Project Descriptions – Senior Design – Fall 2016

Leader Dogs for the Blind – Puppy Transport Unit

Puppies less than 5 lb, and especially puppies born via Caesarian section, cannot adequately control their body temperature in the cold, making transport very risky in inclement weather. For socialization reasons, puppies need to be in physical contact with their litter mates, and should not be separated for long periods of time. Litters sponsored by the LDB are whelped at residential homes and periodically need to be transported to the LDB veterinary facilities. For these reasons, a safe and convenient puppy litter transport unit was required that developed and maintained its internal temperature.

In the Winter 2015 semester four design groups took on this challenge and developed four different versions of a litter transport unit. Two examples of each were delivered to the LDB for use and evaluation. After more than a year of use, the LDB veterinarians have chosen the design they like best (shown below), with the following feedback:



- The features of this unit that the LDB staff likes includes: all components restricted to the lid, no components accessible to puppies, good size, lightweight, use of a car charger, window allows viewing of puppies without opening (and cooling) the unit.
- Features of all units that did not work well: metal components (including screws) quickly corroded when exposed to harsh cleaning chemicals, temperature settings and controls were not accurate, switches and buttons were bumped when handling the units.
- The new units must be stackable. They are used primarily during the winter months, and ease of storage during the remainder of the year must improve.
- Accuracy and control of the temperature settings must be improved, with switches and buttons that cannot be easily bumped when handing the units.
- Clear and concise instructions must permanently be affixed to the unit, in a way that also resists the cleaning chemicals.

The group(s) working on this project will begin with the design reports and models from the Winter 2015 semester, incorporate the feedback from the LDB veterinarians, then build, test and deliver at least 4 new, upgraded transport units by December 6, 2016.

Leader Dogs for the Blind – Transport Carts

In the Winter 2016 semester, several senior design groups collaborated to design and build three carts that would be used by LDB staff to transport anesthetized dogs between surgery, x-ray and their kennels. The carts that were built feature rechargeable electric lift mechanisms, foldable sides and 4-

way pivoting wheels for maximum maneuverability. The carts were designed in close collaboration with the LDB staff and have been in constant use since April 2016.

After using the carts, the LDB staff would like the design, and the three existing carts, modified in the following ways:

- Have the front wheels pivoting, back wheels non-pivoting (like a shopping cart).
- Hydraulic foot lift, not the current battery or electric
- Able to utilize gurney to lift dogs from cart to their kennel cage
- Defined sides to keep awake dogs from moving off cart
- Collapsible side of cart to slide dogs into village kennels instead of lifting
- Keeping length and width to the minimum so we are able roll cart into 5' x 8' suite (door 32" opening)
- Non-marring surface edging to protect doors and frames of the building

It will be important to work closely with the LDB staff to determine the exact reasons for these modifications and to develop a cost-efficient plan to accommodate their needs.

Na4B Test Fixtures

Na4B is a small start-up company located in the OU-INC business incubator. They have developed technology for high-quality, robust grid-scale sodium metal (Na) halide batteries. These batteries operate efficiently at fairly high temperatures, up to about 350 C. Currently, the test cells are assembled and tested within an environmentally sealed glove box, which prevents more than one cell from being tested at a time.

In order to further the development of their product, they are in need of modular test fixtures of two distinct types:

Gas-tight container for one electrochemical cell (disk shapes, 10-20 mm thick and either 100 mm in diameter or 80-90 mm square) that can be assembled within a glove box. This container (Pyrex glass is proposed, but other materials can be considered) must be able to be sealed (argon containment) and locked without tools and while wearing gloves, must insulate the electrochemical cell, be able to accommodate heating to 350C and provide the necessary electrical pass throughs for subsequent battery testing.

Oven cabinet for one or more gas-tight containers. This cabinet must provide a safe, uniform temperature distribution for testing the electrochemical cells. It is proposed to use the Delta DTC temperature controller (will consider alternative PID controllers), must use a solid state relay to switch the heating elements on and off, program touch panel for parameter input and control, and allow connectivity for remote control from PC.

Both of these projects will establish specifications, produce work instructions for testing, propose alternative drafts with pros and cons, determine and document the final designs using decision matrices, create a parametric CAD models, and create bills-of-materials (BOM) providing all engineering and commercial information.

