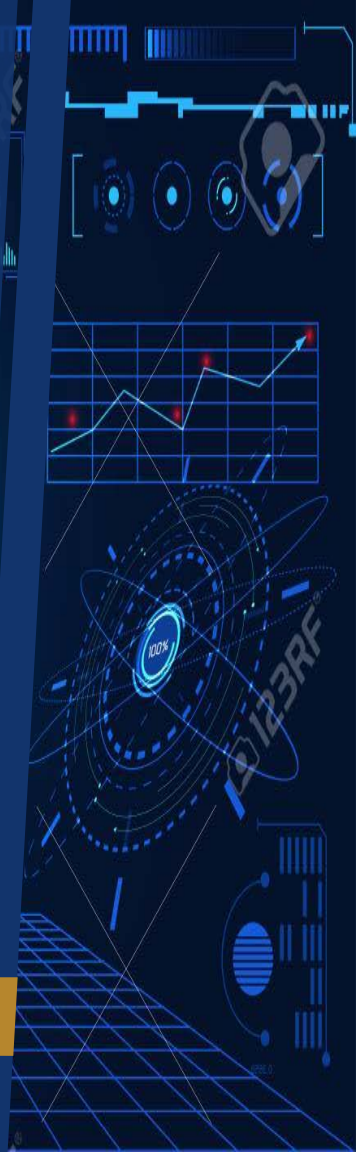
FIU | FLORIDA INTERNATIONAL UNIVERSITY

SENIOR DESIGN PROJECT SHOWCASE FALL 2019

BIOMEDICAL ENGINEERING
EXPO & COMPETITION

DISCOVER DESIGN DEVELOP DELIVER



MESSAGE FROM THE CHAIR

Congratulations Seniors!

As senior Biomedical Engineering students at Florida International University, you have come to the end of an incredible journey. Your Senior Design Projects are a reflection of your efforts and your capstone undergraduate experience.

Your work is an illustration of the many skills you have sharpened during the course of this yearlong project. you have discoered new ways of thinking, designed and developed an engineering solution for a practical problem, and collaborated with your teammates to deliver innovative solutions. It is encouraging to see your accomplishments and to have witnessed your growth as students.

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.

Dr. Ranu Jung

SENIOR DESIGN PROJECT AGENDA

7:30am - Breakfast

8:00am - Welcome from Dr. Ranu Jung,
Chair and Professor of Biomedical Engineering

8:05am - Introduction & Orientation - Dr. Michael Christie, Senior Instructor of Biomedical Engineering

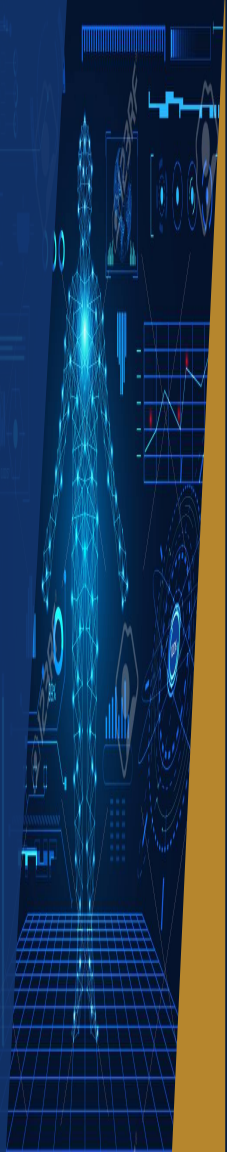
8:15am - Team 1: Wireless Electrode for the SA Node of the Heart

8:40am - Team 2: Auxadyne's XPF Protective Headgear for High-Risk Traumatic Brain Injury Individuals

9:05am - Team 3: System to Quantify the Effect of Visual Inputs on Body Sway

9:30am - Team 4: IMPro:Application of the Gate Control Theory of Pain in Reducing Discomfort During Intramuscular Injections

9:55am - Team 5: Foam-Based Pressure System for Aid in Casting of Transtibial and Transfemoral Amputees



SENIOR DESIGN PROJECT AGENDA

10:20am - Team 6: Rehabilitative Knee Brace

10:45am - Team 7: NeuroFit 360: Companion

11:10am - Team 8: KATT: Knee Analog Test Tool for VERASENSE

11:35am - Team 9: NeuroBeats: A Wearable Stimulator for Parkinson's Disease

12:00pm - Team 10: Garrison Gauge

1:00pm - Lunch

2:00pm - Awards

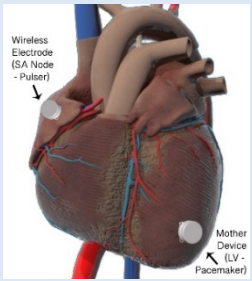
Wireless Electrode for the SA Node of the Heart

