BIOMEDICAL ENGINEERING
SENIOR DESIGN DAY
Friday, December 5, 2008

Project Presentations: 1 to 4 PM
United Technologies Building (UTEB), Room 150

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
The S-90 Go Kart project is an off-road go-kart designed specifically for Sean Stenglein, a 10 year old boy with cerebral palsy. The go-kart has power steering, brakes, shifting and throttle control so that Sean can use it with his limited mobility. The vehicle can be controlled using a steering wheel and pedals, a joystick controller, or a long-range remote control. The remote control will ensure that even with no training, Sean will be able to enjoy the thrill of off-roading while his parents drive wirelessly. The vehicle also has all proper safety equipment built in.

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
Project 1. Assistive Jumping Device
Sean is a ten year-old boy suffering from 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 with. The AJD will ensure the safety of the user while allowing him to enjoy all the pleasures of trampoline jumping.

Project 2. Dynavox Travel Mount
Sean uses a Dynavox touch screen personal computer system to communicate with others. While traveling in a car, there is no location for the computer, thus making it extremely hard for Sean to convey his needs to those around him. The Dynavox Travel Mount will allow for the computer to be visible and easily accessible to the user and to ensure full communication while in a vehicle.
Team Number 4
Three-point bending device for flexure testing of soft tissues
Team Members: Mike Harman, Xuan Nguyen, Eric Sirois
Sponsored by Dr. Wei Sun
In the development of implantable devices that interact mechanically with the body's native tissue, simulations between implant and host are often developed. The accuracy of these simulations depends heavily on the level of detail used in the characterization of any tissue involved (both the host tissue and any tissue present in the new device, as in bioprosthetic heart valves). For this reason, a request is made by the Biomechanics Lab at the University of Connecticut for the construction of a three-point bending device. This device is capable of performing flexure testing and calculating the flexure rigidity, bending stiffness, transmural strains, and transverse shear stiffness of soft tissues. It will be controlled primarily by a LabVIEW program, which will provide an easy-to-use interface for the users.

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 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
A trocar is a useful surgical instrument for laparoscopic surgery as well as the injection or extraction of fluids from the body. One method for testing the performance of a trocar is to measure the force it exerts on the tissues during insertion and withdrawal. The greater the force applied, the less control the user has over the instrument. Therefore, to maximize safety, it is necessary to understand the forces created by the trocar and try to reduce them. The company Covidien has already developed a force measurement device for trocars. However, the device is quite bulky, and does not allow the surgeon to hold the trocar.
properly during the operation. Also, a new nest (the component used to assemble the entire device) must be designed and built for each individual type of trocar. Finally, the device can only measure forces exerted parallel to the trocar. A new force measurement device will be designed and built in order to solve these problems. The size of the device will be minimized to ease its use. A force glove device will be built that will contain force sensors at various regions of the hand and will measure the forces upon insertion and withdrawal of the trocar while allowing for increased control for the user. This will eliminate the need for the design of nest for each specific trocar type and result in a much more effective device for measuring the performance of trocars.

Team Number 10
Burst Testing Device
Team Members: Jeff Otto, 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
Title: Biomechanical Testing of Continuously Sutured Wound Closures
Team Members: Michael Sedlack, Emily Jacobs, Jessica Bruno
Sponsored by Covidien

The objective of this design project is to provide Covidien with a testing method and device to test the biomechanical properties of continuously sutured wound closures. It is critical that the properties of the knots of the suture be included in the testing, while keeping the amount of intact/healthy tissue being tested to a minimum. A pressure sheet system will be employed to accomplish this goal. A polyurethane sheet will be inflated under the sample containing the sutured incision. Pressure from a pump will be applied until the suture breaks. The pressure and force at which the suture fails will be recorded. This design simulates a realistic scenario and attempts to create a standard testing procedure for continuously sutured wounds.
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. Individuals with edentulism do not have teeth to provide mechanical force to the bone, causing it to resorb and become more susceptible to fracture. This device will use ultrasound transducers to provide mechanical stress stimulus to the bones, causing bone growth. The goal is to create transducers that will be powered by a circuit with a rechargeable power supply. The transducers will be custom built, using barium titanate as the piezoelectric material. They will then be put inside of a mouthpiece, which will be worn for a short time daily to prevent bone loss. To prove the effectiveness of the transducers and find the optimal transducer frequency, tests will be performed on BetaGal mice. The results from these tests will determine the appropriate frequency for a human device. Once this is finished, human transducers will be produced for the final prototype.
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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