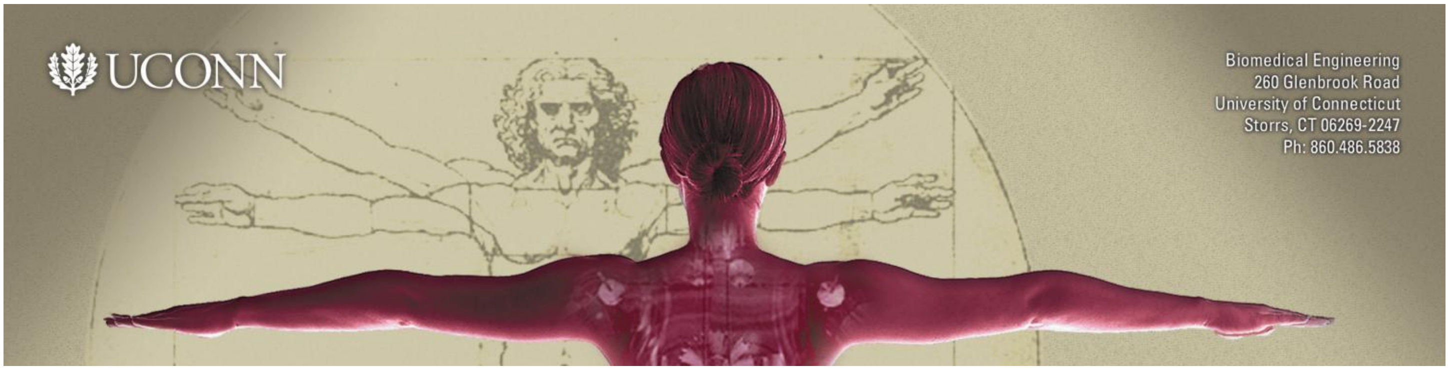

BIOMEDICAL ENGINEERING SENIOR DESIGN DAY

Project Demonstrations
1-4 PM

Friday, May 1, 2009

Student Union Rooms 304 A and C

Biomedical Engineering Program
The University of Connecticut

BME 4900 Senior Design Projects

Team 1
The S-90 Go-Kart
Team Members: James Paolino, Eric Leknes, Alex Jadczak, Tarek Tantawy

Sponsored by the NSF

This project is to design and build a go-kart for a client with severe cerebral palsy. The client has almost no reliable motor control of his body or limbs, ruling out the possibility of him driving traditionally designed go-karts. The idea behind this project is to take the control that he does have and give him the experience of a real go-kart. To do this a go-kart was built from the ground up to meet his specifications.

It has three different modes of control: remote control, joystick control, and steering wheel with pedals control. This will allow the client to use the vehicle on day one, and progress to having more and more control of the go-kart with practice. The vehicle is designed with the client's condition in mind and ensures that his body is positioned correctly for maximum motor control. Since this would be an awkward position for a normal driver the vehicle also is adjustable to allow for a wide range of people to be able to drive it. This go-kart was built from the ground up to meet the client's needs, and it is more versatile and more fun than anything else on the market.

Team Number 2
Standing Gardener and Multi-Terrain Wheelchair
Team Members: Fryderyk Karnas, Robert Knapp, Peter George

Sponsored by the NSF

Sean Stenglein is a ten year old boy with Cerebral Palsy, a condition that can inhibit motor function. Sean wants to participate in activities like other children of his age such as sledding in the snow, going to the beach, or even helping his parents with their gardening, but finds these tasks to be difficult because of his condition. The goal of our team is to create and build two devices (a multi-terrain wheelchair and a standing gardener) to aid Sean in his physical and mental growth, while giving him the ability to participate with his friends and have fun.

Team Number 3
Team Members: Blaine Ericson, Caitlin Martin, Kelly Valentine

Sponsored by the NSF

<u>Project 1. Assistive Jumping Device</u>

The client, Sean, is a ten year old boy with a severe case of athetoid cerebral palsy. A supporting system is necessary in order for Sean to use a trampoline independently. The Assistive Jumping Device (AJD) will stabilize Sean's upper body but still enable him to have full access of his legs to jump. The system is comprised of a harness on a vertical jumping rail to control the user's motion. The rail is then attached to a jib crane for full support of the system. The AJD, thanks to NSF funding, will ensure the safety of the user while still enjoying all the pleasures of trampoline jumping.

Project 2. Travel Computer Mount

Sean's cerebral palsy has left his communication limited to only a few gestures and facial expressions. As a result, he uses a Dynavox touch screen personal computer system to communicate with others. While traveling in a vehicle, there is not a location for the computer, thus making it extremely hard for Sean to convey his needs to those around him. The system attaches to the front passanger seat headrest and allows the user to tilt the computer to the optimal viewing angle. Thanks to NSF funding, the travel computer mount will allow for the computer to be visible and easily accessible to the user in addition to ensuring full communication while in a vehicle.