Team 1

Faculty Advisor: Joshua Hutcheson

Company Sponsor: OR PACE

Sick sinus syndrome recommended treatment is dual chamber pacing stimulation using intravenous lead pacemakers. Post implantation lead related complications are the most common. Leadless pacemakers have been developed to address these problems. The available devices have raised concerns given that they are implanted inside the right ventricle in direct contact with blood posing the risk of being thrombogenic and cases have been reported where the device has dislodged. The current options only offer single chamber stimulation which has been associated with the development of pacemaker syndrome. We focused on the development of an epicardial wirelessly controlled electrode that delivers an electrical stimulus to the SA node when a specific radio frequency is received from a paired epicardial pacemaker located in the apex of the heart, providing dual chamber stimulation without the need to use lead wires and removing the interference with blood flow.



Team 1 *Keandre Blount, Maria Giraldo, Denis Ortega, Gabriel Santana*




ORPACE MEDICAL

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Auxadyne's XPF Protective Headgear for High-Risk Traumatic Brain Injury Individuals

Team 2
Faculty Advisor: Nikolaos Tsoukias
Company Sponsor: Auxadyne

Currently, 5.3 million Americans are affected by Traumatic Brain Injuries (TBI). In a study conducted, about 35.3% of all TBI were fall-related. A traumatic brain injury can range from mild TBI (like concussions) to severe, life-threatening injuries. A protective headgear is needed to benefit high-risk TBI individuals, as well as those who suffer from various neurological disorders (such as epilepsy), from abrasive impacts. The current solution lies within the protection from impacts during falls, that the Auxadyne Protective Headgear offers, with their patented processing of Auxetic Polyurethane Foam (XPF). The foam has a negative Poisson's ratio, is synclastic, has variable porosity, and possesses a kinetic energy attenuation design. The intention is to deliver this protective headgear for high-risk TBI individuals, focusing on epileptic patients, by using XPF to increase impact attenuation and durability, by November 2019 on a $1,500 USD budget.

Team 2 *Brianna Weiss, Michael Fernandez, Shannon Joseph, Xavier Restrepo*




Auxadyne

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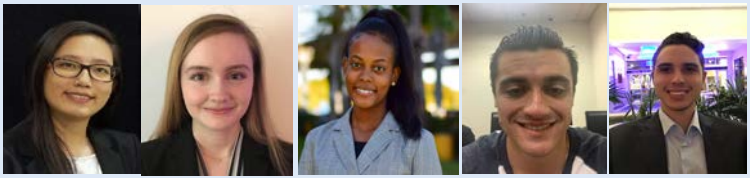
System to Quantify the Effect of Visual Inputs on Body Sway

Team 3
Faculty Advisor: James Schummers
Company Sponsor: NOVA Southeastern University

Autism Spectrum Disorder (ASD) is a neurological disorder that begins in childhood and has been associated with increased postural sway. Currently in optometry clinics, the improvement of body-sway in subjects with autism or binocular deficits is mainly evaluated by the clinician subjectively. The objective of this system is to create an affordable and practical mean to quantify, record and compare postural sway in children to more properly diagnose ASD at an early age. With our device there is a new way to read a patient's body-sway and perform diagnosis. The Nintendo Wii board records the center of mass while the patient is exposed to visual stimuli. During this recording, the patient is wearing electronically controllable shutter goggles designed to assess the change in response to monocular/binocular vision. The output of the project is a system that is able to record real-time data of body-sway changes in response to visual inputs.

Team 3 *Angela Wong Lau, Gabriela Navaza, Zoë Bernard, Esteban Perez, Ramiro Sanchez*



NSU NOVA SOUTHEASTERN UNIVERSITY Florida

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IMPro:Application of the Gate Control Theory of Pain in Reducing Discomfort During Intramuscular Injections

Team 4

Faculty Advisors: Michael Christie, Jessica Ramella-Roman

Company Sponsor: Dr. Mario Nunez

Intramuscular injections are vital to modern healthcare. However, they are painful, and, due to pain memory, patients avoid visits to doctors. When receiving injections, patients, in trying to avoid pain, fail to hold still. This often results in localized tissue damage and additional pain. Current modalities require physicians to use both hands to administer injections. This limits accessibility to the target area and reduces the accuracy of the procedure. With IMPro, patients will no longer fear the injection experience as it reduces pain in intramuscular injections. IMPro mechanically stimulates the target area which reduces the number of pain signals reaching the brain. IMPro also improves the accuracy of injections since it can be used single handedly, allowing physicians to properly position target tissue. IMPro is a cost-effective solution that allows patients to visit physicians without fear of pain, thereby improving their health and longevity.

