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wisconsin engineer
FEBRUARY 2007 VOLUME 111, NUMBER 2

ENGINEERING HALL

From eggs to EXPO

Origin of Engineering EXPO p. 10

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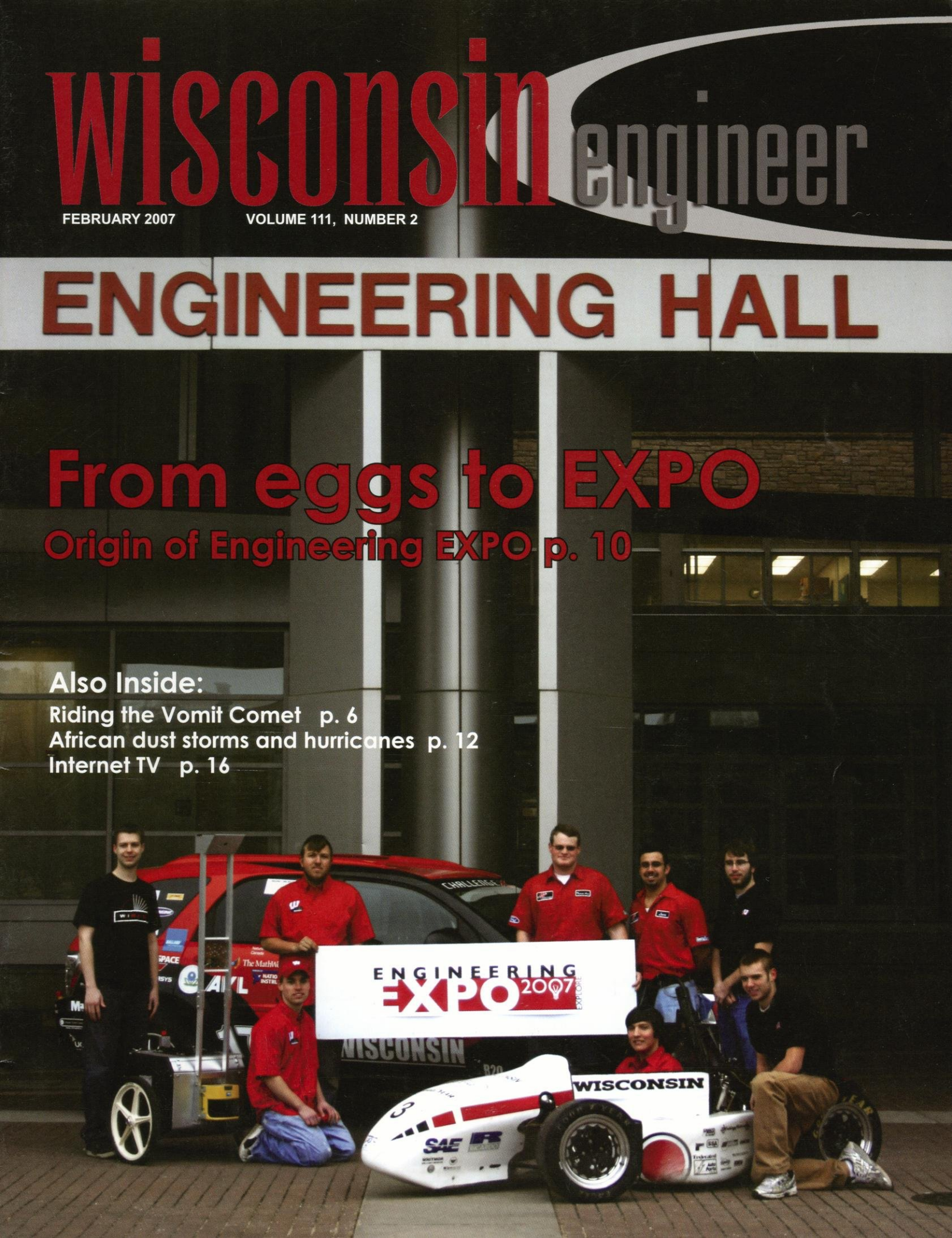

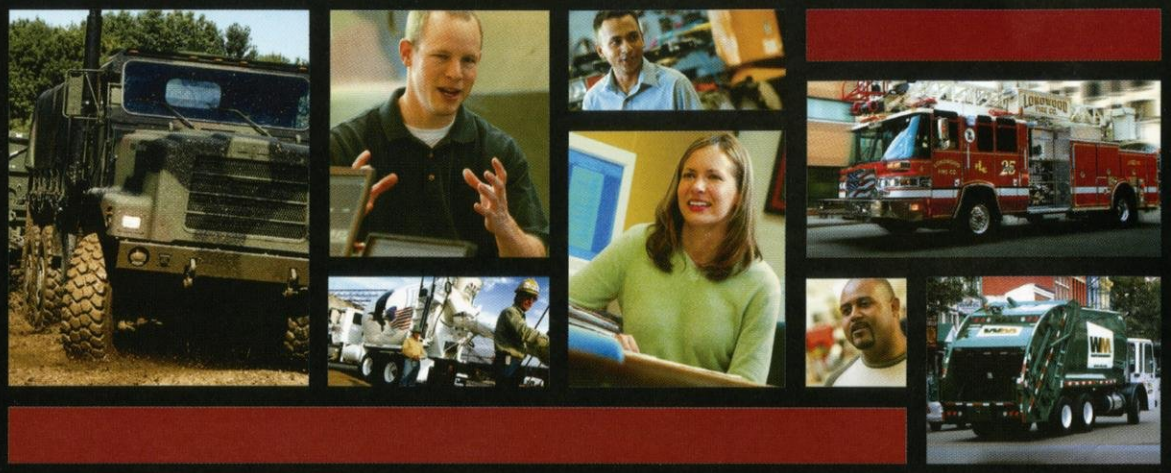

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COVER STORY

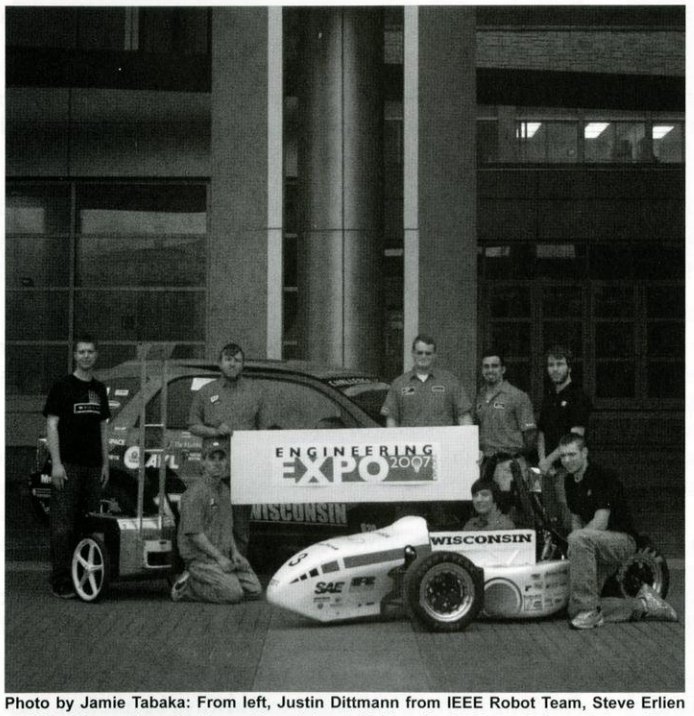
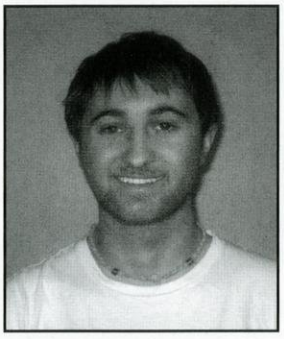


Photo by Jamie Tabaka: From left, Justin Dittmann from IEEE Robot Team, Steve Erlien and Matt Coyne from Challenge X, and Jacob Heiden, David Fautsch (in car), Luca Mantovano, Greg Blaser and Billy Kewer from Formula SAE. Visit these exhibits and more at Engineering Expo, April 19th through the 21st.

FEATURES

COMMENTARY

www.wisconsinengineer.com wiscengr@cae.wisc.edu (608)262-3494 1550 Engineering Drive, Madison, WI 53706



Kevin Jayne
Writing Editor

Badger athletics: the gift that keeps on giving

The holiday season is an annual occasion to count one's many blessings. I love the month-long unwind from fall semester to relax and enjoy myself. I appreciate that break allows time for a full night's rest on consecutive days. I enjoy the chance to brush up on my guitar playing. I am grateful for the opportunity to catch up with old friends and I value the thoughtful gifts from my family. All of these things are just fine and dandy; however, there can only be one thing for which I am most thankful this year: the Wisconsin Badgers.