Team Number 4

Development of Three-Point Bending Device for Flexure Testing of Soft Tissues

Team Members: Mike Harman, Xuan Nguyen, Eric Sirois

Sponsored by Dr. Wei Sun

In this project, we aim to develop a 3-point bending device for flexure testing of soft tissues. The device is intended to accurately characterize tissue stress-strain relationship in the low-strain region (<5% strain) and quantify transmural strain and location of the neutral axis simultaneously. The device can be used to detect subtle mechanical property differences that may exist between native or engineered multi-layered tissues. The stress-strain relationship is useful because it allows the user to predict the response of tissue to an applied load. The location of the neutral axis is important because it allows the user to estimate the contributions of different layers in a multi-layered tissue specimen.

In addition to the primary functions of the device, secondary capabilities are included to maximize the validity and repeatability of the data provided to the user. One secondary function is to provide a stable, physiologically appropriate environment for testing. The other secondary function is to allow for convenient calibration of the force-measuring system. The 3-Point Bending Device features a custom-designed LabView program capable of controlling system hardware, interfacing with the user, and performing the complex calculations required to provide information about the tissue specimen mechanical properties.

Team Number 5

Assisted Leg Holding Device for Medical Procedures

Team Members: Nathan Carvalho, Jonathan Riscica, Jennifer Kleinhans

Sponsored by the SoE

The assisted leg holding device is designed as an easy to use, intuitive, compact, and inexpensive alternative to contemporary leg holders. The device will be safely adjustable to different body sizes and accommodate patient disabilities, such as amputations and movement disorders.

Anti-gravity technology enables staff to position the patient with minimal effort.

Team Number 6
Traumatic Brain Injury Reducing Army Combat Helmet
Team Members: Kristin Ohanian, Jim Veronick, Damian Frankiewicz

Sponsored by the SoE

The Advanced Combat Helmet currently used by the United States Army was mainly designed to protect the head against blunt trauma from projectiles. However, many of the injuries experienced by soldiers in the current wars in Iraq and Afghanistan are due to traumatic brain injuries, not blunt trauma. Warfare practices have evolved from the projectile fire commonly used in previous wars to currently used improvised explosive devices (IEDs). The helmets presently used do not adequately protect soldiers against closed brain injuries sustained from improvised explosive device detonations. Traumatic brain injury is also common among motorcyclists. Many motorcycle helmets in use are an excellent protection from these types of injuries. The proposed project aims to incorporate the design of the much safer motorcycle helmets into to the Advanced Combat Helmet. The goal is to improve upon the current design to produce a helmet that will reduce the risk of traumatic brain injury caused by IEDs.

Team Number 7
Synthetic Abdominal Wall
Team Members: Andrew Preusse, Amanda Ko, Richie Ren

Sponsored by Covidien

A synthetic abdominal wall is used in training for medical professionals to practice surgical skills and in the lab as a device for developing and testing medical apparatuses. Currently, the most common test material is porcine tissue. We would like to move away from animal testing and towards a reusable synthetic model. Our client is Covidien and we have been charged with updating their current representation for a closer imitation to that of its counterpart in vivo. There have been relatively few attempts to improve this device simply because it is secondary in consequence to either surgical training or trocar development. We propose to design an improved model with excellent resemblance to a human/porcine abdominal wall for its environmental impact on animal testing as well as its reusability. Our model will have a four layer design imitating specific layers of the abdominal wall. The skin will be represented by a mixture of silicone rubber and rubber fill. Vinyl will be used to mimic fat. The material used to simulate the muscle layer will be polyacrylonitrile (PAN) fibers, and thermoplastic polyurethane will be the superficial fascia layer.

Team Number 8
Shoulder Simulator
Team Members: Sean Frenette, Manraj Singh, Sajal Swaroop

Sponsored by Covidien

The shoulder simulator is to be used as a surgical practice tool to recreate entering the shoulder joint. The simulator will reduce the need for cadavers as well as animal use in surgical practice techniques. Covidien has an immediate need for simulating the entering of the joint space. The tissue layers of the shoulder (skin, muscle, and bone) will be recreated using materials that have similar mechanical properties to the real tissues. The layers will also be easily replaceable and the entire model will be watertight to allow for insufflation. The user will be able to make an incision in the outer layer and insert a cannula or endoscope into the cavity. The deeper tissue layers will provide the resistance and feel of entering the joint space. The user can then place screws, anchors, or other devices just as in a real arthroscopic surgery.

