

# ILLINI HYBRID RACING

October 2010

## Newsletter

## Motorola Awards 2010 Innovation Generation Grant



motorola  
foundation

The University of Illinois Formula Hybrid Team is the proud recipient of a 2010 Innovation Generation Grant awarded by the Motorola Foundation. The grant targets organizations inspiring students to learn about and pursue careers in science and technology.

The Formula Hybrid Team is a registered student organization at the University of Illinois open to all

students regardless of their formal degree program. The team works to create opportunities for students from both engineering and non-engineering fields of study to cooperatively collaborate on engineering and science aimed at the construction of an open-wheeled formula hybrid racecar. The Formula Hybrid Team is a primarily extra-curricular student activity funded through corporate, private and educational donations.

The Motorola Foundation grant of \$30,200 will cover nearly one-third of the teams 2010-2011 fiscal needs. The team expresses our sincerest gratitude to the Motorola Foundation for supporting us and believing in the educational value of this extra-curricular activity.



The 2010 chassis; powercoating services provided complements of Advanced Powder Technology, Inc

## Off to a Strong Start

Team hard at work over summer and fall

The University of Illinois Formula Hybrid Team is off to a strong start preparing for the 2011 Formula Hybrid International Competition in Loudon, NH beginning May 1st. Over the summer members of the team stripped the 2010 chassis down to its bare frame, making way to powdercoat the chassis and begin design of the 2011 vehicle.

Powdercoating services were provided complements of Advanced Powder Technology, Inc.

of Dieterich, Illinois. The team could not be happier with the brilliant job, friendly service, and rock solid surface provided by APT.

With the car stripped, the team took the opportunity to modify the drive motor and mount the drive motor and generator to a dynamometer for testing. In order to get the best possible performance out of our AO Smith E317 motor and Yaskawa A1000 motor drive, we mounted an encoder directly to the motor shaft.

The ECE Machine Shop, located on campus, modified the motor shaft and motor housing to permit the encoder to be rigidly attached to the rear of the motor casing. This created a more compact and robust package than the timing belt layout used last season. With the encoder installed and the motor mounted in the University of Illinois Grainger Power Lab, the team is ready to begin testing and tuning.

## Record Student Involvement

This year's Quad Day and E-Night were both great successes for the team. Quad Day is a campus wide event permitting University of Illinois student organizations to share their programs with the entire student body. Located on the main quad on August 22nd, the event encourages students to get involved, helping advance both their educational and social skills. E-Night, a similar event hosted August 30th by the Engineering Council, is a place for all students to come out, learn about, and get involved in engineering oriented student organizations. Between Quad-Day and E-Night, over 250 students expressed interest in joining the team, signing up to receive regular team emails. The team has record participation and continually expands its organization and goals to provide ample opportunities for all interested students.



Interested students speak to team members at the annual Quad Day

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**7 months until competition day!**

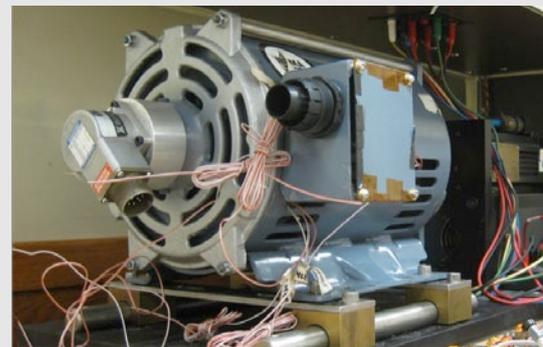
# Engineering the 2011 Racecar and Looking Towards 2012

Due to a number of 2011 competition rule changes (especially one that limits the battery pack voltage to 300V rather than 400V as in 2010) the team has decided to re-engineer the 2010 Formula Hybrid car over the course of the Fall semester and bring it to the 2011 competition. Notable projects include modular battery pack design, cell-by-cell battery management system development, chassis torsional rigidity testing, dynamometer powertrain testing and tuning, suspension simulation, open to limited slip differential conversion, control strategy advancement and optimization, repackaging of a 200V motor drive, addition of a servomotor drive for improved power generation capabilities and elimination of the engine starter motor, and complete redesign of the braking system.