While the athletic tradition and success of UW-Madison is only one small part of what makes our school so incredible, it is the latest on a long list of things to be proud of. The University has long been and always will be revered for its academics. The beauty of the campus terrain, state-of-the-art facilities and rowdy social scene are not going anywhere, either. Consistent athletic success, however, can be fleeting.

Though every sports fan may have his or her own scale for gauging the state of the program, the easiest way is by judging the three biggest sports: football, basketball and hockey. The football team recently finished its season with its second straight Capital One Bowl, once again defeating a team ranked highly in the Southeastern Conference. In setting a school record for victories and laying all doubts about the recent coaching change to rest, Bret Bielema has the program in the best shape it's ever been. Bo Ryan's boys currently have only one loss (hopefully this is still true come print time) and are off to their best start in over 90 years. The team is receiving national recognition with its top-five ranking and has the leading player of the year candidate in Alando Tucker. Finally, the hockey team, despite struggles early this season, is the reigning national champion and will have the opportunity to defend if they can get things going in the second half of their season.

Things have not always been this way, which is why it's so important to enjoy the accomplishments of our athletes. While we watch these teams achieve newfound status among the elite programs of the country, as students we should all cherish the time we have here and the privilege to be a part of something so special.

When I arrived in Madison as an inexperienced young freshman, I knew relatively little about our athletics program and its proud traditions. I had never sprung out of bed hours before kickoff to begin tailgating, and I had never participated in an 80,000 person sing-a-long. I had surely never devoted more than a few straight seconds to jumping around and had no idea adjacent student sections could offer such vile commands towards one another.

However, I picked up on things quickly, and soon thereafter became obsessed with all things cardinal and white, as is easy to do living in Madison. In four—oh so very short—years, I've become a bonafide Badgermaniac (complete with the website membership, of course) and have amassed a collection of red garments large enough to shame a matador himself.

Fortunately, I still have another year of student section eligibility remaining—a lot of us engineers are awarded a fifth—though games may have a different feel next year. Several of my closest friends and roommates will be graduating this spring, and as any fan knows, whom you celebrate the victory with can be as important as the win itself. This is why I have chosen to reflect back upon my time as a student fan a year early, with the idea that it will allow me to revel in each Badger triumph and chorus of "Varsity" as if it were my last.

Though I have so many memories of college, the ones that stand out the most are undoubtedly tied in with sports. The camaraderie forged through sporting events lasts a lifetime, and I will always value the friendships that were both created and strengthened during my time here.

And though friends from school may go their separate ways, Badger fandom is a lifelong journey, and there will always be another season to enjoy.

On Wisconsin. W!

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ECMA ASM

The *Wisconsin Engineer* magazine, a charter member of the Engineering College Magazine Associated, is published by and for engineering students at UW-Madison. Philosophies and opinions in expressed in this magazine do not necessarily reflect those of the College of Engineering and its management. All interested students have an equal oppertunity to contribute to this publication.
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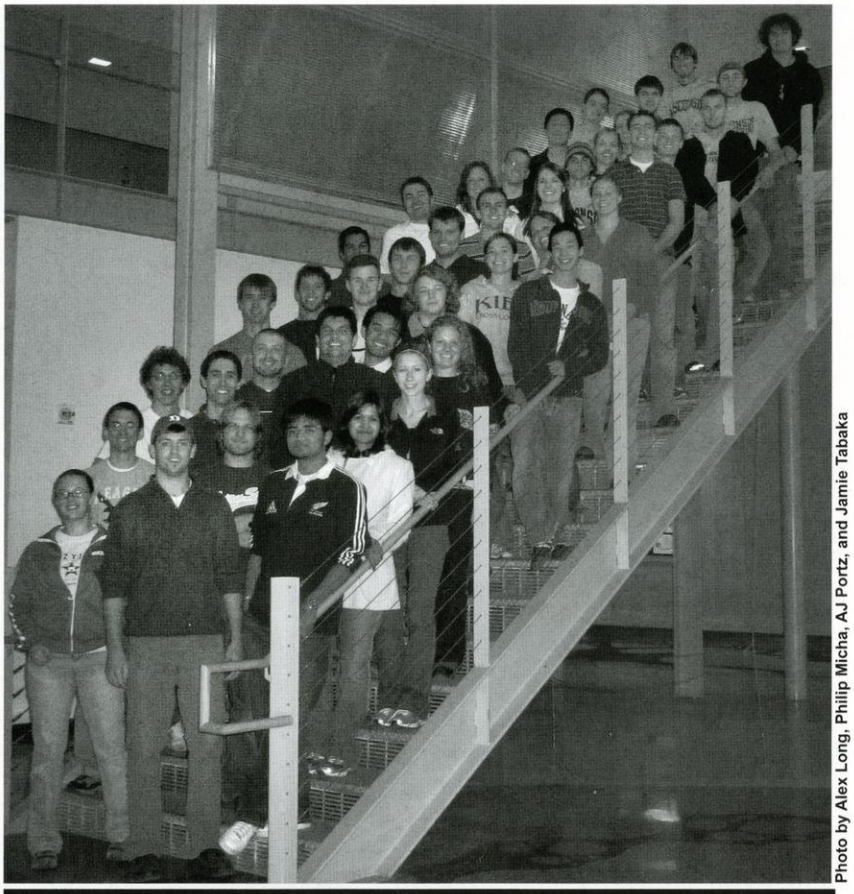


Photo by Alex Long, Philip Micha, AJ Portz, and Jamie Tabaka

It takes all kinds:

ECE Professor values variety

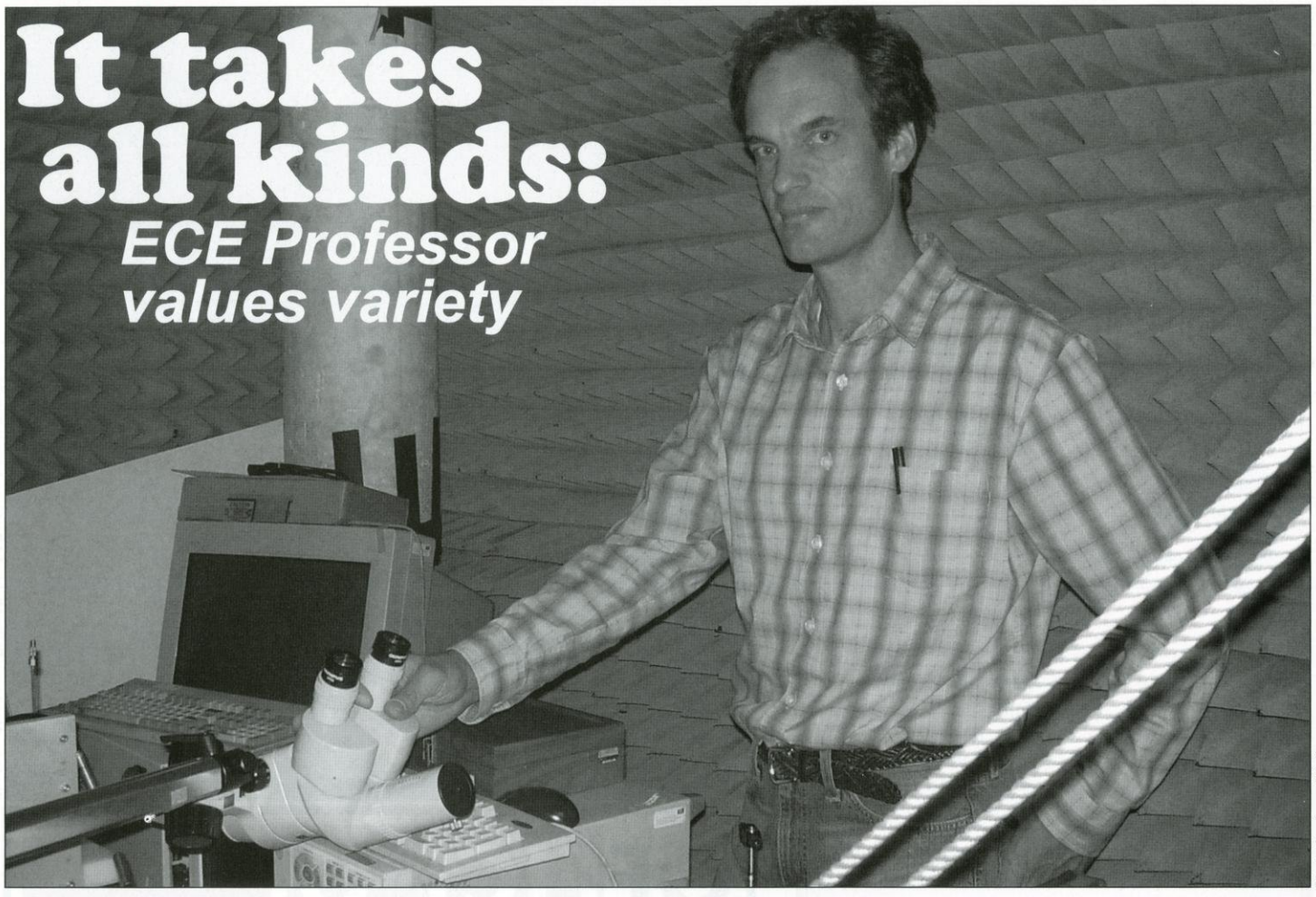


Photo by Anna Mielke

By Paul Kamenski

"One of the more important variables in engineering is the dollar sign," UW-Madison professor of electrical engineering Daniel van der Weide says. As do all good engineers, van der Weide carefully defines his variables, especially their dependence on money. His ECE 601 class, "Business for Engineers," pays tribute to that dependence by covering the basics of accounting, marketing, finance, business planning and management. He hopes to prepare his students for making their own ideas or inventions into a successful business endeavor.

