

ILLINI HYBRID RACING

January 2011

Newsletter

Team members attend Mahomet Science Day

The team attended Mahomet Science Day at Lincoln Trail Elementary where they taught 3rd through 5th grade students about energy conversion and hybrid vehicles.

Team members designed and constructed a demonstration platform that consisted of a heavily weighted wheel, a generator, and an interesting set of loads. With this setup, elementary students had both an entertaining and educational experience as they spun up the wheel by hand, then recaptured the kinetic energy of the wheel through the generator, and finally converted it to other forms of energy such as motion, light, and sound using the various loads.

The children got a hands-on experience they really enjoyed, while also getting a truly tactile feel for how regenerative braking works. Six team members attended the event and taught a total of 6 classes of 3rd through 5th graders. Illini Hybrid Racing members described the experience as both



Lincoln Trail Elementary student learning about energy conversion

fun and rewarding, and with the regenerative braking demonstration rig complete, look forward to more opportunities to teach younger generations about energy conversion and hybrid vehicles.

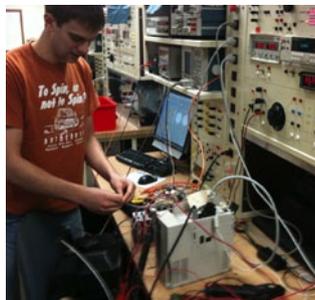
Yaskawa Electric Becomes Orange and Blue Partner



Throughout last season, Yaskawa Electric was an invaluable supporter of the University of Illinois Formula Hybrid Team. The success of our first season would have undoubtedly been far more difficult without their generous contributions of both product and consultation. This season, the team is very excited to not only enjoy Yaskawa Electric's continued support with both product and technical support, but also a significant increase in in-kind donations from Yaskawa's impressive line of power electronics and electric machinery.

Edward Tom, a Drives Application Engineer at Yaskawa Electric, provided substantial as-

sistance in aiding the team to select a variable speed motor drive to power our modified AO Smith E317 induction motor. Mr. Tom also aided in the selection and acquisition of the servomotor and servomotor drive that will provide the vehicle's onboard power generation when coupled to our Briggs and Stratton racing engine. The team recently received the two state-of-the-art A1000 motor drives, two high efficiency Sigma-5 rotary servomotors, and two SGD V Servo Amplifiers. The redundancy of equipment will both protect the team from failures at competition and provide a unit for bench testing and software development on campus.



Team member interfacing servo amplifier with servo motor and National Instruments CompactRIO

All the members of the University of Illinois Formula Hybrid team would like to extend our great appreciation to Yaskawa Electric, our latest Orange and Blue Partner. Yaskawa joins our other Orange and Blue Partners, which include the Motorola Foundation and National Instruments.

Gamma Technologies provides simulation software and training

Gamma Technologies became one of the Illini Hybrid Racing team's newest sponsors providing both heavily discounted access to their modeling and simulation software and a full day of free training at their Westmont, IL offices. With their generous contribution, the team received the software package GT-Suite, which is a single software tool for modeling and simulation of systems in automotive and transportation engineering. The software contains numerous applications including engine performance modeling, acoustics of intake and exhaust, and fuel injection systems, to name just a few.

Five team members visited Gamma Technologies and were trained specifically with regard to the Hybrid Electric Vehicle Modeling application. From their full day of training, they attained valuable knowledge on the use of the application, and are working to pass this training along to other team members. GT-Suite will certainly prove a valuable simulation tool as the team searches for both low-cost near-term improvements and long-term substantial design modifications. Once again, a special thanks to Gamma Technologies.



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Profile of the month

2011 ORANGE AND BLUE PARTNERS

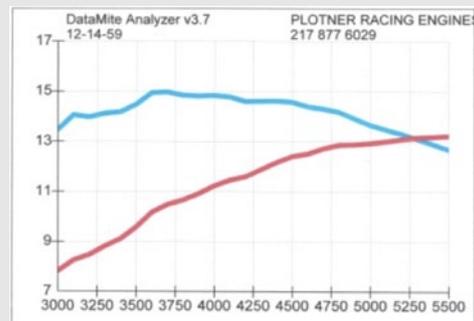


motorola foundation



Engine Dynamometer Testing

To verify the specifications of the 2010-2011 UIUC Hybrid Car's power plant, the Briggs and Stratton 206cc Animal engine required dynamometer testing. After a good deal of searching for an appropriately sized dynamometer, the team was put in contact with Mr. Mark Plottner of Decatur. Mr. Plottner is an avid go-kart racer