Also during the Fall semester, the team will

begin design of the 2012 car. Due to the considerable complexity of a hybrid vehicle compared to the standard Formula SAE all combustion system, the team is moving to a two year design cycle with a single vehicle completed each year. In other words, two vehicles will always be in development, but staged one year apart. The first year targets a complete system design, followed by manufacturing and assembly of all mechanical systems. The second year focuses on the manufacture and integration of all electrical components as well as final system testing and tuning.

To help with documentation and to prevent propagation of errors from year to year, the team is implementing a design process modeled off of those used in the automotive industry. The process requires component owners to hold design reviews that graduate the components through



AO Smith E317 motor with shaft coupled encoder mounted for dynamometer testing

Engineering Development, Design Validation, Production Validation, and Continued Compliance Testing. Each component has a specific set of tasks that must be completed in order to pass to the next phase. Additionally, a 7-step method for problem solving will be utilized for resolving failure issues.

## Students Attend Motorola Innovation Generation Network Conference

On July 12th, three formula hybrid team members, Dylan Erb (undergraduate general engineering), Emma Corley (undergraduate mechanical engineering), and Gabriel Benavides (Ph.D. aerospace engineering) attended the 2010 Motorola Innovation Generation Conference in Schaumburg, IL. The team gave a short presentation on the second day of the event in a breakout session titled, "Innovation Generation University." Additionally, during the day and a half event, the team members participated in networking sessions, panel discussions, program demonstrations, a keynote address given

by Sally Ride (first female astronaut), and a handful of other group activities. The primary focus of the event was the sharing of best practices

***"By bringing Formula Hybrid to K-12 students, the team hopes to help inspire the next generation of young engineers"***

geared towards inspiring young minds to seek careers in Science, Technology, Engineering,

and Mathematics (STEM). The three team members found the event educational and returned with a number of ideas on how to improve the effectiveness of the University of Illinois Formula Hybrid Team as a collaborative and inspirational program. For example, the team now plans to integrate five K-12 educational events into the teams 2010-2011 program. By bringing Formula Hybrid to K-12 students, the team hopes to help inspire the next generation of young engineers that will eventually continue the legacy of great engineering at the University of Illinois, and more specifically, Illini Hybrid Racing.

## 2009-2010 Season In Review

The team officially became a University of Illinois Registered Student Organization (RSO) in September of 2009 with just a handful of ambitious students with their sights set on attending competition in May of 2011. However, before development could take place on the car itself, substantial work had to be done to gain workspace and sponsors, locate a faculty advisor, recruit a wider member base, and acquire tooling and raw materials.

The first challenge was gaining the support of the U of I Engineering Design Council. The council not only offers matched funding, but workspace in the Engineering Student Project Lab (ESPL). In other words, the support of the Design Council was essential for the start-up and long-term success of the U of I Formula Hybrid Team. However, while our initial two-year design-build plan provided sufficient time to effectively bring our first car to competition, the council was clear on the fact that they neither "provide seed funding" nor supported "two-year programs." They gave us one week to submit a revised proposal, with both proof of substantial sponsorship, and a one-year design-build plan. Through the hard work of our founding members, the team suc-

cessfully raised approximately \$32,000 in cash and in-kind commitments and developed an ambitious plan to convert the 2008 FSAE car to a hybrid system in one semester.

After reviewing the teams revised proposal, the Engineering Design Council granted the team \$7,000 in matched funding in November and space in the Engineering Student Project Lab (ESPL) in late December of 2009. This left barely four months for the team to outfit the shop, increase membership, redesign the FSAE vehicle as a hybrid, locate sufficient sponsorship, attain components, manufacture the vehicle, test, and finally travel to New Hampshire. Though the task was clearly ambitious, the students were committed to meeting the challenge.

Thanks to a team of dedicated students, enthusiastic sponsors, and countless other sup-



The team at the 2010 Formula Hybrid International Competition held at New Hampshire Motor Speedway, Loudon, NH in May 2010

porters, the Illini Hybrid Race team completed an incredibly successful first season. Ultimately, after a furious semester, the team raised over \$60,000 in cash and in-kind donations, assembled its first proto-type, and brought the vehicle to competition in May 2010. While the first season was extremely hectic, it was also amazingly educational and rewarding for all the students involved. In the end, fifteen members of the team traveled to Loudon, New Hampshire, and tirelessly participated in the three day event, working

*continued overleaf*

**2009-2010 Season In Review (continued from previous page)**

with judges to meet every qualification of the mechanical and electrical inspections. Though with some disappointment a fusing complication prevented participation in dynamic events, the team

performed admirably in the static events. Thanks to the great sportsmanship of fellow competitors, attention to detail provided by the judging staff, and gracious support of countless sponsors, the

first season has surely provided a solid foundation that shall make the 2011 season an even greater success. Season One yielded 16th place. Season Two we aim for 1st.