Van der Weide's belief that the scope of engineering is becoming ever broader (or, as Thomas Friedman would say, that the world is getting even flatter) has led him not only to emphasize the importance of business in engineering but also to appreciate and take advantage of an interdisciplinary approach to all the engineering problems he faces. His openness to various problem-solving approaches might be most apparent in the broad range of graduate students and post docs in his group, coming from backgrounds in biochemistry, electrical engineering, biomedical engineering, radio physics and chemistry.

"I feel like I learn more and perhaps educate better in a lab/discussion environment, which is why I tend to be an experimentalist. I really enjoy working out problems in conversation, which is ironic, since I did most of my undergrad and graduate studying alone."

- Daniel van der Weide

"In short, I like to pursue ideas that are a bit unconventional in their blend of disciplines," van der Weide says. Thus, he studies "the intersections of high frequencies, microwave through terahertz radiation, and biological entities like membranes and proteins" to support his "wide-ranging interests in medical devices, medical imaging and spectroscopy."

His passionate pursuit of knowledge unbound by the confines of any department even landed him a joint professorship in the radiology department, a discipline outside his formal education. His recent work in the field of radiology includes the development of a minimally invasive treatment for tumors in the liver. Through a procedure that uses a 17 gauge needle (a littler larger than 1 mm in cross-section) and high power microwaves, patients who are, as van der Weide says, "interested in a route around surgery," could opt to more or less "cook" the tumor in place. This form of treatment has potential to be used in the lungs and kidneys as well.

In addition to the time he spends preparing for and giving lectures for the classes he teaches, van der Weide writes proposals to fund his research projects, advises students

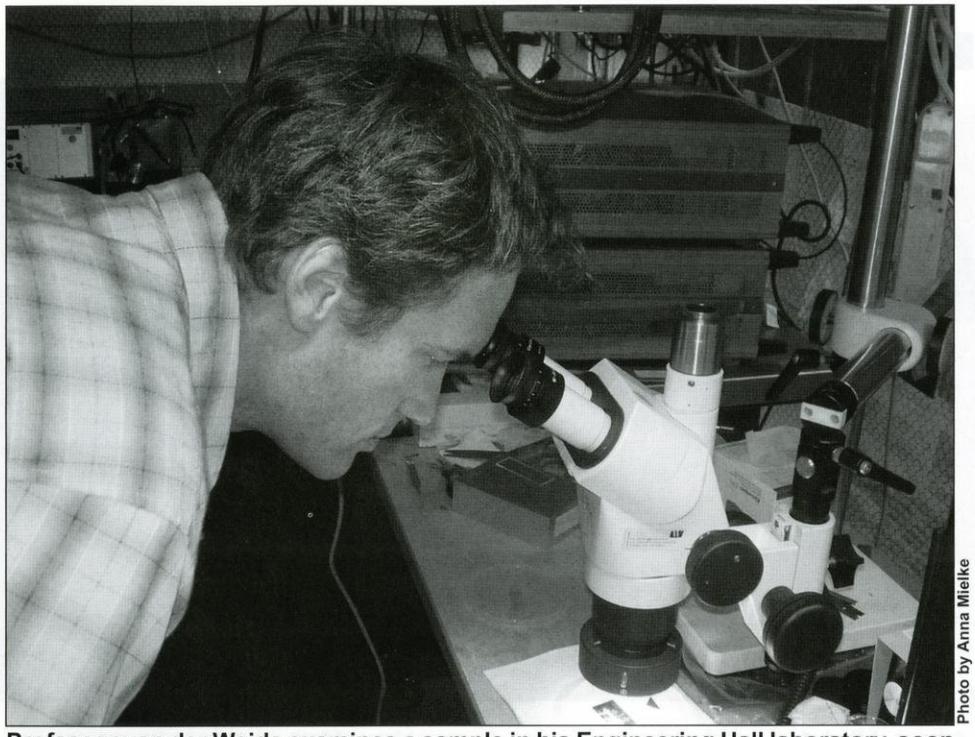


Photo by Anna Mielke

Professor van der Weide examines a sample in his Engineering Hall laboratory, soon to be analyzed in a scanning electron microscope.

and post docs and travels to present results from his research.

When asked if he considers himself more a teacher or researcher, van der Weide was equivocal.

"I enjoy teaching in the lecture format, but it has its limitations," he says. "I feel like I learn more and perhaps educate better in a lab/discussion environment, which is why I tend to be an experimentalist. I really enjoy working out problems in conversation, which is ironic, since I did most of my undergrad and graduate studying alone."

Aside from his visible position as a professor, van der Weide is also known as a father, an athlete, and a friend to many.

"In short, I like to pursue ideas that are a bit unconventional in their blend of disciplines"

- Daniel van der Weide

"I have 50 percent placement of my three kids, Noah, Jonah and Silke (12, 10 and 8), all of whom attend Madison public schools, so I'm making lunches and getting them off to school many mornings," van der Weide says.

In addition to caring for his kids, he also takes time each day to maintain his own physical and mental wellbeing.

"I like to exercise daily, and that usually involves a run through part of the Arboretum, listening to whatever's on my iPod. Since I went through a more-or-less self-imposed cultural deprivation during the first years of my graduate work and subsequent career, some music that others would consider old is refreshingly new to me; now I listen to Alice in Chains or Radiohead, but tomorrow it could be Outkast, Joni Mitchell, Yes, Chili Peppers or less mainstream stuff," van der Weide says.

Fusing van der Weide's passion for sports and learning, he says he loves having conversations "on a bicycle ride with a math professor or on the golf course with a physics professor."

Van der Weide also commutes just as he solves engineering problems, with varied approaches.

"I like bicycle racing, though now I'm fairly content with just riding fast with others," he says. For days when he wants to outpace cyclists, van der Weide takes to the streets on his Harley-Davidson Softail bike.

Formal Education

- B.S. in electrical engineering with a minor in Latin, University of Iowa, 1987
- M.S. and Ph.D. in electrical engineering, Stanford University, 1989 and 1993, respectively

Work Experience

- Motorola
- Hewlett-Packard
- Watkins-Johnson Company
- Lawrence Livermore National Laboratory
- Post-doctoral work at the Max Planck Institute, Stuttgart, Germany
- Professor, University of Delaware

UW-Madison Courses

- ECE 447: Applied Communications Systems
- ECE 547: Advanced Communications Circuit Design
- ECE 601: Business for Engineers

Van der Weide can also be found with his kids boating on Lake Michigan or up north on Lake Tippecanoe. Finally, if traveling by land or by sea is not fast enough, van der Weide takes to the sky as he continues to pursue an instrument rating as a private pilot.

Transportation aside, van der Weide's capability, with the support of his team of interdisciplinary researchers, to explore ideas that extend beyond any easily defined field of study clearly makes him a professor to keep up with. WE

Author bio: Paul Kamenski is a third-year undergraduate double majoring in physics and materials science and engineering.

RIDING THE "Vomit Comet"

Courtesy of Pete Penegor

One student's account of a ride on NASA's "Weightless Wonder"

By Pete Penegor

Ever since I was a little kid, I've always wanted to become an astronaut, at least after I realized I couldn't become a Jedi. This past summer I was given a little taste of this lifestyle when I went to Houston's Johnson Space Center with the UW Zero-G team.

This team participates in NASA's Reduced Gravity Student Opportunity Program. In this program, hundreds of teams from colleges across the nation submit proposals for experiments to be tested in NASA's C-9 plane which simulates zero gravity. NASA selects teams to bring to Houston, Texas to test their experiments. Three members of the team fly in the plane to perform the zero-gravity experiment.

Courtesy of Pete Penegor

Pete Penegor and Andrea Martin experience weightlessness in the C-9 with the capillary action experiment in the middle.

I joined the Zero-G team in the fall of 2005 when it had just chosen the concept for the next experiment and was starting to design it and write the proposal. The experiment would test the volumetric flow of water due to capillary action in zero gravity.