Dynamometer data compliments of Mark Plottner

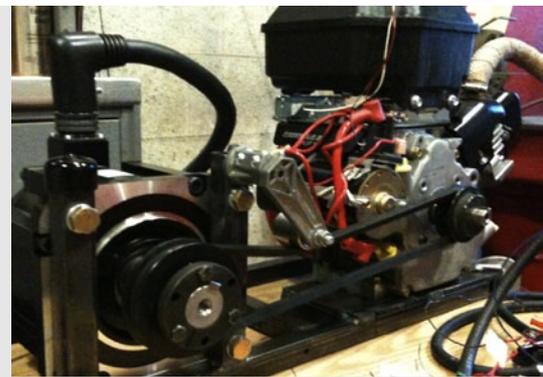
with numerous wins to his name. He also recently acquired a professional grade go-kart inertial dynamometer equipped with a 300lb steel disk. This dynamometer was ideal for initial testing of the Animal engine.

The engine delivered an indicated peak 13.3 hp and 15.0 ft-lbs of torque. These figures signifi-

cantly eclipsed the advertised power and torque of the B&S Animal engine (8.0 hp and 10.5 ft-lbs of torque). The UIUC Animal engine is a factory direct hybrid of the Briggs and Stratton Animal and World Formula engine components. The World Formula engine slots right above the Animal in B&S's go-kart engine lineup and its better flowing head and higher compression piston as installed on the UIUC engine likely contributed to some of the gains seen in our dynamometer test. Fuel consumption data has yet to be collected to determine at what cost the UIUC Animal engine achieves the increased power output. Regardless, the dynamometer data conducted with Mr. Plottner provided encouraging results. A special thanks to Mr. Plottner for his time and the use of his dynamometer in order to conduct this test.

Our own dynamometer testing rig

In order to collect more elaborate performance data on the engine-generator system, the team has constructed a bench top dynamometer using the vehicles generator and a resistor bank. Members from the Engine, Chassis, Control Systems, Power Electronics, and Electric Machinery teams collaborated in order to build the very solid rig. The Briggs and Stratton Animal Racing Engine is coupled mechanically to the Yaskawa Sigma-5 Servo motor using a belt and pulleys. With a LabView user interface and our National



Briggs and Stratton engine coupled to Yaskawa servomotor for testing

Instruments cRIO, a speed reference is delivered to the Yaskawa SGD Servo Amplifier. The amplifier, in turn, applies the proper 3-phase current to the generator to achieve the necessary torque on the engine and maintain the speed. The engine throttle is then actuated using the same Labview interface via a small servomotor attached to the Animal's throttle cable. The whole system very closely models the actual vehicle power plant, and provides valuable fuel-to-battery pack efficiency vs. power output data. The servo amplifier provides an output of both RPM and estimated torque. This data will allow the team to optimize the hybrid system for the endurance event. The dynamometer is near completion and should provide valuable data in the near future.

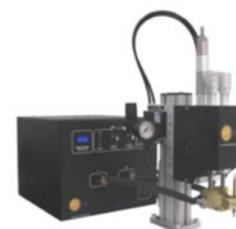
University of Illinois increases support to Formula Hybrid

The Formula Hybrid team has received increased assistance from the University of Illinois Engineering Design Council, the Student Organization Resource Fee (SORF) board, and college of engineering departments, totaling nearly \$24K this season.

Based on a proposal and presentation to the University of Illinois Engineering Design Council, the team was awarded \$12,200 in matched funding as well as another year of access to the Engineering Student Project Lab where much of the design and construction takes place. While corporate in-kind donations provide substantial assistance in helping the team reach competition, attaining monetary support can be especially challenging. The matched funding is a huge help towards fulfilling the yearly budget, and the ESPL workspace really makes the whole project possible. A special thanks to the Engineering Design Council for seeing the educational value of

students participating in this outstanding competition!

We have also been fortunate to receive generous assistance from both the SORF board and the Electrical and Computer Engineering (ECE) department. SORF is a program started in 1978 to support student activities and programs. Their main premise is to provide funding in a variety of categories from travel expenses to equipment fees, and has been vital in our purchase of a 320 watt-second dual pulse spot welder procured from Sunstone Engineering. This machine will allow us to make accurate, clean and strong welds to our batteries, providing better performance and improved safety. SORF will cover \$5,000 of the \$7,000 cost of the battery welder and provide an additional \$750 in assistance for the \$1,500 competition fee. The department of Electrical Engineering has donated \$5,000 to assist with general materials, equipment, machining, and



Sunstone Engineering battery welder

travel costs. Special thanks to the SORF Board and the ECE Department!

Finally, we would like to thank the Mechanical Science and Engineering department for their gracious contribution of \$1,000 and their continued support of the Illini Hybrid Racing team. The donation will enable us to purchase tools and materials necessary for the production of the final vehicle.

