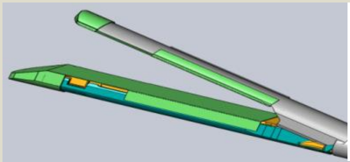
2012-2013

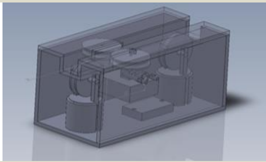
Senior Design Projects

Biomedical Engineering Technology Expo and Competition

Friday, April 19th, 2013
7:45 a.m. – 3:30 p.m.
FIU Engineering Center, EC 2300

FIU Biomedical Engineering
Florida International University





Discover Design Develop Deliver

Discover Design Develop Deliver

Senior Design Project AGENDA

7:45am	Breakfast
8:15am	Welcome by Dr Ranu Jung, BME Chair and Professor
8:20am	Introduction and Orientation by Dr Anthony McGoron, BME Undergraduate Program Director
8:30am	Team 1: Decrease Loading Time of Staple Line Reinforcement System on a Linear Endoscope Stapler *Sponsor: Syntheon LLC*
9:00am	Team 2: Designing a Mechanical Tool to Assist in the Attachment of Left Ventricular Assist Device *Sponsor: HeartWare, Inc.*
9:30am	Team 3: Pin to Bar: External Fixation for Tibia Fractures *Sponsor: Biomet, Inc.*
10:00am	Team 4: Novel Sub-Cerebral Catheter Design to Minimize Occlusions and Backflow *Sponsor: Engineering Resource Group*
10:30am	Team 5: Automated Device for Size Based Isolation of Circulating Tumor Cells (CTC) *Sponsor: University of Miami Pathology Lab*
11:00am	Team 6: Mechanical Optimization of Robotic System for Trans-Radial Catherization *Sponsor: Hansen Medical*
11:30pm	Team 7: Automation of Bone Demineralization *Sponsor: University of Miami Tissue Bank*
12:00pm	Team 8: Cervical Traction Device for Spinal Surgery *Sponsor: WB Engineering*
12:30pm	Judges Deliberations and Lunch (BME Conference Room)
1:30pm	Senior Design Award Ceremony and Reception

DISCOVER DESIGN DEVELOP DELIVER

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 2013

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Spring 2013
Senior Design Projects

Decrease Loading Time of Staple Line Reinforcement System on a Linear Endoscopic Stapler

Team #1: Shail Parikh, Alex Bode, Keisha Richards, and Julia Sanchis
Faculty Advisor: Jorge Riera Diaz
Company Sponsor: Derek Deville, Syntheon LLC

Abstract

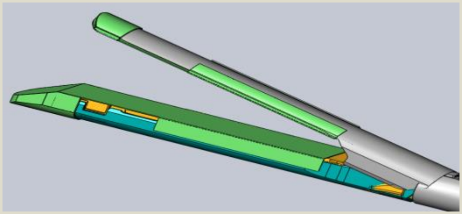
Internal stapling with linear endoscopic staplers during bariatric or colorectal surgery is an effective way to both cut and staple tissue simultaneously in a spatially limited area. With leakage from the staple line being a risk in these procedures, surgeons have taken to using staple line reinforcement systems, which consists of an absorbent material that is attached and used with the stapler. One issue with these reinforcement systems, however, is that they can be a hassle due to proper alignment on the stapler and attachment time. The goal of this project was to design a staple line reinforcement system that allows quick and efficient attachment of the material to the stapler. This was accomplished by creating a reinforcement system that incorporates a packaging allowing attachment to the stapler in two steps. By providing this method of attachment, the chance of error and user frustration is reduced, ensuring ease of use

Shail Parikh

Alex Bode

Keisha Richards

Julia Sanchis



SYNTHEON

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Designing a Mechanical Tool to Assist in the Attachment of Left Ventricular Assist Device

Team #2: David Cardenas, Alvaro Franco, and Anthony Palacios
Faculty Advisor: Sharan Ramaswamy
Company Sponsor: HeartWare Inc.

Abstract

HeartWare is a company that specializes in ventricular assist devices to treat heart failure, which is a condition that affects the ability of the heart to effectively pump blood from the left ventricle of the heart to the aorta. Currently, there is an estimated 5.7 million cases of heart failure in the United States, with heart failure attributing to 55,000 deaths per year. HeartWare is currently working on a new version of the Ventricular Assist System, which includes miniaturizing the pump in order to fit a less invasive surgical procedure. A tool was designed in order to meet the extra demands that are set forth by implementing a less invasive procedure, specifically the limitations that are imposed by the limiting space and visualizations that standard procedures otherwise would allow. The mechanical tool was designed, simulated, machined, and prototyped with the intentions of meeting the different needs that were requested by HeartWare.

