

## Proposed Capstone Projects for Winter-Spring 2010

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### John Deere Capstone Projects (2):



#### **Power Take-Off (PTO) Model for Co-Simulation and Controller Development** Company:

Description: Modern drivetrain components are complex systems, with physical elements and software controlled electrohydraulics. Developing these systems requires input from mechanical and electrical or software engineers. Numerical models allow the performance of the system to be analyzed and optimized before expensive prototype hardware is build. In some cases, these models are also used to develop and test proposed control algorithms for the systems.

Drivetrain Engineering uses Easy5<sup>TM</sup> software from MSC Software as the primary simulation tool. This software allows the physical characteristics to be modeled in great detail. The Drivetrain Electronics (Controls) group would like to use the control software (written in C++) as an input to the model to allow analysis and tuning of control algorithms, a function that is not well supported by Easy5. A simpler model of the PTO system created with Matlab/Simulink would be able to use the C++ code as an input, and allow the control tuning to be done numerically, rather than with physical hardware.

- Sophisticated and complex models of typical Deere PTO systems are available in Easy5.
- Control software is available in C++.
- Easy5 does not readily allow direct use of control code to drive the model
- Easy5 and Simulink modeling approaches are somewhat different, preventing a direct or simple translation.

Deliverable: Simulated Prototype Model with validated test results

Technology: CAD Modeling, Matlab/Simulink modeling, Controls, C++

Disciplines: ME/AgE (2-3), ECE (1-2)

## Honda Capstone Projects (3):



### 1. Portable Water Purification System

Company:

Description: A portable water purification system is needed to produce potable water. The contaminated water will include chemical or biological contaminants that will need to be removed to produce drinkable water. The purification system will use existing technologies to eliminate the given contaminants found in the Scioto River. Power for the system will be supplied by a gasoline powered generator. The system will be portable, robust and easy to assemble in the field.

Deliverable: Prototype

Technology: Mechanical Design, Water Purification Techniques

Disciplines: ME/AgE (3), BioE/ChE (1)

### 2. Metal Stamping Part Deformation Evaluation

Description: Surface deformations on the outside contour of exposed car body parts are very important to car quality. These deformations need to be identified early in the process of the assembly of the car. In particular, the identification of these deforms is important in the metal stamping quality inspection process to correct the source of the defect. In addition, physical criteria need to be defined for these deforms to classify deforms as acceptable or unacceptable. Once this physical criterion is defined, an inspection process needs to be developed to detect and identify unacceptable parts.

Deliverable: Evaluation Process, Criteria Classification

Technology: Measurement Methods, Six Sigma, Manufacturing Processes

Disciplines: ME (2), ISE (2)

### 3. Metal Stamping Defect Detection System (ABIS) Evaluation

Description: The automated vision system to detect metal stamping deformations needs to be assessed for HAM to put into the inspection process. The automated vision system (ABIS) needs to be evaluated and compared to the current quality inspection process of metal stamping parts. The system will need to be evaluated on its ability to identify a defect based on its physical characteristics (i.e. size, shape and depth) and location. In addition, the system will need to be tested for consistency of locating and reproducing the physical characteristics of the deformation.

Deliverable: Evaluation Process, Criteria Classification,

Technology: Measurement Methods, Six Sigma, Software

Disciplines: ME (2), ECE (2), CSE (1)

### **Rockwell Automation Capstone Project (1):**



#### **1. Thermal Solutions for Industrial Electronics**

Company:

Description: TBD

Deliverable: TBD

Technology: Industrial Electronics, Thermal Sealing

Disciplines: ME (3), ECE (1)

### **Rolls Royce Capstone Project (1):**

#### **1. Mold Etch and Wash Automation System**

Company:

Description: TBD

Deliverable: Prototype

Technology: Mechanical Systems, Controls, Automated Equipment Programming

Disciplines: ME (3), ECE (1)

## **Replex Plastics Capstone Project (1):**

### **1. Efficient Solar Cell**

Company: Replex is a privately owned manufacturer of convex mirrors and domes, optical domes for security cameras, and playground domes. Replex has a significant interest in applying their technology and knowhow to enter the solar energy market.

Description: Replex has shown that current solar technology is generally not commercially viable due to the large area of real estate required to produce energy. Replex has a concept to develop a high-density solar energy conversion system by applying their mirror technology and expertise to develop a practical, cost-effective, and durable solar energy conversion module that can be mounted on “free” real estate such as roof tops. The heart of the technology is the solar mirror which will magnify the sun’s energy in a way that makes cost-effective use of the light energy environment in the Midwest which includes a large amount of scattered rays and a significant number of cloudy days.