Capillary action is the process by which liquids creep up the sides of the container they are being held in. For example, when you measure a liquid in a graduated cylinder, you measure from the bottom of the meniscus and not the top line, because the liquid has crept up the sides. If there is no gravity, the liquid should theoretically creep up the sides to an infinite height. To test this hypothesis, we used a block with very precisely cut vertical channels. When we hit zero gravity, the block was lowered into blue colored water. We taped the experiment with a digital video camera so we could see how the water behaved.

We didn't hear back until December that our proposal had been accepted. Our flight week was chosen for Aug. 10-19, 2006. Following our acceptance Doug Lipinski, our

team leader, stepped down to let someone else have the opportunity to fly. The team decided who would be the new 'flyer' based on who had put forth the greatest effort throughout the semester. I was chosen to be the new flyer.

We finished building the experiment over the summer and finalized our travel arrangements. Our team received travel sponsorship from the UW department of engineering physics and the Space Sciences and Engineering Center. Due to summer school exams, we left at about 10 a.m. on Aug. 9 and continued to drive through the night straight to Ellington Air Field in order to make the orientation at 7:30 a.m. Two Monster Energy drinks later, I was still exhausted. But rest would have to come later; the next day was going to be dedicated to flight training.

The training began with a series of lectures on, among other things, motion sickness and hypoxia—altitude sickness caused by the lungs' inability to absorb oxygen at low pressures. The training ended with a trip to the hyperbaric chamber. This chamber depressurized the room to simulate the altitude of the C-9 we'd be flying in, giving us hypoxia when we took off our oxygen masks. During this time, we were supposed to note our symptoms of hypoxia so we would be able to tell if the plane depressurized during actual flight.

Ever since I was a little kid, I've always wanted to become an astronaut, at least after I realized I couldn't become a Jedi.

The main symptom of hypoxia is euphoria, which is the best part of the hyperbaric chamber. While in this state, they gave us an easy test comprising simple math problems and other easy questions. When I answered the test question about my symptoms, I wrote, "lightheaded, more lightheaded, even more lightheaded." When it was all over, I was kind of sad.

After our day of training, we had the weekend to get ready for the week of flying ahead of us. Each team was broken down into two groups that would fly on alternating days. I flew on the first day. My group arrived at the field early to take our motion sickness medicine. After we got situated, the plane took off. We were allowed to get out of our seats about a minute after the plane left the ground. Even though the plane was still climbing at about a thirty degree angle, we rushed to our experiment, started the camera, closed off the box and waited nervously.

Courtesy of Pete Penegor

The 2006 Zero-G flyers, in back from left Meg Reinbold, Keith Rein, Andrea Martin, in front Pete Penegor and Mai Lee Chang.

In order to simulate zero gravity, the plane flies a series of parabolas, going up and down for about two hours. At the peak of the parabola you experience zero gravity for roughly fifteen seconds; at the bottom of the parabola you feel twice the force of gravity, which is very unsettling.

The plane first started in the downward section, so we were all stuck to the floor, lying flat on our backs like the training taught us. Then the engine noise changed abruptly and we slowly floated up.

It was the craziest feeling ever.

Basically, your body is being tossed in the air, but the C-9 plane blocks all the wind resistance and serves as a point of reference. I had a chance to look out one of the small windows, and all I could see was the horizon at about a 45-degree angle. We are so used to the presence of gravity that experiencing zero gravitational pull can feel like a whole new world. There are no forces acting on your body, so the feeling is very soothing but also very disorientating at the same time.

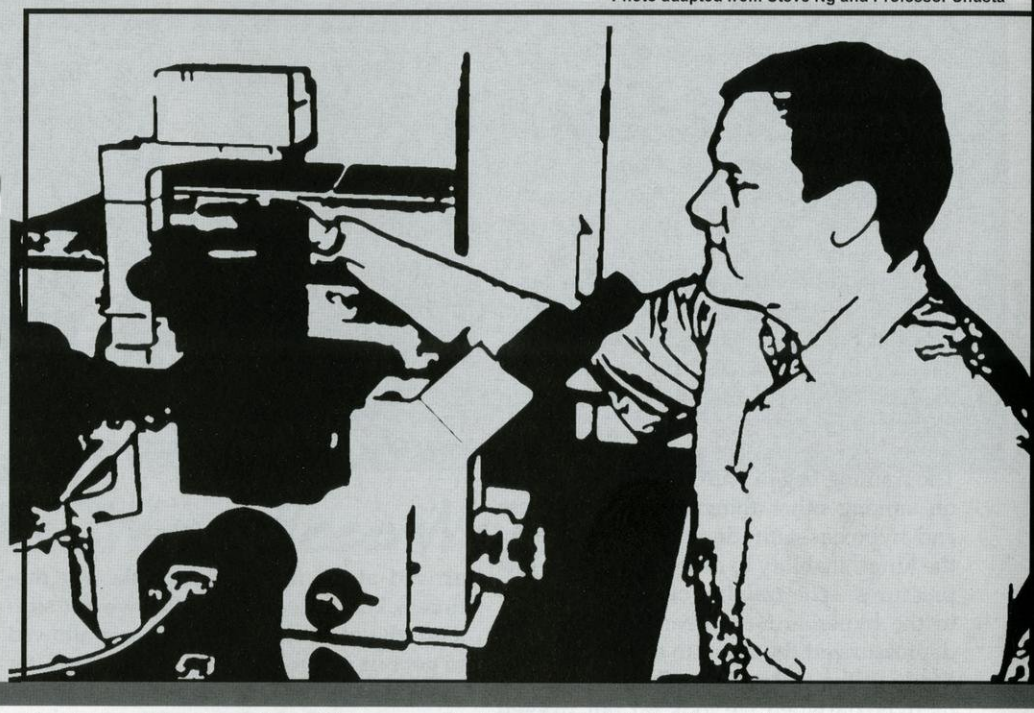
NASA likes to call their C-9 plane the "Weightless Wonder," but most refer to it as the "Vomit Comet." After some time in flight I became quite sick and actually vomited in zero gravity—not many people can say that. The rest of the team, all of whom also threw up, received shots of sedative in their arm. I think the only reason I didn't receive a shot was because, while I was puking, I was smiling the whole time. WE

Author bio: Pete Penegor is a junior in engineering mechanics and astronautics. He wants to be an astronaut.

VIP ACCESS

Getting past the BBB to deliver drugs to brain tissue

Photo adapted from Steve Ng and Professor Shusta



Professor Shusta using a fluorescent microscope to identify antibodies on the yeast that recognize specific target cells.

By Victoria Yakovleva

In the brain, the capillaries comprise a 400-mile so-called freeway. When a drug is intravenously injected into a patient, the drug flows throughout this 400-mile freeway in an attempt to access the brain to treat deteriorating brain tissue. However, to prevent unwanted trespassers from entering the brain, a selectively permeable blood-brain barrier (BBB) impedes the journey of the drug.

The building blocks of the BBB, known as the endothelial cells, prevent anything that doesn't meet the VIP access criteria — such as a molecular weight of no more than 600 Daltons — from entering the brain tissue. This is a problem, according to Professor Shusta from the chemical and biological engineering department at UW-Madison, because 98% of traditional small molecule pharmaceuticals are essentially overweight and thus can't get into the brain.

"In addition, nearly one third of all drugs in clinical trials today are not those small molecules but even larger particles [like] proteins and DNA," says Shusta. In other words, the drugs to treat mentally degenerative conditions such as stroke, Alzheimer's and Parkinson's exist but are just economically worthless.

This is where Shusta's research group steps in to help maneuver a means of successfully delivering the drug cargo across the selectively permeable BBB. "Our job is to somehow get from inside the blood vessel into the brain tissue," says Shusta. To find this means of cargo delivery, Shusta's lab group observes nutrient delivery to brain tissue.

...a billion different "fuzzy" yeast cell balls are contacted with the so-called Velcro pad of endothelial cells.

"It turns out that there are a couple of neat ways that nutrients get into the brain that perhaps we could take advantage of for drug delivery," says Shusta. To get into the brain, the nutrients flowing through the bloodstream attach to the receptors on the endothelial cells. These nutrients are then engulfed (endocytosed) and trafficked through (transcytosed) the cell in an energy-dependent fashion to get to the other side.

Shusta explains how his research group is "trying to go under the radar and use the same types of transport systems to not deliver nutrients but to deliver drugs." In order to do so, a protein that targets the endothelial cell receptors is needed. For Shusta's lab, this protein is the antibody, which, according to Shusta, is "very good at binding to things, recognizing things, and targeting [things] for degradation." Simply put, the antibody is a top-of-the line vehicle.

However, not just any antibody will work. In order to successfully deliver drug cargo, an antibody must be able to bind to the surface of the BBB, endocytose from the bloodstream into the BBB, and then transcytose out of the BBB into the brain tissue.