David Cardenas

Alvaro Franco

Anthony Palacios

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Pin to Bar: External Fixation for Tibia Fractures

Team # 3: Christopher Emerson, Karina Rincon, Yaxel Tablada, and Priscilla Torres
Faculty Advisor: Anthony J. McGoron
Company Sponsor: Biomet, Robert Sixto

Abstract

In the United States, approximately 492,000 tibia fractures occur each year, which can be addressed through external fixation. External Fixation is a minimally invasive procedure that is utilized to treat bone fractures caused by high-energy trauma and degenerative diseases. These devices have been modified through time and significantly provide support in the healing process at the fracture site. In addition, there are various configurations for external fixators to treat distal tibia fractures, including circular, unilateral, bilateral, and hybrid devices. Each of these provides sufficient rigidity and stability for fracture healing. Team Tret's proposed modality is a unilateral, pin to bar system for tibia fractures with a design approach that will allow proper pin alignment during surgical insertion, a simple assembly for device installation, while providing fracture alignment.

Christopher Emerson

Karina Rincon

Yaxel Tablada

Priscilla Torres

BIOMET

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Novel Sub-Cerebral Catheter Design to Minimize Occlusions and Backflow

Team #4: Carolina Alvarez, Joseph Chue-Sang, Rodrigo Gaibor, and Douglas Wright
Faculty Advisor: Michael Christie
Company Sponsor: Engineering Resource Group

Abstract

Neurodegenerative disorders currently affect approximately 6.1 million people in the United States, with predicted rises in prevalence expected into the 21st century. Challenges related to treatment methods abound, including complications associated with therapeutic delivery across the blood-brain barrier. Investigational studies have assessed catheter designs to improve the efficacy of convective enhanced delivery (CED) into the brain parenchyma. CED would allow for the targeted delivery of a wide range of both macro- and micro-therapeutics, with applications in the treatment of Alzheimer's and Parkinson's diseases and brain cancers. Currently, catheters used during CED are plagued with post-insertion occlusions and backflow in the created annulus between the exterior of the catheter and the brain. This project entails the development of a sub-cerebral catheter that restricts a pressure spike caused by catheter occlusions to within ± 25% of terminal CED pressure and minimizes backflow height to ≤ 3 mm of injected drug volume.

Carolina Alvarez

Joseph Chue-Sang

Rodrigo Gaibor

Douglas Wright

Engineering Resources Group Inc.

Biomedical Engineering
FLORIDA INTERNATIONAL UNIVERSITY

Automated Device for Size Based Isolation of Circulating Tumor Cells (CTC)

Team #5: Jennifer Carrasquilla, Andres Pena, and Rudy Rodriguez
Faculty Advisor: Nikolaos Tsoukias
Company Sponsor: University of Miami Pathology Lab

Abstract

Second to heart disease, cancer is the leading cause of death in America, which accounts for 1 in every 4 deaths. The root cause of death associated with cancer is the metastatic spread of cancer cells. A new promising investigative procedure, based on a liquid biopsy, aims to capture and enrich Circulating Tumor Cells (CTCs), which are cells that have gained access to the circulatory system. These cells will eventually cause new tumorous growths away from their origin. Capturing the CTCs using a novel micro-filter technology will allow for enumeration and characterization of these cells, providing information useful for diagnosis and therapy. The major drawback is that the process currently requires many manual process to filter the blood, making it time consuming and tedious for processing multiple samples. This project is an endeavor to create a working prototype to automate the current filtration technique used by the University of Miami's pathology lab. Automation will allow this process to be utilized in a larger scale while also maintaining safety protocols, eliminating variability, and increase efficiency.

Jennifer Carrasquilla

Andres Pena

Rudy Rodriguez

UHealth UNIVERSITY OF MIAMI HEALTH SYSTEM | UNIVERSITY OF MIAMI MILLER SCHOOL of MEDICINE

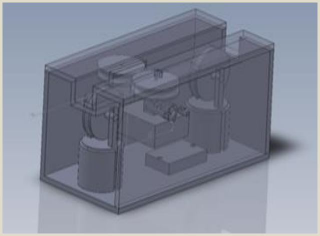
FIU Biomedical Engineering FLORIDA INTERNATIONAL UNIVERSITY

Mechanical Optimization of Robotic System for Trans-Radial Catheterization

Team #6: Wilfred Franco, Tuan Nguyen, Alejandro Torres, and Celisse Zabalo
Faculty Advisor: Ranu Jung
Company Sponsor: Hansen Medical

Abstract

Hansen Medical, a leader in intravascular robotics, has developed the Magellan Robotic System and Robotic Catheter to address the growing demand for robotic precision during surgical procedures. Although the use of the Magellan Robotic System has mostly been applied to femoral catheterization, Hansen Medical seeks to apply this robot to trans-radial catheterization because of the advantages of using this approach, among which are less bleeding, a shorter recovery time, and better access for more obese patients. The objective of this project is to design a device that will accompany and assist the Magellan Robotic System by preventing buckling of the catheter during trans-radial insertion, since the current system has presented this problem. The new electromechanical design proposed by our team is small, aesthetically pleasing, and incorporates a pulling mechanism, completely eliminating the buckling and bowing problem of the current design.