Continental provides support

This season the Formula Hybrid Team received a gracious donation from Continental AG of \$500. The Hybrid Electric Vehicle division of Continental offered to provide equipment pertaining to the electric powertrain; however, with a powertrain already defined, a monetary donation was deemed the most advantageous solution this season. Continental has an exhaustive history of supporting everything from athletic sports (specifically the FIFA World Cup) to professional motorsports and we were happy to be able to establish a relationship with them. We are most thankful for their support.



Dynapar provides optical encoders

Illini Hybrid Racing is proud to welcome Dynapar to the team! Dynapar has generously committed two of their HSD25 Harsh Duty Optical Encoders. This robust encoder will be used to provide the speed feedback from the drive motor to the A1000 motor drive. It is this feedback that enables torque control, and gives the accelerator pedal a very intuitive feel. The HSD25 was designed specifically for high shock and vibration environments, so it should feel right at home in our hybrid racecar! Special thanks to Rafi Wilkinson, from Dynapar, for making this sponsorship possible. The team looks forward to showcasing their encoders at competition.



Dynapar HSD25 Optical Encoder

Airtech provides carbon fiber and vacuum bagging materials



The Formula Hybrid international competition requires all vehicles to have a body that covers the chassis in such a way that there are no openings into the driver compartment except from the top. In order to fulfill this requirement without adding excess weight to the car, the team decided to design and construct a carbon fiber body. We would like to thank Airtech International for their generous carbon-fiber cloth and vacuum bagging materials donation. This donation will enable the team to make a lightweight

carbon fiber body using the Vacuum Assisted Resin Transfer Molding process. This process uses vacuum-sealing in order to remove air and voids from the carbon fiber cloth and force layers of carbon fiber against each other for better resin-fiber bonding. The two opening setup, one opening for air to be sucked out using the vacuum pump and the second for resin to be induced into the fabric from an external source, enables excellent control over the strength-to-weight ratio of the final product. Once again, thank you Airtech for becoming one of our newest supporters!



Plymouth Tube Company gives plant tour and donates tubing



On Friday November 19th, one member from each of the University of Illinois's Baja, Formula, and Formula Hybrid teams headed to Streator, IL to visit the Plymouth Tube Co. Alloy and Carbon Seamless Steel Tubing plant. Upon arriving, the three were given a thorough tour of the facility and the seamless steel tube drawing process. The process begins with a hollow that is first

cleaned in a variety of different solutions, then covered in liquefied animal fat to reduce friction in the drawing process. Then one end of the hollow is swaged to allow for better gripping. The tube is then drawn through a die on the drawing bench. Next, the ends are cut and the tube is sent through a series of angled rollers that straighten the tube. The tube is finally checked for cracks

and irregularities and the alloy composition and size is printed along the tube.

After observing the different steps of the process, the teams were allowed to pick through a stockpile of various tubes. The University of Illinois Baja, Formula, and Formula Hybrid teams would like to thank Plymouth Tube Co. for their continued generosity!

Team member profile

Mark Teramoto

Name: Mark Teramoto

Subsystems: Body, Chassis, Suspension

Mark Teramoto joined the University of Illinois Formula Hybrid Team early this season and just completed his third semester as a mechanical engineering student. Although he's relatively new, he has quickly become one of the hardest working members. It is already clear how much Mark enjoys engineering, because he actively participates in three different mechanical subsystems: body and aero, chassis, and suspension.

Mark enjoys working with his hands, and put them to good use by helping to fabricate the torsional testing

Major: Undergraduate Mechanical Engineering

Hometown: Honolulu, HI

and engine dyno rigs. One of Mark's biggest roles on the team is the modeling of the carbon fiber body using Unigraphics. Mark excels at transforming rough ideas into the three-dimensional model. Because of his cross-functional work between the different subsystems, Mark has a great understanding of what each mechanical team is doing and helps to avoid issues between those subsystems. We can only hope to gain more members like Mark. Keep up the great work!



Mark measuring chassis torsional rigidity



Why you should support Formula Hybrid

The automotive industry has sought after students participating in Formula SAE since its conception in 1978. Qualifying for an internship at Ford Motor Company and Honda Motor Company specifically requires Formula SAE involvement. The competition has acknowledged educational value.

With an annual budget in excess of \$65,000, the Illini Hybrid Racing Team at the University of Illinois seeks out funding from a variety of resources in

order to keep the team rolling. Monetary and in-kind donations made by our corporate sponsors are often matched by either the University of Illinois College of Engineering or College of Engineering departments. The donations that our sponsors provide are essential to the team's success. The team expresses deep gratitude to our sponsors for making the whole project possible.

2011 TEAM SPONSORS

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Special thanks to the University of Illinois at Urbana-Champaign Formula SAE and Baja SAE teams for their invaluable contributions to Illini Hybrid Racing