To first figure out which antibodies will stick to the BBB surface, Shusta toys with a cellular version of "Velcro catch." The

About the background: Yeast displaying an antibody that specifically recognizes a target on the brain endothelial cell surface.

fuzzy balls he uses are in the form of yeast cells. Each yeast cell has about 50,000 copies of one particular antibody; these antibodies are the tiny hairs on the yeast cell balls. About a billion different "fuzzy" yeast cell balls are contacted with the so-called Velcro pad of endothelial cells. When a yeast cell ball comes into contact with an endothelial cell pad and sticks, the antibodies on the yeast cell can bind to endothelial cell receptors.

Out of the billion types of antibodies initially tried, only about 10 to 1,000 of them actually stick. From this incredibly smaller number of feasible antibodies, it must then be determined which antibodies not only stick to the surface of the endothelial cell but also endocytose. To determine this, secondary antibodies tagged with a fluorophore are used to label the primary antibodies that managed to stick.

The first secondary antibodies registered are red fluorescent antibodies that label the primary antibodies on the surface of the endothelial cell. Fluorescent microscopy images then display red dots on the surface of the endothelial cell, indicating which antibodies did not internalize.

To see which antibodies managed to internalize, green fluorescent secondary antibodies are employed. To allow the green fluorescent antibodies to enter the endothelial cell, a mild detergent is used to permeabilize the endothelial cell membrane. The green fluorescent antibodies are then able to label the antibodies that endocytosed.

This plucking process determines which antibodies can attach to the endothelial surface and internalize. However, getting into the BBB is not enough. To complete a successful drug delivery, the antibody must be able to travel through the endothelial cell to the other side. This process of transcytosis has not yet been tested on the antibodies that have passed the first two tests. In the future, Shusta would like to see how the elite antibodies hold out on the third and final test. WE

Author bio: Victoria is a freshman at UW-Madison who intends to major in biomedical engineering.

From eggs to expo

By Katie Klescewski and Marshall Stringfield

Before the riots of Halloween and the madness of Mifflin Street Block Party, there was a different holiday cause for concern: St. Patrick's Day.

Spring has always been a busy time for UW-Madison's engineering students. In 1912, following the lead of those at the University of Missouri, they declared St. Patrick a fellow "plumber" or "slide-rule pusher" and held a small horse-drawn carriage parade on March 17.

By 1920, the modest parade had become an all-out celebration, eventually dubbed the Cavalcade of Death. It featured an elected St. Patrick and floats – many of them mocking students in different fields of study, particularly the law students, or "shysters." According to a 1938 issue of the Wisconsin Engineer, one 1920 float was the "wrench" that screwed the Law School "nut" off the "bench." Over the years, the jabs at the Law School only became more condescending and abusive. A 1938 float spotlighted an effigy head labeled, "This is not the north end of a horse going south, it is a lawyer." Needless to say, the shysters did not take this lying down.

Photo by 1938 Photography Staff

The 1938 issue of Wisconsin Engineer Magazine showed this image of a float from the fateful St. Patrick's Day parade that year.

In 1923, the law students kidnapped the elected St. Pat and carted him off to Middleton. Two years later they topped themselves by introducing well-aged eggs to the engineers from the tops of State Street buildings. As the Wisconsin Engineer reported, "many paraders' as well as bystanders' clothing was ruined, for the aim of the lawyers was no better than their judgment."

The feuding quieted down for a time until 1933 when the law students claimed St. Patrick was a lawyer. This was too much for the plumbers who quickly padlocked the law building, forcing the shysters to use the basement entrance. A janitor finally filed through the chain only to discover it contained a soft lead link which could easily have been pulled apart. Point for the plumbers!

The feuding escalated until 1938, when the annual parade turned into a full-on riot. Eggs, mud, garbage, and fruit blackened the sky, and "more than once one shyster grabbed another to throw at the parade; after all, it is rather hard to tell one rotten egg from another," the Wisconsin Engineer reported. Some shysters even dared to come close to the street for a better shot, prompting an engineering student "to show the misguided souls better ways." This strategy turned out black eyes, bloody noses and bruised faces for both sides, but it didn't end there.

This strategy turned out black eyes, bloody noses and bruised faces for both sides, but it didn't end there.

Following the parade, some law students were still not convinced of St. Pat's apparent slide-rule pushing profession and, consequently, were rolled through the mud to teach them to behave themselves. The law students retaliated by storming the Engineering building where they broke glass, dumped out trash cans and flooded the lower level, leaving six inches of standing water on the floor. The engineering students ended the dispute by forcing the shysters out with the powerful spray of a fire hose.

The engineering faculty was not amused by the seemingly endless feud and searched for a way to divert the students' riotous behavior into more constructive and positive activities. Thus, in 1940, the Engineering Expo was born. Consisting of 40 students and 30 industrial exhibits, the first Expo

was "a roaring success," prompting exiting remarks from visitors such as "a swell show," "wouldn't have missed it for the world," and "when's the next one?"

This success encouraged the university to host the event again the following year, however, the start of America's involvement with WWII put the plans for future Expos on hold. After an 11-year hiatus, Expo resumed in 1953 as a triennial event. In 1959, under the leadership of future Dean of the College of Engineering John Bollinger, the event became a biennial tradition with three basic objectives: to bring industry into the University and acquaint its students with practicing professionals, to illustrate the role of engineering in the lives of the public and to offer young people a chance to see the school and learn about engineering as a profession.

Fast forwarding to present day, this three-day event–held every other April–continues to promote its original objectives and values. Engineering Expo features individual and group exhibits from various engineering fields. Engineering companies across the nation are also invited to participate. This unique combination aims to provide anyone age six to 106 a fascinating experience.

"Expo is a place where students and the public can come to look at what is going on in the engineering world and participate in it by doing hands-on activities… it is definitely a place where they can have fun," Christopher Westphal, the Expo's school outreach chair, says.

Each individual Expo proudly stands behind a slightly different theme and mission statement, however, its educational message remains the same. Hence, the College of Engineering takes pride in supporting Expo. Not only has it given exhibitors and other engineering student organizations a constructive means for creativity without the use of rotten eggs, but it also gives them a chance to impact the lives of the younger generation in a positive way.

"I strongly believe this state and nation need to educate a lot more people about engineering, science and math; so, anything we can do, within reason, to raise the awareness of the next generation of what engineering is, what engineers do and the positive impact it can have on the quality of life and people is something we really need to do," Paul Peercy, dean of the College of Engineering, says.

Photo by Muhamad Yahaya

The staff of Engineering Expo 2007 at a meeting with several Deans and administrators in the College of Engineering. Expo 2007 will be held April 19–21.

Although many schools across the country now hold some version of a technology exposition, one unique characteristic of the UW's Expo is that each is run entirely by a new team of students. As soon as one Expo is over, new people are interviewed to fill the vacated co-chair positions. The two chosen individuals then select a new executive team of about 15 students. The finalized committee then embarks on a two-year journey of biweekly planning meetings in an effort to make each Expo more remarkable than the previous.

"The entire history of Expo is amazing," Forrest Woolworth, the Competitions Chair, says. "Where it has come from and where it has gone is impressive."

Although Woolworth describes the planning, preparation and fundraising as "incredibly involved," this effort is not without reward and many skills are learned throughout the process. Each member of the student executive committee learns about leadership, networking, organizational skills and has a unique chance to leave a lasting impression.

"I want to give back," Westphal says. "For students who have no idea what an engineer is or no idea how math and science can be applied to real life and the interesting projects they can do with it, this is a once in a lifetime opportunity."

In addition to the hands-on exhibits of both students and professionals, this upcoming Expo will feature several keynote speakers, as well as the Wonders of Physics and Science is Fun presentations. There will also be many live competitions including a computer coding contest, a Sudoku challenge and robotics battle.

If you have ever wondered what engineering is all about, or even if you haven't, UW-Madison's 28th Engineering Expo on April 19–21, 2007, offers a unique way to learn how the engineering process applies to oneself.

"[Technology is] everywhere, it's in the cars we drive and foods we eat," Mark Mastalski, faculty Expo advisor, says. "I think it's very important for everyone to… see what's going on because the fact of matter is that everything we are doing here on campus at some level will somehow affect our lives."

Expo gives people of all ages a chance to unlock their innovative side as they dive into the complex world of engineering and explore the possibilities of the future. All characters are welcome, no costumes are required, but rioting is prohibited. WE

Author bios: Katie Klescewski is an English (creative writing) and technical communication student at UW-Madison

Marshall Stringfield is a senior at UW-Madison who is currently majoring in industrial and systems engineering.

