

Spring 2012

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Senior Design Projects

Biomedical Engineering Technology Expo and Competition

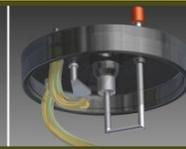
Friday, April 20th, 2012

8:00 a.m. – 4:30 p.m.

FIU Engineering Center, EC 2300

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INTERNATIONAL
UNIVERSITY



Senior Design Project AGENDA

- 8:00am Breakfast
- 8:45am 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: Erekt-Alarm Posture Monitoring System
Sponsor: WB Engineering
- 9:30am Team 2: Instrumentation Design to Change Delivery of DePuy Dorsal Nail Plate System
Sponsor: DePuy
- 10:00am Team 3: Liquid TEM Microfluidic Device
Sponsor: Sterling Point Research LLC
- 10:30am Team 4: Process Improvement Deliverables for AmnioGraft® and Prokera® products
Sponsor: Bio-Tissue
- 11:00am Team 5: Development of a Mechanical Fixture and Test Protocol for a Radial Head Plate System
Sponsor: Skeletal Dynamics
- 11:30am Team 6: Femoral Trial for Total Knee Arthroplasty
Sponsor: Mako Surgical Corp.
- 12:00pm Team 7: Improvement of Aerosol Drug Delivery System
Sponsor: Department of Pulmonology Research, Mount Sinai Medical Center
- 12:30pm Team 8: CerebraPROBE: A Remote Introducer for Catheters Using the Medtronic Navigus Trajectory Guide
Sponsor: ERG Inc.
- 1 :00pm Judges Deliberations and Lunch
- 2 :00pm Senior Design Award Ceremony and Reception

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 2012*

Erekt-Alarm Posture Monitoring System

Team # 1: Christian Forment, Daniel Garcia, Reynier Santos, Ricardo Siu

BME Advisor: Dr. Ranu Jung

Sponsor: WB Engineering

Abstract

Back related pain is currently one of the leading complaints that can be addressed through palliative care (1). In 2008, the Journal of the American Medical Association published an article that nearly \$86 billion is spent annually in back related problems between treatment, diagnostics, medications and other procedures (2). Most of the conditions that lead to back pain are preventable if proper posture is adopted before permanent spine deformation takes place. However, correcting improper posture can be challenging if constant monitoring is not available. It is this project's objective to develop a method that will accomplish such a task. The project thus aims to design and manufacture a low cost prototype that monitors and records the user's posture while warning the user when he or she adopts an incorrect posture.

1- Raofi S, Schappert SM. Medication therapy in ambulatory medical care: United States, 2003-04. Vital Health Stat 13 2006; 13: 1-40.

2- Martin BI, Deyo RA, Mirza SK, et al. Expenditures and Health Status Among Adults With Back and Neck Problems. JAMA: The Journal of the American Medical Association. 2008;299(6):656 -664.



Christian Forment



Daniel Garcia



Reynier Santos



Ricardo Siu



Instrumentation Design to Change Delivery of DePuy Dorsal Nail Plate System

Team # 2: Caterina Pette, Nuria Gil, Maria Gonzalez, Andrew Musto, Jonathan Stansel

Advisor: Dr. Nikolaos Tsoukias

Sponsor: DePuy a Johnson & Johnson company

Abstract

The gold standard for the repair of distal radius fractures is open reduction internal fixation. DePuy Trauma currently has a less invasive form of open reduction with their Dorsal Nail Plate (DNP) Anatomic system. Current DNP trays are consigned to healthcare systems around the US and require couriers to inventory and sterilize the equipment after use. DePuy Trauma would like to transform the reusable tray into a sterile disposable kit in order to change their business model. As a disposable kit, the system could be shipped to customers around the US and internationally reducing courier expenses and allowing consecutive procedures to be performed. The implementation of a disposable kit is currently not possible due to the cost of instrumentation: outrigger, drill guide, and locking screws. The project is to design new instrumentation unique to the DNP system that will facilitate the manufacturing cost without losing functionality while still addressing the current modality.