Wilfred Franco

Tuan Nguyen

Alejandro Torres

Celisse Zabalo

Automation of Bone Demineralization

Team #7:John Perez, Azael Sarmiento, Bryant Thompson, and William-Jose Velez
Faculty Advisor: Nikolas Tsoukias
Company Sponsor: Nathan Kast, University of Miami Tissue Bank

Abstract

This project seeks to automate the process of bone demineralization currently being performed at The University of Miami Tissue Bank (UMTB). As of now, the procedure is performed manually and takes up to 5 members to complete deminerilzation. The process introduces a cycle of reagents, including 1% Peracetic Acid, 1M HCl, Phosphate Buffered Saline (PBS), Ethanol and a series of water rinses, to complete the demineralization process and reduce residual calcium level to a range of 2-8%. The automated process implements a custom LabVIEW code with a dedicated Guided User Interphase (GUI) to initiate and suspend the process when need be. A National Instruments Data Acquisition Unit (DAQ) sends signals (0-5v) to drive peristaltic pumps, which drive the introduction and withdrawal of liquids from the reactor where the cortical bone, roughly 200-350 microns in size, is contained in a 50-micron pore filter bag.

Bryant Thompson

Azael Sarmiento

John Perez

William-Jose Velez

UMTB UNIVERSITY OF MIAMI TISSUE BANK

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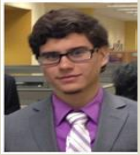
Cervical Traction Device for Spinal Surgery

Team # 8: Ronald Montoya, Juan Sebastian Perez-Larrota, Zaid Sheikh, and Christian Vargas
Faculty Advisor: Ranu Jung
Company Sponsor: Werner Blumenthal, WB Engineering

Abstract

The current methods employed in the operation room to achieve cervical vertebrae separation are deemed highly invasive and therefore very unsettling for both surgeons and patients alike, as evidenced by the Caspar Distraction Pins. In an effort to achieve this separation of cervical vertebrae without making any incision, a design based on mechanical engineering principles has been developed while providing movement and fixation of the subject’s head to surgeons. Surgeons often need x-ray images before making the appropriate incision on the patients, so the device was made with radio translucent materials, while providing measurable feedback for the head’s movements.



Christian Vargas

Juan Sebastian Perez-Larrota

Zaid Sheikh

Ronald Montoya

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Summer 2012
Senior Design Projects

Discover Design Develop Deliver

Senior Design Project AGENDA

7:45am	Breakfast
8:15am	Welcome by Dr Ranu Jung, BME Chair and Professor
8:20am	Introduction and Orientation by Dr Anthony McGoron, BME Undergraduate Program Director
8:30am	Team 1Pulsatile Circulatory Loop System for HVAD Testing *Sponsor: HeartWare, Inc.*
9:00am	Team 2: Thrombogenic Assessment of Materials for Potential Application in an Implantable Blood Access Valve *Sponsor: D.D.D. Lab, Inc.*
9:30am	Team 3: Test Loop Mechanism for Transcutaneous Energy Transfer System (TETS) *Sponsor: HeartWare, Inc.*
10:00am	Team 4: Linear Motion System for the Antalgic-Track Spinal Decompression Unit *Sponsor: CMSI, Inc.*
10:30pm	Judges Deliberations (BME Conference Room)
11:30pm	Senior Design Award Ceremony and Reception

Pulsatile Circulatory Loop System for HVAD Testing

Team # 1: Ashanna Biltoo, Kelly Mesa, and Natalie Cortes
Faculty Advisor: Anthony McGoron
Company Sponsor: Neil Voskoboynikov, HeartWare, Inc.

Abstract

This projects reports on the development of a portable continuous closed loop testing system in which simple pulsatile waveforms are generated. The loop will be used in preproduction testing of Heart Ventricular Assist Devices (HVADs) at HeartWare, Inc. This type of testing is required for characterization of the HVADS and assessment of design defects. The design of the loop took into consideration the frequency and amplitude characteristics of the waveforms as well as the total systemic resistance. These attributes fell within physiologically analogous ranges for both healthy and congestive heart failure conditions.

Ashanna Biltoo

Kelly Mesa

Natalie Cortes

HeartWare

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Thrombogenic Assessment of Materials for Potential Application in an Implantable Blood Access Valve

Team # 2: Tatiana Bejarano, Janelle Cunningham, and Adrien Nicolas
Faculty Advisor: Sharan Ramaswamy
Company Sponsor: Manuel Dugrot, D.D.E. Lab Inc.