IMPro

Team 4 *Carlos A Roche, Monica Karas, Manuel Vazquez, Sepehr Soroushiani*




Mario Nunez M.D.

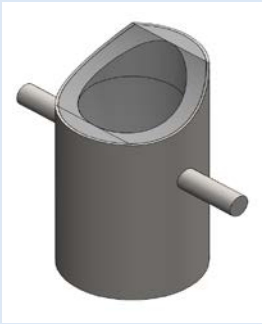
Foam-Based Pressure System for Aid in Casting of Transtibial and Transfemoral Amputees

Team 5

Faculty Advisor: Michael Christie

Company Sponsor: Garrison's Prosthetic Services

There are 200,000 lower limb amputees in the United States. This number is expected to double by 2025. Transtibial and transfemoral prosthesis help to restore functionality and mobility in patients. Two criteria for designing lower limb prostheses are accurate casting and comfort. Comfort is achieved by creating a total contact fit which is produced by applying radial pressure circumferentially on the cast. Current modalities are expensive and inaccurate, leading to frequent revisions of prosthetic sockets. Our device uses polymeric foam which is compressible and provides a restoring force that is optimal for the casting procedure. It enables the prosthetist to apply uniform pressure throughout the cast, resulting in improved prosthetic fit and reducing the frequency of revisions. This device provides a cost-effective and clinically sound alternative to the market that will improve the quality of life of lower limb amputees.



Team 5 *Jay Yeung, Luis Guardia, Shanika Pascal, Hany Fleitas*




GARRISON'S Prosthetic Services
RESTORING BALANCE RENEWING HOPE

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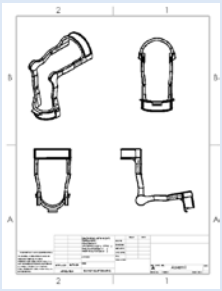
Rehabilitative Knee Brace

Team 6

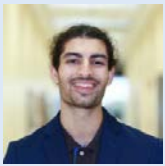
Faculty Advisors: Zachary Danziger, Michael Christie

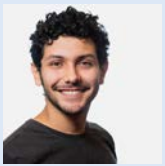
Company Sponsor: Dr. Mark Rossi, FIU Department of Physical Therapy



Modern advancements in healthcare and longer life expectancy have led to an increase in the geriatric pop ulation and an increased demand for geriatric care. A larger geriatric population is correlated to a higher incidence of patients undergoing knee arthroplasty, commonly known as knee replacement surgery. Post-surgery care for older patients who have undergone knee arthroplasty requires very long rehabilitation time to regain the leg mobility, strengthen the lower limb muscles, and regain a normal gait. The aim of the present device is to produce a rehabilitative knee brace that provides resistance during extension and flexion of the lower leg which would promote activation of leg extensor and flexor muscles. The present device will serve as a viable rehabilitation option for post knee surgery patients by providing the patient with easy to use, home-based physical therapy, which mitigates costs associated with on-site clinical treatment.

Team 6 *Hannah Nelson, Mariell Pascual, Jonathan Williams, Baarbod Ashenagar*





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Nicole Wertheim College of Nursing & Health Sciences

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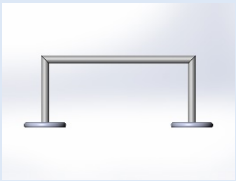
NeuroFit 360: Companion

Team 7
Faculty Advisor: Ranu Jung
Company Sponsor: NeuroFit 360

Companion is a gait training apparatus invented to assist individuals with spinal cord injuries restore their gait control; these individuals are classified as paraplegic level B or C on the ASIA scale. Currently, these individuals are confined to receiving therapy in the clinical setting by a medical professional, thus limiting the duration of their rehabilitation therapy. Companion will allow these individuals (classified as clients) to continue therapy at home with the assistance from their family members (classified as helpers) by providing additional rehabilitation time aside from the clinical setting therapy. Companion is a four piece apparatus composed of a footplate, two shin and thigh cuffs, along with a vest component to assist in the transfer of motion. The use of Companion represents a rehabilitative option for clients by providing a compliment to therapy in the clinical setting, with the aim of decreasing recovery time and restoring normal gait.