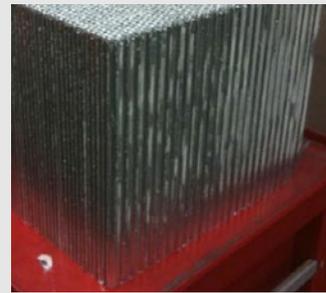
**Plascore Donates Impact Attenuation Honeycomb**

The impact attenuators for both the 2010 and 2011 Formula Hybrid cars feature an aluminum honeycomb impact structure donated by Plascore Inc. This is an important safety component as it slows the car down reliably in case of a collision.

The competition rules require that the attenuator stop the competition car, traveling at 7 m/s with an average deceleration of less than 20 g. The aluminum honeycomb was ideal for our purposes as it allows us to ac-

curately determine its crush behavior due to its unique property of a constant deformation force throughout the stroke of the material. An aluminum honeycomb with crush strength of 245 psi quasi-static nominal was selected because it provided a sufficiently small attenuator size to allow for convenient packaging in the front of the car.

We would like to thank Plascore Inc. for their donation and valued support!



**Team member profile**

**Joseph Paquette**

**Name:** Joseph Paquette

**Subsystem position:** Chassis

**Graduation Date:** May 2011

Joe Paquette, otherwise known as Joey "add more heat" Paquette, is one of only a handful of leaders on the Illini Hybrid Racing Team. Joey is currently the chief mechanical officer for the 2010-2011 academic year as well as the chassis team leader. Joey is a committed student who also spends considerable hours working in the shop. You'll find him testing the previous car, designing the new chassis, or just welding two random pieces of metal together. He is one of the more experienced welders on the team and keeps himself busy by sharing his knowledge with fellow teammates.

When Joey isn't working on the Hybrid car, working at

**Team position:** Chief Mechanical Officer

**Major:** Undergraduate Mechanical Engineering

**Hometown:** Chicago, Illinois

his job, or working on classes, he likes to spend his time working on his own car or motorcycle. Noticing a trend? He is a classic achiever with a "need for speed". From changing timing belts on his car, to building fiberglass panels for his restored café racer bike, he is always finding new ways to improve his toys.

Joey is a critical asset to our team and is devoted to building the best car possible. He will show up at the shop at anytime of day or night, and is not afraid to learn something new. Keep up the great work Joey, and when in doubt just "Add more heat!"

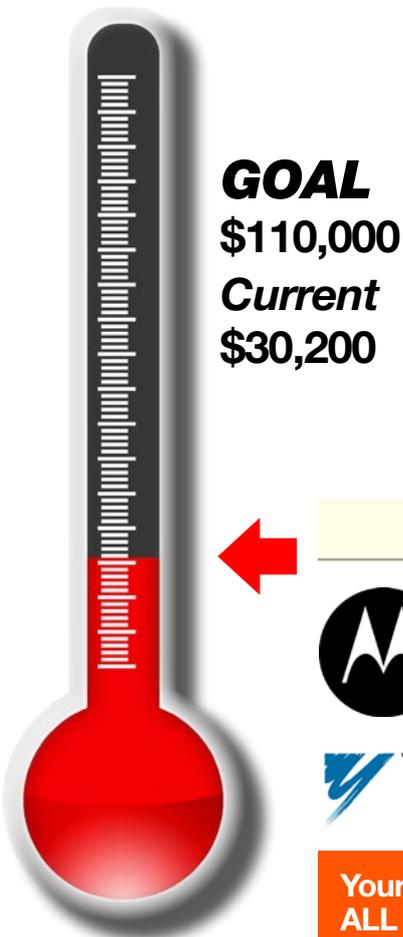


Joseph Paquette

**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 \$100,000, 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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**Your company could be here. ALL DONATIONS ARE FULLY TAX DEDUCTIBLE**

**Interested? Contact us today for more information**

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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