that affect the retina and optic nerve. These diseases can lead to deterioration of vision and in some cases blindness if diagnosed late. In order to develop better methods of diagnosing these diseases, testing of developing methods on rodents is performed. These animals have small eyes so a positioning system that can help image the same retinal regions repeatedly is important. A design concept was developed based on a Gimbal system, which would allow positioning to be easily performed in 3 translational and 2 rotational axes. The design was constructed in the machine shop at FIU and tested in Dr. Jiao's laboratory by imaging a rat's retina with Optical Coherence Tomography

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Bone Particulate Drug Delivery Device for Spinal Fusion through the Posterior Approach

Team # 2: Ricardo Santivanez , Gabriela Franqui, Joseph Aguila
Faculty Advisor: Dr. Anthony McGoron
Company Sponsor: University of Miami Tissue Bank, Nathan Kast

Abstract

Spinal fusion surgery generally requires a biologic implant to promote bone fusion between two or more vertebrae. In some instances, the implant comprises of a bone microparticulate powder with which the surgeons completely fill the void formerly filled by the disc. Because the majority of spinal fusion surgeries require a posterior approach, surgeons find it difficult to deliver the bone microparticulate powder through the narrow orifice created during surgery, often giving rise to microfractures and incomplete fusion of the vertebrae.

Our device, developed from inputs gained directly from orthopaedic surgeons, allows surgeons to deliver dry, microparticulate bone powder directly and precisely into a bony void through the narrow orifice of a posterior surgical approach. Similarly, the device allows surgeons to pack the bone powder firmly into the void, ensuring contact with all orthotopic sites and giving rise to a much higher chance of successful and complete fusion of the vertebrae.

Ricardo Santivanez

Gabriela Franqui

Joseph Aguila

UMTB UNIVERSITY OF MIAMI TISSUE BANK

FIU Biomedical Engineering FLORIDA INTERNATIONAL UNIVERSITY

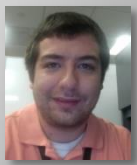
Modified 1.5mm Plate for Hand Fracture System

Team # 3: Rad Akhter, Vania Galarraga, Giovanni Giraldo, David Hojnacki
Faculty Advisor: Dr. Ranu Jung
Company Sponsor: Biomet Inc: Alfredo Casteneda

Rad Akhter

Vania Galarraga

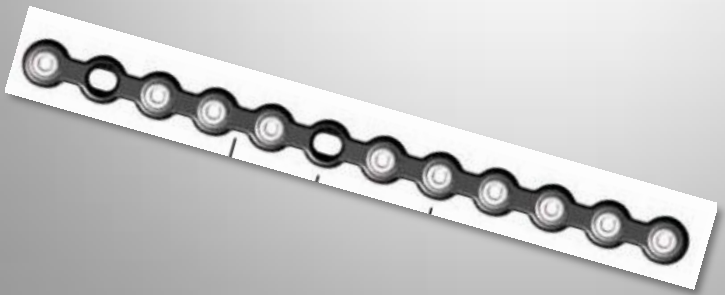
Giovanni Giraldo



David Hojnacki

Abstract

Biomet Inc. currently has a Hand Fracture System (HFS) on the market which has captured a small percentage of the hand market when compared to its competitors. However, the A.L.P.S hand plating system provides unique features the competitors do not have: customizable plate size and shape. Team 1's project aims to deliver a prototype of an improved version of the 1.5mm plate currently used in the A.L.P.S hand system. Through root cause analysis, computer simulations, and experimental testing, Team 1 will redesign the plate in such a way that the prototype will be functionally equivalent to the predicate device, shortening of the plate will occur between the nodes, and the slim profile of the predicate device will be maintained. Through a successful design, Team 1 will help improve the customers' perception of quality of Biomet products, and preserve its competitive advantage.



BIOMET ORTHOPEDICS

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Fully Automated Device for Viable Circulating Tumor Cell Capture and Recovery

Team # 4: Carlos Argueta, Florencia Goluboff, Heber Farall, Kimmy Okany
Faculty Advisor: Dr. Nikolaos Tsoukias
Company Sponsor: University of Miami Pathology Research Center. Ram Datar, Ph.D.

Abstract

Circulating tumor cells (CTCs) play a critical role in tumor dissemination. Currently, it is not possible to carry out in vitro functional studies on live CTCs for two major reasons: First, the available techniques for CTC capture are inefficient and require fixation or other processes that kill or greatly reduce the viability of CTCs, and second, cells from only 1-5% human epithelial solid tumors can be expanded in culture routinely. Thus, while genomic and phenotypic profiling of CTCs are possible, their transcriptomic analyses and functional experiments examining drug sensitivity or other dynamic biological response are impossible to carry out in most cases. A platform capable of capturing viable CTCs and expanding them in vitro would deliver a transformative new approach to study human cancers. We are developing an automated filtration device that will help overcome the barriers to utilize a microfilter-based technology with precisely engineered pore shape architecture to capture *viable* CTCs.


Kimmy Okany


Florencia Goluboff


Carlos Argueta-Leon


Heber Farall

U miami

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The Department of Biomedical Engineering thanks the engineers and managers of the sponsoring companies for offering the Senior Design projects and for their continued student guidance and support.

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