African dust leads to hurricane bust

By Natalie Forster

As Charles Darwin neared the Cape Verde Islands off the west coast of Africa at the beginning of his famous voyage aboard the Beagle in 1832, he would write about clouds of dust powdering the ship, covering navigational instruments and stinging peoples' eyes. One hundred seventy-four years later, researchers at UW-Madison from the Cooperative Institute for Meteorological Satellite Studies (CIMSS) have discovered a link between the same dust storms that plagued the Beagle and the ferocity of hurricanes in the Atlantic Ocean.

Only this time, the dust elicits no tears. A CIMSS study published in October 2006 shows that large amounts of dust, which blow west from the Sahara Desert to the Atlantic Ocean, are present during periods of quiet hurricane activity, and vice versa—a link that suggests dust clouds may cripple the tempests.

Darwin never knew his good fortune.

The finding begs the question, "will this link help forecasters predict hurricanes?" Not yet, according to Amato Evan, assistant researcher at CIMMS and lead author of the study, but that capability is where he hopes to go with future research.

"If we can predict dust activity three or four months ahead of time, maybe then we can also predict some element of the hurricane activity," Evan says.

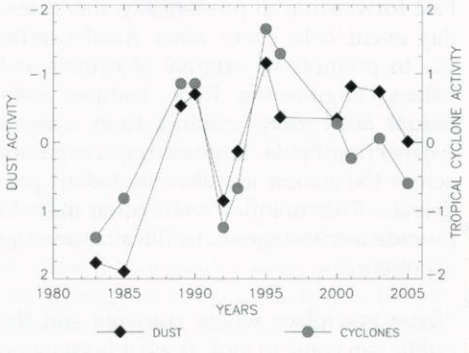
Researchers have long debated the effects of global warming on hurricane activity, but no one has ever suggested anything like this. Although still in the early stages of research, Evan believes dust storms are another part of the big picture.

"It makes sense that the dust storms would be having some kind of an effect on the [hurricanes]," Evan says. "When I saw an increase in hurricane activity, I saw a decrease in dust activity. And for other years when there was a big increase in dust activity, I saw a decrease in the hurricane activity."

Evan explains dust storms affect three of the many conditions favorable for hurricane formation. These hurricane-friendly conditions are (1) air that gets cooler with height, which causes the rapid mixing of air; (2) uniform wind speed with respect to height, which keeps the storm level and (3) high humidity, which condenses to form clouds and rain.

On the other hand, dust storms are characterized by (1) warm air at high elevations, (2) fast air at high elevations (a condition known as wind shear) and (3) dry air. The warm air creates an inversion—it acts as a blanket to reduce the temperature change between low and high, thereby reducing the potential for mixing. The fast elevated air tilts the storm, and the dry air prevents the formation of clouds and rain. Like adding a base to an acid, these dust storm characteristics help neutralize brewing storms.

Chris Velden, researcher and leader of the CIMSS team, and Jason Dunion, a National Oceanic & Atmospheric Administration (NOAA) researcher, coauthored the study and were the first to find a few isolated cases showing the link. Evan took the study



Courtesy of Amato Evan

The data for this graph was obtained by filtering satellite data since 1983 to show this inverse relationship

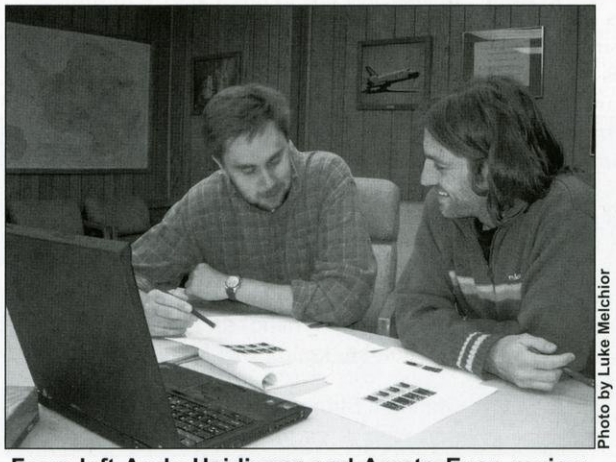


Photo by Luke Melchior

From left Andy Heidinger and Amato Evan reviewing satellite data leading to the inverse correlation between hurricane frequency and dust blowing off the west coast of Africa.

one step further, blowing the dust off of 25 years of satellite data to show that the link was recurrent and dependable.

This was not an easy task. To researchers sifting through satellite data, dust clouds often looked like regular clouds. Andy Heidinger, researcher for NOAA's Satellite and Information Service and CIMSS, and also another co-author of the study, spent six or seven years tinkering with computer algorithms to detect dust clouds in satellite data; the amount of dust he found was astonishing.

A single dust storm contains quantities of dust comparable to the 540 million tons of ash that were coughed up by the eruption of Mount Saint Helens in 1980. The volcano's hiccup darkened the sky for almost two weeks, forcing nearby airports and highways to close due to poor visibility and settling ash.

Darwin can relate.

"Generally the atmosphere is hazy," Darwin reported in the Voyage of the Beagle. "This is caused by the falling of impalpably fine dust, which was found to have slightly injured the astronomical instruments. The dust falls in such quantities as to dirty everything on board and to hurt people's eyes."

Evan says these dust storms affect sunsets as far away as Florida, Puerto Rico and the Caribbean, and they may even contribute to the asthma and other respiratory problems of some people in this region.

"One dust storm can basically cover more than half of the Atlantic Ocean," Evan says.

Darwin reached a similar conclusion.

Photo by Luke Melchior

Researcher Amato Evan standing before a satellite dish on top of the Atmospheric, Oceanic and Space Sciences Building, where he conducted his research.

New research suggests a link between African dust storms and the occurrence of hurricanes in the Atlantic Ocean.

"I have found no less than fifteen different accounts of dust having fallen on vessels when far out in the Atlantic," Darwin wrote. "It has often fallen on ships when several hundred, and even more than a thousand miles from the coast of Africa, and at points sixteen hundred miles distant in a north and south direction."

It is no surprise that these massive clouds of dust may possess the power to stifle a brewing hurricane. What's not entirely clear yet are the forces that cause the periodic changes in dust activity.

"We really don't know what causes dust activity to change from one year to the other, so that's kind of the next big unknown," Evan says. "It's probably related to ocean temperature, but it's also probably related to other things like maybe even vegetation density in the Sahel region. It might be related to how much it rained the year before in that area. There's only been a little bit of work on that, so we're really not totally sure, but that's what I'm starting to try to do now.

Evan hopes to continue his research so that he may come to understand the driving forces behind the dust. While hurricane forecasting is still just a hope for the future, the idea that dust storm and hurricane activity are inversely related introduces a new possible approach to the problem.

So if you're ever sailing across the Atlantic and your ship is caught in a dust storm, be thankful for the dust in your eyes—it may have foiled a hurricane bent on sending you to Davy Jones's locker. WE

Author bio: Natalie Forster is a fifth-year senior majoring in mechanical engineering. This is her second article with Wisconsin Engineer.

Wisconsin Action Toward Kyoto Protocol

Wisconsin lawmaker responds after federal no-show on Kyoto

Photo by Daniel Davenport

The familiar coal power plant at the corner of Mills and Dayton is an example of a large producer of greenhouse gasses.

By Matt Stauffer

Scientists across the globe have come to the consensus that greenhouse gasses, including carbon dioxide, are causing Earth's climate to change. In turn, policy makers are recognizing the threats associated with a major climate shift and are beginning to take action to slow our destructive behaviors. A statewide effort has begun in Wisconsin to reduce our emissions, and ultimately our negative effect on ecosystems worldwide.

The Kyoto Protocol is an international treaty with the objective of reducing the effects of climate change associated with greenhouse gas (GHG) emissions. More than 165 countries have ratified the treaty, which became a legally binding contract as of Russia's entry in November 2004. Each participating country has its own set of individual target emission levels. Most developed countries pledged to reduce their GHG emissions by 5 percent of their 1990 emission level over the period of 2008 to 2012.

The United States and Australia are the only two developed nations in the world who have not ratified the Kyoto Protocol. Leaders in Washington have given several reasons why America is not part of the protocol, with rationale ranging from questioning the validity of global warming to decrying the effect that an energy tax would have on our economy.

So what does this have to do with Wisconsin? Well, to compensate for what critics believe is a lamentable lack of action by the federal government, some individual states are taking initiative by developing their own emissions policies. These states are setting emission reduction standards and rewarding companies for investments in renewable energy sources and efficient development techniques.

States including Wisconsin have taken similar initiative on past environmental issues when the federal government has failed to do so. In 1986, Wisconsin was one of the first states to pass strict acid rain laws and soon after outlawed the production of CFCs, which were contributing to a hole in the ozone layer. Congress eventually passed a national acid rain control policy in 1990.

Ultimately, climate change and greenhouse gas emissions are global problems that demand global action.

It seems history is repeating itself.

"States are taking the lead, but states are not the ideal level to lead," Spencer Black, a Wisconsin state representative and active environmentalist, says. "It should be done by the federal government, working with other countries worldwide."