Team 7 *Jessica Zatarain, Kelsie Bryant, Harmen'S Marc, Guillermo Paz*

NeuroFit 360
NEUROLOGICAL INJURY RECOVERY AND WELLNESS CENTER

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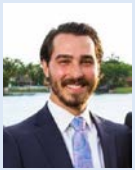
KATT: Knee Analog Test Tool for VERASENSE

Team 8
Faculty Advisor: Sharan Ramaswamy
Company Sponsor: OrthoSensor

The number of total knee arthroplasty (TKA) surgeries performed has significantly increased to over 300,000 in the US and 3 million worldwide every year. It is estimated that 1 in 5 people are unsatisfied with results and need to undergo revision surgery due to malalignment and soft tissue imbalance. OrthoSensor's VERASENSE provides a wireless sensor-assisted knee balancing quantification technique used in total knee replacement surgeries. The company needs a test tool that anatomically represents the knee joint during TKA to accurately characterize how certain physiological conditions affect the sensor's performance. The design of the project delivers a knee model that includes hard and soft tissue analogs and metal implants amongst other components used for characterization testing. The fixture provides an anatomically representative test mechanism that will be able to characterize temperature effect on load drift at 37°C and Radio Frequency (RF) Signal attenuation using RF absorbers.

Team 8 *Sarah Jimenez, Manuel Garcia, Andres Arango, Marie Senatus*



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NeuroBeats: A Wearable Stimulator for Parkinson's Disease

Team 9

Faculty Advisor: Markondeyaraj Pulugurtha

Company Sponsor: Weinstock Physical Therapy, PC

Parkinson's disease (PD) results in significant impairments to mobility, in the form of bradykinesia, akinesia, and gait ataxia. Several clinical studies have demonstrated the effectiveness of peripheral nerve stimulation in the alleviation of these symptoms, using both mechanical and electrical methods. Furthermore, other studies have shown that music also has potential in mobility in patients with PD. Our sponsor, Dr. Ben Weinstock, has proposed a device that delivers both vibrational and nerve stimulation synchronized to a musical rhythm – NeuroBeats: a wearable stimulator for Parkinson's disease. To address this need, Team 9 has designed, manufactured, and tested a wearable device, placed on the lower leg, that delivers transcutaneous electric nerve stimulation (TENS) and vibratory stimulus, in synchrony with an auditory stimulus (music).

NeuroBeats

Team 9 *Vanessa Guevara, Kelsey Quevedo, Jose Solis, Jorge Barter*




WEINSTOCK PHYSICAL THERAPY, P.C.

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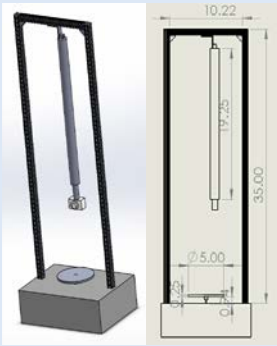
Garrison Gauge

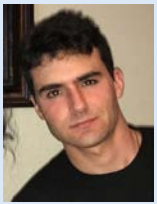
Team 10
Faculty Advisor: Wei-chang Lin
Company Sponsor: Garrison's Prosthetic Services

Maintaining proper fit of a prosthetic device is pivotal to user comfort. Fit of the prosthetic to the residual limb changes over time. In the clinical setting, the inner perimeter of the socket is compared to measurements of the residual limb to determine whether a replacement is required. Prosthetists are hampered by current hand-held technology which is prone to error. The objective of this project is to deliver an automatic gauge that measures the inner perimeter of a prosthetic socket with higher accuracy and precision. The system is composed of two distance sensors attached to an actuator, to take measurements along the height of the socket. Simultaneously, the socket is incorporated into the system by attachment to a base that revolves 360 degrees using a stepper motor. The system is verified through a series of tests that measure range accuracy, axial alignment, and reflectivity.



Team 10 *Joanise Casimir, Caroline Nunez, Alexandra Tchir, Joseph Zatarain*



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THANK YOU
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OR PACE

Auxadyne

NOVA Southeastern University

Dr. Mario Nunez

Garrison's Prosthetic Services

Dr. Mark Rossi, FIU Department of Physical Therapy

NeuroFit 360

OrthoSensor

Weinstock Physical Therapy, PC

Garrison’s Prosthetic Services

ABOUT OUR PROGRAM

The Department of Biomedical Engineering (BME) is part of the College of Engineering and Computing at FIU and is a prime resource for biomedical engineering education, training, research, and technology development. BME is an ever-evolving field that uses and applies engineering principles to the study of biology and medicine in order to improve health care.

Located in Miami, Florida, Florida International University, a Top 100 public university that is designated a Carnegie Highest Research (R1) and Carnegie Community Engaged institution is committed to high-quality teaching, state-of-the-art research and creative activity, and collaborative engagement with the local and global communities. The Department of Biomedical Engineering is ranked among the Top 50 schools providing the best value to students nationally, #1 for bachelor's degrees awarded to Hispanics, and #3 in bachelor's degrees awarded to African-Americans. We are preparing a diverse community of biomedical engineers and are engaged in translation of research to health care applications through discovery, innovation, entrepreneurship, and community engagement.

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Biomedical Engineering