Caterina Pette



Andrew Musto



Nuria Gil



Jon Stansel



Maria Gonzalez



Liquid TEM Microfluidic Device

Team # 3: Grace A. Castillo, Enmanuel Cordova, Menline Lu, Aliaksandr Zaretski

Advisor: Dr. Wei-Chiang Lin
Sponsor : Sterling Point Research, LLC

Abstract

Currently, pharmaceutical, microbiology, proteomics and other biological laboratories are relying on electron microscopy for imaging of subcellular structures and processes. Whereas conventional light microscopy is effectively used for cellular identification, morphology and interactions, only electron microscopy techniques (scanning electron microscopy - SEM, transmission electron microscopy - TEM) provide resolution fine enough for subcellular imaging. Although an essential and powerful analytical imaging technique, electron microscopy of biological samples has its limitations. Most limitations come from sample preparation methods for the technique. This project offers an alternative to the current sample preparation methods that addresses the issues of sample preparation duration, cost-effectiveness, accessibility, and introduces a novel promising sample property - viability



Enmanuel Cordova



Grace Castillo



Menline Lu



Aliaksandr Zaretski



Process Improvement Deliverables for AmnioGraft® and Prokera® Products

Team # 4 : Jorge Chaux, Luis Fernandez, Luis Ramirez, Stephanie Van Gulden

Advisor: Dr. Sharan Ramaswamy

Sponsor: Bio-Tissue, Inc.

Abstract

BioTissue, Inc currently has a time-involved method in the cutting of amniotic membrane (AM) fragments with a scalpel through the guidance of two rulers. This method causes a relatively large margin of error and is rather tedious. The primary objective of this project is to minimize user variability and provide a robust electro-mechanical cutting mechanism; specifically, we aim to deliver a device capable of cutting the AM flawlessly in five different sizes and two shapes. A linear actuator connected to a mold cutting press will be employed to effectuate a precise blade pressure or stress so that a consistent cut can be achieved regardless of user or number of cuts made. The project will increase the company's production by 150% and reduce their process time by 60%.



Stephanie Van Gulden



Luis Ramirez



Jorge Chaux



Luis Fernandez



Development of a Mechanical Fixture and Test Protocol for a Radial Head Plate System

Team # 5: Patricia Santana, Kamau Pierre, Alexander Rodriguez, and Andreina Castro

Advisor: Michael Christie, PhD

Sponsor: Skeletal Dynamics™

Abstract

Skeletal Dynamics™ is on the verge of commercializing their latest device; a radial head plate system. This product is an internal fixation device intended to serve as a treatment option for fractures of the radial head in which the head is still salvageable. The system aims to secure the fracture and support the bone during its healing process. During patient recovery, however, the plate will be subjected to forces that could potentially compromise its integrity and undermine its performance. There is therefore a need by the company to assess their plate's effectiveness in withstanding biomechanical forces during fracture recovery. Our project addresses this need whereby we seek to evaluate the strength capabilities of the plate system. By designing and developing a test fixture for attachment of the company's and an existing predicate plate system, our team further seeks to develop a test protocol for the execution of mechanical strength testing of both plate systems. In so doing we aim to verify that Skeletal Dynamics™ radial head plate system's performance is significantly equivalent, if not superior, to a market approved device.