Representative Black has drafted legislation similar to California's "Global Warming Solutions Act," the first state law of its kind. As of this writing, Black planned to introduce the bill in January when the new legislative session convened. Its passage will likely be difficult, since Democrats failed to take control of the State Assembly last November. (Republicans have historically been less enthusiastic about environmental policy than Democrats.)

"We did this because we didn't think we should just sit on our hands with this issue. Also, states taking action is like a prod to the federal government to take action," Black says.

The legislation establishes a mandatory reporting system to track levels of GHG emissions from businesses and calls for a reduction by 25 percent of our 1990 level by the year 2020. Like the California law, this legislation will allow companies to meet their target emission in the most economical fashion. Market mechanisms such as carbon credit trading and investments in renewable and sustainable energy projects count towards that ultimate reduction goal. There is an emergency provision included that would allow the governor to halt the implementation of the regulations for up to a year should a significant economic problem occur.

The three major industries that will be affected by legislation that limits GHG emissions are utility companies, the transportation industry and the agriculture industry.

The generation of electricity accounts for 30 percent of annual U.S. GHG emissions.

States have considerable authority over the production of electricity within their borders, and many are already encouraging the development of sustainable energy production. Wisconsin's renewable portfolio standard requires that the state will produce 10 percent of its electricity from renewable sources by 2015. Wisconsin also offers "green pricing," which allows customers the option of paying a premium on their electric bills to have their portion of power be provided by designated renewable sources.

Transportation accounts for 27 percent of GHG emissions annually, so any plan to reduce emissions must include efficient transportation measures. Again, Wisconsin has taken some steps toward this goal already. For instance, on March 1, 2006, Governor Jim Doyle issued an executive order calling for increased use of renewable fuels in vehicles owned and operated by the state. The order requires all agencies to reduce the use of petroleum-based gasoline in the state's fleet 20 percent by 2010 and 50 percent by 2015. Reducing use of petroleum-based diesel fuel 10 percent by 2010 and 25 percent by 2015 is also part of the order. To meet this goal, vehicles will be filled as often as possible with ethanol blends E-10 or E-85 or with biodiesel.

"States are taking the lead, but states are not the ideal level to lead. It should be done by the federal government, working with other countries worldwide."

-Spencer Black

Agriculture contributes 7 percent of the total GHG emissions in the United States and is the major source of nitrous oxide and methane, two other harmful GHGs. Aside from reducing agricultural emissions, there are opportunities for Wisconsin farmers to turn a profit from this new legislation. As demand for corn- or soybean-based ethanol increases, the price of these crops will likely increase, making them more valuable.

There are also projects to offset emissions from other sectors by sequestering carbon in plants, which naturally consume carbon dioxide and convert it into oxygen and carbon by the process of photosynthesis. However, Wisconsin's resources don't really lend themselves to trying to tackle this approach alone.

"The process of carbon sequestration by plants is extremely slow business," says William Bland, UW-Madison professor of soil science. "We would be better off to focus on conservation rather then on sequestration." While it is difficult to precisely measure the exact amount of carbon that a given plot of vegetative land can sequester, it's quite clear that Wisconsin's farmlands are not enough to curb the enormous amounts of carbon dioxide that we are producing daily.

Ultimately, climate change and GHG emissions are global problems that demand global action. The United States is the world leader in emissions but, as evidenced by its reluctance to ratify the Kyoto Protocol, has done little to address this problem on a federal level. State action such as Black's proposed legislation cannot substitute for a coordinated national effort, but it can help to provide the framework for such a response. WE

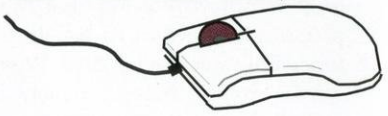
Photo by Daniel Davenport

Ethanol 85 pumps such as this one located at a local Stop-N-Go are beginning to appear more commonly throughout Madison.

Author bio: Matt Stauffer is a junior in materials science and engineering. This is the last article he will write for a while, since next semester he will be in Everett, Wash. working for Kimberly-Clark.

FROM REMOTE TO MOUSE:

Internet promises to change how we watch TV



By Matt Treske

The way we communicate has changed dramatically over the last century. From the telegraph to the radio, the television to the internet, each step has revolutionized the way we receive information. Especially in recent years, the number of media making their way into our living rooms has increased at a rapid rate. Many of us no longer rely solely on the daily paper or scheduled television program for our information, news or entertainment.

Receiving television through the internet is a fresh form of media sharing that is quickly gaining popularity. The basis behind internet television is nothing revolutionary, but the technology and possibilities it will allow for are.

The average college student has most likely witnessed internet television on many occasions–whether visiting a website to stream the latest news clips, downloading cartoons and videos over peer-to-peer (P2P) networks or logging on youtube.com to rate the most recent video uploads.

But the possibilities of internet television do not end at one and a half minute clips of Brett Favre's post game press conference or home videos of cats desperately clinging to the fins of revolving fans. The technology promises to some day bring us live or on-demand television at any time, any place and on nearly any screen.

Currently, most television viewers receive programming through analog signals, satellite receivers or cable connections. With the introduction of set-top boxes such as the "Slingbox," which allows consumers to watch cable, satellite or digital video recorder programming wherever they are (along with the ability to stream live television programming right onto their computer screen), the internet is making a big push for its own spot in the living room.

"That way you can TIVO something on your TV downstairs and transfer it wirelessly to another TV or even cell phone," Donald Jackson, a telecommunications writer and analyst, says.

Two forms of "TV over the internet" currently find themselves at the center of discussion and debate all over the globe. One of them is Internet Protocol Television, better known as IPTV, and the other is the more generically named "internet television."

IPTV will resemble the cable and satellite television of today — offering all the same features, including on-demand and pay-per-view programming. It uses company-owned hardwiring to deliver television programming to an internet protocol address. However, this similarity to cable television makes the technology geographically bound.

Internet television, the more intriguing of the two, is more of an outgrowth of the already exploding phenomenon that is the internet. Internet television differs from IPTV in terms of the way it will be sold, distributed and received.

With internet television, programmers will have a direct connection with the consumer. Their programming will be shared between computers much like information is shared between computers today. This makes it much easier for publishers to target niche audiences, making the programming cheaper to produce and distribute. In return, users are provided with a greater selection of television programs.

The way programming will be shared over the internet remains to be seen. There are several competing ideas on how to send consumers programming over the internet, all of which seek to please the viewer in ways conventional television cannot.

The most obvious choice for sending consumers programming over the internet is to stream it to their computers from a central server. Streaming in this manner, however, is highly inefficient, and it puts an enormous amount of strain on the central server.

One solution to this problem is to take a P2P style approach. The complete program will be made available via stream from the network's central server. Bits and pieces of this program will then be stored on every consumer's computer. Each computer will then upload these pieces to other viewers. This P2P approach would take strain off the central server and essentially create thousands of small servers from which to download information. This process is similar to commonly known data sharing programs like Napster and Bittorrent.

Jackson, however, believes that the technology needed to transfer much higher amounts of data will be there by the time internet television is ready to take off, thus making the shift to a P2P network unnecessary.

"On a P2P approach, you are inherently dependant on somebody else's computer working properly'" Jackson says. "Networks are getting faster and faster, and they can actually support this stuff. High speed is getting so cheap… fiber optics are everywhere."

Production studios will also save money with internet television–its cost is not nearly as high as its cable equivalent. This allows television programs to use excess money to offer a greater number of select programs, in addition to traditional programming, for more narrow target audiences. These targeted programs will be more relevant to viewers' specific entertainment or intellectual values.


Photo by Steve Koralesky

This is one college student's internet TV setup. This student was motivated to hook up his computer to the TV as most computer screens are too small for comfortable viewing. Most computers can be connected to a television with an s-video cable and a 3.5 mm audio cable, both components found at your local electronics store.

However, internet television will not take off unless companies are able to generate income. Several ideas are being considered that would allow both the company to succeed and the consumer to get what he or she wants.

IPTV will be able to generate money the same way cable and satellite television companies do today. On the flipside, internet television networks will need to be more innovative if they want to cash in. Outside of charging the consumer a fee per download or signing them to a contract for a certain set of channels, internet television could mimic the industry they are aiming to replace by showing ads during programming, but in a new way. By running ads through an internet television channel, the advertiser knows exactly who's watching, and what viewers' preferences are, allowing for a custom set of commercials for each viewer.

Many consumers, however, have fled to internet television to get away from advertisers and obnoxious commercials. Internet television, therefore, could also make money by giving consumers the option to skip over commercials for a monthly premium.

The internet television revolution is on the horizon and is set to explode sometime within the next decade. Buckle your seatbelts, make waste of your dish and toss out your coaxial cables because you may soon be watching the next episode of CSI on your cell phone.

Author bio: Matt Treske is a freshman engineering student. This is his second article for the magazine.