Deliverable: Prototype

Technology: Solar Energy, Product Market, Engineering Physics

Disciplines: ME (2), ECE (1), MSE (1), MBA (1)

## **L-3 Communications Nova Engineering Capstone Project (1):**

### **1. Miniature, Low Power Pan/Tilt Mechanism for a Camera**

Company: L-3 Nova Engineering, a division of L-3 Communications, develops and manufactures state-of-the-art wireless data communication systems, including ad hoc mesh network mobile routers, unattended sensor systems, flight test telemetry devices, advanced waveform implementation and software-defined radio systems primarily for military field applications.

Description: Unattended cameras may need adjustments in horizontal and vertical field of view following emplacement. While several commercial products exist that provide this capability, the current offerings can be substantial in size and power consumption. The goal of this program is to develop a small, low-power pan/tilt mechanism that can be controlled from a remote location. L-3 Nova Engineering can provide a modest amount of funding for purchase of hardware required by this program. L-3 Nova Engineering will also provide background on the intended application and will consult on a weekly basis with the project team.

Deliverable: Prototype

Technology: Servo control systems, Product Market Analysis

Disciplines: ME (2), ECE (1), MBA (1)

## **COSI Capstone Project (1):**

### **1. Zula Science Station Exhibit Design**

Company: COSI is one of the premier science centers in the country and is focused on creating an educational, hands-on environment for visitors of all ages to better understand science, industry, health, and history.

Description: Recently, COSI has been testing the feasibility of replicating small, cost effective exhibitions that are designed around a series of content themes related to the Zula Patrol. We are calling these exhibitions “Science Stations.” The target customers for the Science Stations are science centers, children’s museums, libraries, planetariums, daycare facilities and schools. For this project, COSI wishes to design and manufacture a new interactive exhibit which fits on our “Science Station” platform.

Science Stations are portable units in which all the interactive components that sit on top, fit in the unit when it is being transported. The Science Station must be self contained, use no electricity (except possibility batteries) and most importantly they do not require facilitation. Interactives typically take up ½ the top of a Science Station with a graphic panel separating the two sides. The units are designed for both indoor and outdoor use, and they must be able to withstand extreme temperature changes and the elements. Activities must not be too heavy (typically less than 100 lbs.), and the components must be able to handle the shock, stress and vibrations associated with constant travel and visitor use. All components must be capable of mass production, and the total cost (parts and labor) for building each Science Station should be in the \$2,000 to \$3,000 range.

We have three exhibit ideas from which we would like you to choose two for development of a Science Station:

- Hydrogen Ping Pong Ball Launcher (A ball launched by igniting hydrogen and oxygen)
- Freeze/Thaw (A demonstration of how freezing water can impart great force)
- Divided By Percentages (A visual/interactive graphic showing the chemical makeup of air.)

Deliverable: Design drawings, Graphical material, Working Prototype

Technology: Mechanical design, industrial design, materials, human factors

Disciplines: ME (2), Ind Des, ISE

## **Weldon Capstone Project (1):**

## 1. TBD

Company: Weldon, a Division of Akron Brass, designs and manufactures lighting devices and custom electrical control solutions for specialty vehicle markets such as school buses and emergency vehicles.

Description: TBD

Deliverable: Prototype

Technology: TBD

Disciplines: TBD

## Via Performance Capstone Project (1):

### 1. Servo-controlled exercise equipment

Company: Via Performance is a start-up business affiliated with Lemonade Neighborhood Fitness. Via has developed a software system and sensor interface that, when integrated with a piece of exercise equipment, allows the programming and tracking of user exercise and fitness regimes.

Description: To fill niche in the market and to create a complete programmable exercise system, Via wishes to develop a servo-controlled exercise piece that has the ability to interface with the software system and can provide iso-tonic (constant force), iso-kinetic (constant speed), and iso-metric (constant force, zero displacement) modes. Furthermore, this piece must accept commands from the Via software and provide sensor feedback including force, displacement, and time.

Deliverable: Business analysis and Prototype

Technology: Business development, Servo control systems, ergonomics

Disciplines: ME (2), ECE (1), MBA (1)

## Lake Shore Cryotronics, Inc. Capstone Project (1):

### 1. TBD

Company: Lake Shore is a privately held corporation which has been an international leader in the development of innovative measurement and control technologies since 1968. They supply a range of cryogenic temperature sensors and instrumentation which have been expanded in the last ten years to include instrumentation and systems for studying magnetic properties of materials.

Description: Lake Shore manufactures a hand-held gauss meter (Model 410) which is an important but low-volume product. They would like to repackage the product to reduce cost and modernize the ergonomics in order to reposition this in the market and increase their sales volume and gross margin. This repackaging does not include redesigning electronics, software, or basic functionality. The repackaging will include the design of the basic instrument enclosure, the probe (both direct and remote mount), literature, and carrying case.

Deliverable: Product design documentation, prototype

Technology: Packaging design, manufacturing cost analysis, market analysis, Industrial design

Disciplines: ME (2), Ind Des, MBA