Abstract

Enabling continuous blood access and a port for drug delivery remains a problem for chronic, hospitalized patients due to lack of robust vein, thrombus and infection problems with prolonged in vivo needle retention. Accordingly, our sponsor has developed a blood access valve (BAV) device that can further reduce complications, while providing a continuous site for blood access; however materials selection at the blood-contacting surface needed to be investigated in order to minimize platelet adhesion. Thus the goal of this project was to develop a flow loop that simulates intravenous blood flow in order to test candidate materials for the BAV. The team determined the best test method for identifying effects of thrombosis on the selected material was to add mepacrine, a fluorescent dye, to the blood in order to visualize and quantify platelet adhesion on tested materials using a florescence microscope. After performing the trials, the team would provide suggestions on the least thrombogenic material to use in the magnetic access valve. The valve will provide repetitive access to the vein by a single vascular port alleviating the pain and discomfort associated with multiple access sites. Due to the amount of chronic hospital patients that require regular access to their blood stream, and in consideration of other areas of need such as for kidney dialysis patients where frequent blood access is required, this device has the potential for a relatively large market-share in the health care industry where current conventional treatment using tubes and needles are sub-optimal.

Tatiana Bejarano

Janelle Cunningham

Adrien Nicolas

D D E LAB INC.

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Test Loop Mechanism for Transcutaneous Energy Transfer System (TETS)

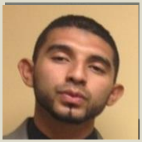
Team # 3: Rahul Kohli, Anisley Valenciaga, and Samir Castillo
Faculty Advisor: Dr. James D. Byrne
Company Sponsor: HeartWare

Abstract

Left Ventricular Assist Devices (LVADs) are widely used today as a bridge to transplant and are successful in prolonging life, but the current method of charging increases the chance of infection. A new system is being implemented that allows for wireless charging through the skin called a Transcutaneous Energy Transfer System (TETS). This system includes two coils (one implanted in the body and one external but aligned). Energy transfer is achieved when the external electronics produces an AC current flowing through the external coil to generate a time-varying electromagnetic field. A voltage is induced on the implanted coil, which is converted to power the heart pump. While this system decreases the chance of infection when a connector or wire is passed through the skin, another issues is that it will cause the body's skin/core temperature to increase. There is a need by the company for a test loop mechanism that will be able to determine the temperature rise prior to in-vivo tests (animal trials) and for quality assurance post-production. Our project addresses this need by designing a test loop mechanism that includes four major components. The first component is a skin and core phantom that will have properties similar to that of the human skin and core. The second is a heating system that will allow the core phantom to be heated to a desired temperature. The third is a mechanism that will allow the distance between the two coils to be varied. The fourth component will be a data collection system that will include temperature measurement devices placed throughout the core phantom and around the skin phantom and an external computer that will collect this data and store it.

Rahul Kohli

Anisley Valenciaga



Samir Castillo

HeartWare

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Linear Motion System for the Antalgic-Trak Spinal Decompression Unit

Team # 4: Katherine Chacon, Andrew Mendoza, and Mikel Dualos
Faculty Advisor: Dr. Ranu Jung
Company Sponsor: Daniel Glenn, Contract Manufacturing Solutions, Inc.

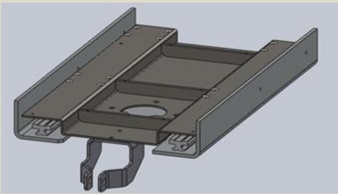
Abstract

Contract Manufacturing Solutions, Inc. is the manufacturer of the revolutionary Antalgic-Trak spinal decompression device from Spinetronics, LLC. Through a series of controlled motions, a patient can receive beneficial decompression therapy clinically proven to enhance their quality of life. In its current configuration, the Antalgic-Trak utilizes a series of roller bearings that travel along the interior of a track system to accomplish the linear motion required. This linear motion is achieved with the use of a linear actuator being controlled by a programmable logic controller. However, the roller bearings require excessive and costly adjustments in order to function optimally throughout the stroke of the linear actuator. This bearing system also contains a noticeable straight line deviation during its motion. This project involves replacing the roller bearing systems throughout the Antalgic-Trak with superior performing linear slide systems which require less adjustment time and also provide a more controlled means of linear motion.


Katherine Chacon


Andrew Mendoza


Mikel Dualos



cmsi
Contract Manufacturing Solutions, Inc.

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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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10555 West Flagler Street
EC2610
Miami Florida 33174

Contact: bmeinfo@fiu.edu; 305-348-6950

http://www.bme.fiu.edu/