Patricia Santana



Kamau Pierre



Alexander Rodriguez



Andreina Castro



Biomedical Engineering
FLORIDA INTERNATIONAL UNIVERSITY

Femoral Trial for Total Knee Arthroplasty

**Team # 6: David Neuman, Mileidy Aguado, Karla Landaburo,
Sandra Mantilla, and Michael Prieto**

Advisor: Dr. Michael Brown

Sponsor: Mako Surgical Corp

Abstract

Osteoarthritis (OA) is a debilitating ailment caused by wear and tear of the joints, affecting approximately 27 million Americans [1]. Each year, an estimated \$5700 per person is spent to treat people suffering from OA [2]. Most of the cost comes from the 581,000 knee replacements that are performed each year.. In knee arthroplasty cases, implant trials are used to test for impact, range of motion (ROM), and laxity in order to make sure that the prostheses that will be implanted in the patient provides the proper alignment and correct angles so the femur, tibia, and patella bones will align adequately after the new surfaces have been implanted. As of date, the implant trials in the market are reusable and must be reprocessed and re-sterilized between procedures. These factors place a burden on the hospital and the company providing the instrumentation, as the company is responsible for supplying the reusable trials, maintaining and replacing the equipment, and performing inventory. Because of this, MAKO Surgical Corp has asked us to deliver disposable trials, along with a method of insertion and extraction for surgeries in order to ensure proper placement and sizing of the permanent implant.

[1] "CDC - Arthritis - Data and Statistics - Arthritis Related Statistics." *Centers for Disease Control and Prevention*. Web. 19 Nov. 2011.

<http://www.cdc.gov/arthritis/data_statistics/arthritis_related_stats.htm>.

[2] "Osteoarthritis Fact Sheet." *Arthritis Foundation*. Web. <http://www.arthritis.org/media/newsroom/media_kits/Osteoarthritis_fact_sheet.pdf>.



Michael Prieto



David Neuman



Sandra Mantilla



Mileidy Aguado



Karla Landaburo



Improvement of Aerosol Drug Delivery System

Team # 7: Andrés Medellín, Melissa Palacios, Fernando Rea, Kathryn Tracy

Advisor: Dr. James Byrne

**Sponsor: Dr. Juan R. Sabater, Department of Pulmonary Research,
Mount Sinai Medical Center**

Abstract

Modern aerosol delivery systems function by continuously producing an aerosol to ensure its subject inhales the administered medication. Simply placing a nebulizer in-line with a constant flow of air results in an aerosol loss of approximately 60–70%. To mitigate the repercussions associated with “free breathing”, we have enhanced an already existing aerosol drug delivery system by successfully synchronizing its Harvard apparatus ventilator with a Rosenthal dosimeter to deliver modifiable doses of medication strictly when the subject is inhaling.

The Harvard pump delivers a column of air to push the aerosol through the tubing mechanism while controlling the subject’s breathing pattern. A control circuit was implemented into the Harvard pump to effectively dictate the Rosenthal dosimeter to deliver the aerosol as it is being created.

By establishing a more productive approach to aerosol drug delivery, testing pharmaceuticals on live models will allow for more accurate dosage response curves towards assessing the impact of the drugs.



Andres Medellin



Melissa Palacios



Fernando Rea



Kathryn Tracy

Mount Sinai
MEDICAL CENTER

CerebraPROBE: A Remote Introducer for Catheters Using the Medtronic Navigus Trajectory Guide

Team # 8: Fritzline Cesar, Michael Lopez, Rudolph Piatyszek, Paola Sepulveda

Advisor: Michael Christie, PhD

Sponsor: Engineering Resources Group, Inc. (Chris Ross)

Abstract

There are currently 7 to 10 million patients worldwide living with Parkinson's disease (PD) and it is projected that by 2030, these numbers will double. Current methods prove to be insufficient for treating PD, and with increasing proof that gene therapy and stem cell treatment for PD is the way of the future, methods to accurately inject these treatments into the necessary areas of the brain is important. Currently, a process is being developed that will allow surgeons to map their paths of insertion using real-time MRI scans and remotely align their probe insertion path along the projected trajectory while the patient is in the MRI machine. There currently is no method of probe insertion other than manual insertion, which will be difficult to the surgeon as the patient is within the MRI machine. This project entails the design, manufacturing, and testing of a prototype, dubbed the named CerebraPROBE, for controlled introduction into brain tissue that provides smooth and accurate motion without interfering with the Navigus Trajectory Guide, that is 100% MRI-compatible with a maximum depth penetration of 100mm."



Fritzline Cesar



Michael Lopez



Rudolph Piatyszek



Paola Sepulveda



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.



Biomedical Engineering
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