Team Number 9
Force Glove
Team Members: Kevin Seekell, Angela Gilbert, Maria Rodriguez

Sponsored by Covidien

The Force Glove is a convenient device used to measure the forces generated during the insertion or withdrawal of a trocar. A trocar is used in laparoscopic surgeries to puncture through the abdominal wall and provide access into the body for other types of surgical instruments. Inserting the trocar with too much force introduces a risk of injury to the patient. So, knowing the maximum forces needed for insertion and withdrawal is a key safety measure when using trocars. The Force Glove uses four sesnsors located on the fingers and palm in order to measure these forces. Having these sensors integrated into a glove allows the user to hold the trocar as they normally would during surgery. A casing strapped onto the user's forearm contains an LCD screen and Bluetooth module. The LCD screen displays the maximum forces measured at each sensor while the Bluetooth module sends all of the measured force values wirelessly to a nearby computer to be graphed and saved using LabVIEW. The Force Glove allows for the accurate measurement of forces during trocar insertion and withdrawal without impeding on the user's grasp on the surgical tool

Team Number 10
Burst Testing Device
Team Members: Jeff Ott, Kevin Rocco, Kyle Benedict

Sponsored by Covidien

The burst-testing device will examine wound closure strength through a bursting method. This device will be suitable for the testing of surgical staples and sutures. The optimal design is a wet test which uses two plexiglas chambers with the sample medium in between creating an impenetrable barrier from which a burst test can be run. Using LabVIEW automation for the test, the optimal design makes use of cameras and pressure transducers to run the test, recording its entirety, and developing results without use of a researcher. The design allows for different materials to be tested, allowing both live and synthetic colon materials to be used, which will help determine the usefulness of the test. A pressure system controlled by LabVIEW will implement pressure until failure of the wound closure is detected by the cameras. The burst testing device allows for repeatable and reliable results of wound closure strength.

Team Number 11
Biomechanical Testing of Continuously Sutured Wound Closures
Team Members: Michael Sedlack, Emily Jacobs, Jessica Bruno

Sponsored by Covidien

The surgical device company, Covidien, is in search of a novel testing fixture and method to evaluate the biomechanical properties of continuously sutured wound closures. The senior design team has developed a testing system that incorporates a pressure chamber with an inflating polyurethane sheet. The sutured sample lies over the inflating sheet and over a force sensor. The force that the sutured sample can withstand is measured and recorded. This system will provide Covidien with a true-to-life simulation of suture failure and accurate force values.

Team Number 12

Title: Stimulating Bone Growth Using Piezoelectric Ultrasound Transducers in Dentures

Team Members: Matthew Eschbach, Robert Sterling Nesbitt, Joseph Ouellette, Sarah Roberge

Sponsored by Dr. Shiva P. Kotha

The purpose of this design is to create a device that will maintain the integrity of the mandible and maxilla for people with edentulism. Since people with edentulism do not have teeth to provide mechanical force to the bone, the bone starts to resorb. When bone resorbs it becomes weaker and is therefore more susceptible to fracture. The device will use ultrasound transducers to maintain the bone. Ultrasound mechanical energy will propagate through the gums and into the bone. This propagation will provide mechanical stress stimulus to the bones causing bone growth.

The design utilizes a mouthpiece with fitted transducers that were custom built using barium titanate as the piezoelectric material. Using an amplifier circuit the transducers run on a simple 9V rechargeable battery.

The signal is then run though one of five oscillators, selected using a knob, that produce the desired frequency of the output signal.

To prove the effectiveness of the transducers and find the optimal transducer frequency, tests will be performed on BetaGal mice. The transducers will be applied directly to the jaw of the mice once a day for ten minutes for a span of 30 days. Two trials will be done to ensure the accuracy. Afterwards, the mice jaws bones will be stained for the enzyme Beta-Galactosidase, which the mice have been genetically altered to synthesize when bone growth occurs. The results from these tests will determine the optimal frequency for bone growth.

The Biomedical Engineering (BME) Senior Design course is intended to engage students in a meaningful experience by bringing together concepts and principles learned in the biomedical engineering curriculum, extend this theory to practical application, then to plan and construct a finalized product.

This experience is comprehensive, reflecting all aspects of the engineering design process along industry guidelines. Problem solving for large-scale, open-ended, complex and sometimes incompletely defined systems is the primary emphasis of these courses.

Students use the web to describe and report progress on their project. Students have also utilized the web to facilitate communications with other universities in joint projects. The Senior Design homepage is located at:

http://www.bme.uconn.edu/bme/ugrad/bmesdi-ii.htm

Interested individuals are welcome to visit this site to experience first-hand what BME senior design is all about.

For more information regarding the BME Senior Design course contact:

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