Oscillo Drive Modeling and Testing

Wave Water Works is a local small business with a unique, patented product called the *Oscillo Drive*. This interesting transmission takes an oscillatory rotational input and converts it to a unidirectional rotational output, without the use of springs or levers. This enables the Oscillo Drive to work in any physical orientation and it can be easily scaled from keychain size to large industrial applications. It has been developed primarily to capture the energy of water waves, but other potential applications are also sought.

This project will consist of the following:

- Model (in Catia or SolidWorks) the Oscillo Drive mechanism, analyze the model for stress and mechanical efficiency, and produce high-quality animations of its operation.
- Develop a bench test system that will (1) produce an oscillatory (variable frequency and amplitude) motion (2) to be used as input to a supplied Oscillo Drive transmission (3) driving a low-speed generator. The input and output power (among other parameters) of the test system will be measured and recorded for up to 1000 continuous hours (42 days).
- Explore and compare wave energy capture with the Oscillo Drive to other forms of energy production (fossil fuels, solar, wind, etc.).
- Explore and propose other applications and or markets for the Oscillo Drive transmission.
- Explore and propose improvements to the Oscillo Drive system.

LogiCoul Solutions – Continued Development

LogiCoul Solutions' Interfacial Process Stimulation IPS ™ technology is used to lower a storage battery's internal resistance and create more energy transfer sites at the interface between electrolyte and electrodes. Reducing the internal resistance of a storage battery leads to faster charging, a key feature for lead acid batteries in order to enhance fuel savings and lower operating temperatures, which in turn can save cooling costs in large EV battery packs, and additional energy can be extracted for longer run times between charges.

IPS is achieved by introducing electric currents of variable frequency, intensity and duration. The frequencies used are mainly in the audible range; each type of battery has a specific pattern of the IPS signal. The effect of the right parameter set results in a substantial reduction of the internal resistance of the battery. This internal resistance can be measured in different ways. LogiCoul uses impedance spectroscopy (EIS) to determine the internal resistance by measuring the intercept of the high frequency branch of the curve with the real axis of a complex Nyquist plot.

A previous OU senior design team rebuilt and partially documented an older IPS signal generator, allowing LogiCoul to begin working with Li Ion batteries from a large Tier 1 automotive supplier. LogiCoul intends to use the result of this project as an initial blueprint for a stand-alone production device, designed to be integrated with a battery management system.

The project proposed for the Fall 2016 semester consists of:

- Familiarization with LogiCoul's current testing and data analysis procedures; run tests and measurements on lithium-ion batteries using the existing signal generator
- In order to automate the test process and minimize human interaction, design and implement an interface between the signal generator, its controlling computer and the EIS measurement equipment
- Complete and implement a standalone IPS circuit design begun in the previous semester, with the following goals:
    - minimize the number of components while providing the current level of functionality for research and development
    - portable, that so it could be transported to a customer lab for tests.
    - allow variation of the IPS parameters: frequency, duration, amplitude; allow frequency superposition and the use of sinusoidal, triangular and square waves

Non-disclosure and non-compete agreements are required before students can commence work on this project.

Serapid – Rigid chain sprocket parameterization and optimization

Serapid Company is the rigid chain technology specialist. Our know-how allows the transfer of load (light or heavy) by pushing or pulling. Our products are able to work as well as for horizontal loads (for example: moving a carrier) and for vertical loads (for example: lift platforms). It is a mechanical technology replacement for the hydraulic jack.

In order to move the chains, our driving system is composed of sprockets or gears. We have multiple driving systems so we can use our products chain for vertical or horizontal load but also depending on the characteristics such as speed and vibration.

The technology has been developed and refined, but is in need of parameterization and optimization. The specific project is to define the perfect path of the chain using an involute circle sprocket profile for a 90° driving system. The deliverables should include, if possible, a Solidworks sketch with the integration of formulas with chain parameters (roller diameter, number of teeth, chain pitch). The final report will include descriptive geometry to allow fast design and development of future configurations.

Non-disclosure and non-compete agreements are required before students can commence work on this project.