UW-Madison Hybrid Vehicle Team drives towards the next generation of SUVs

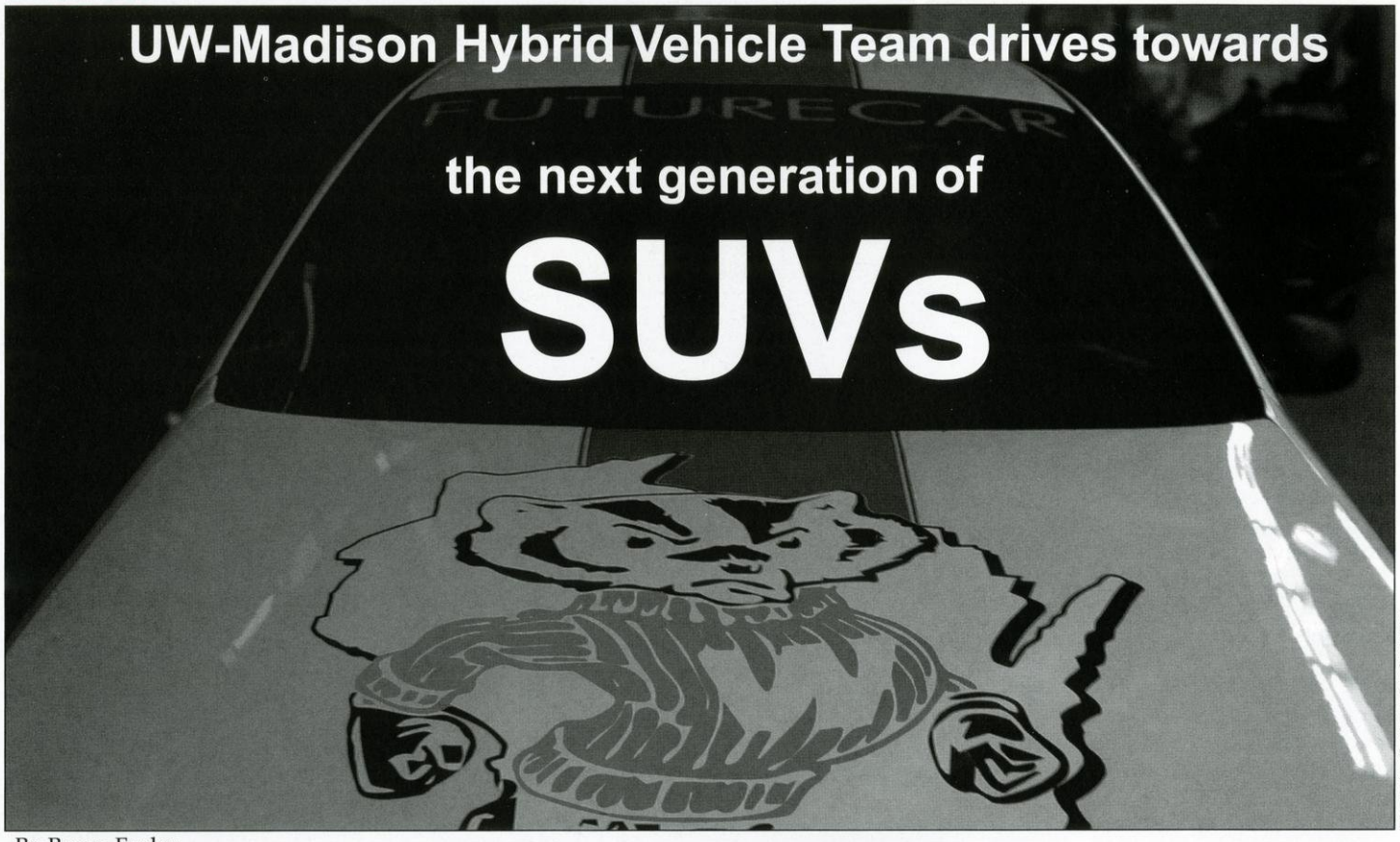


Photo by Zachary Prefontaine

By Bryan Fosler

The UW-Madison Hybrid Vehicle Team has been stirring up press about creating a more fuel-efficient SUV with their new Chevrolet Equinox hybrid. With a second-place finish in the second year of a four-year competition, the alternative fuel SUV is already making waves.

The team is composed of about 30 members, primarily underclassmen, with majors ranging from mechanical engineering to philosophy; all have little or no previous experience with automotive hybrids.

The Hybrid Vehicle team has been around for more than 15 years, and 90 percent of the members are undergrads, even though most schools only trust grad students to work on research of this scale.

Becky Gunn, the team leader of the Hybrid Vehicle Team, directs the crew.

"The main purpose is to enable students to learn more about cars and hybrid technology and inspire creative ideas for vehicle technology for the future," Gunn says. "We're students learning about the future of automotive technology."

The team's main focus is a program called "Challenge X" that was started in 2005 by the U.S. Department of Energy (DOE) and General Motors Corporation (GM). The Challenge X competition began when these groups saw the need to explore more advanced vehicle technologies that address energy and environmental problems.

The four-year-long program includes annual competitions to rate the vehicles in several different categories. The final goal is to produce a 99-percent-complete consumer vehicle.

Not only did [the team] take home a second-place overall ranking, they also earned 11 awards in categories ranging from Best Technical Presentation to Best Engineering Fabrication and Workmanship.

In the first year, the teams perform research and simulation work to determine the design of the hybrid. The team then submits its completed proposal in hopes of getting selected to pursue the challenge.

If the team is lucky enough to get the keys to a brand new Chevrolet Equinox, they are able to start the competition. Back in 2005, UW-Madison won this opportunity and began working on their vehicle, the "Moovada".

"To see something that I've worked on from computer simulation, through the times when the car was completely torn apart, to eventually being put together and able to drive the car is an amazing experience," Gunn says.

Integrating the powertrain and all other components into the Equinox is the main concern of the second year. Because UW-Madison has extensive experience with alternative fuels such as biodiesel, the team chose to work with a biodiesel hybrid engine coupled with an electric motor.

Currently in the third year, the team is working hard to fine tune the vehicle. The team and its competitors are scrambling to work out all the kinks in the drivetrain systems and toiling to get the finished car looking clean and streamlined. Final adjustments to the Moovada will improve its handling, driving and ultimately its consumer appeal.

The fourth year consists of additional consumer acceptability modifications. The competition will conclude with a road rally ending in Washington, D.C. This will chal-

lenge the students to design their vehicle so that it can operate reliably under normal passenger-vehicle driving conditions.

What sets the Moovada apart from other hybrid vehicles competing in Challenge X?

"We spend hours working with the best materials and taking extra care to make sure no detail of the car is left unfinished or looking unprofessional," Gunn says. "Our team won the award for workmanship last year for producing a vehicle that appears to be something off the GM assembly line."

In addition to completing the hybrid vehicle and participating in the yearly competitions, one part of the requirements of Challenge X is to participate in some type of outreach program. The UW-Madison team plans to meet and exceed this requirement this year. For example, the team holds science- and math-related events on campus, and also general publicity events to gain sponsors. This year the team is becoming more involved with children of all ages, allowing them to tour the garage and possibly develop an interest in the project and in hybrid vehicles in general.

In June 2006, the team placed second overall out of 17 well-known universities throughout North America in the Challenge X competition. Not only did they take home a second-place overall ranking, they also earned 11 awards in categories ranging from Best Technical Presentation to Best Engineering Fabrication and Workmanship. Their faculty advisor, Dr. Glenn Bower, won the award for Outstanding Long-Term Faculty Advisor as well.

Photo by Zachary Prefontaine

This is the Chevrolet Equinox, named the Moovada, that was given to the team for the Challenge X competition.

The Moovada is a "through-the-road" 4-wheel drive hybrid, meaning that a biodiesel engine runs the front two wheels, and an electric engine runs the rear wheels. The team's improvements have boosted the Moovada's fuel efficiency from 17 to 36 miles per gallon (mpg).

Beyond doubling the mpg of the standard Equinox, the Moovada has earned the Ultra Low Emission Vehicle (ULEV) certification by the California Air Resources Board by emitting 50 percent less harmful emissions than the average new car.

The Hybrid Vehicle team's weekly meetings consist of a recap of what the team is currently working on and usually include a team-building activity. Among the favorites are paper airplane races, creeper (a dolly used to work under cars) races and anything that involves dropping objects from a balcony. The meetings are usually Fridays at 3:30 p.m. in the Mechanical Engineering Building, and new students are always welcome to join.

After all of their hard work, how does team leader Becky Gunn feel about their chances for Challenge X?

"I'd be lying if I said I didn't expect us to get first this year," Gunn says.

Author Bio: Bryan Fosler is majoring in biomedical engineering and wishes the best of luck to the Hybrid Vehicle Team in their 2007 competition.

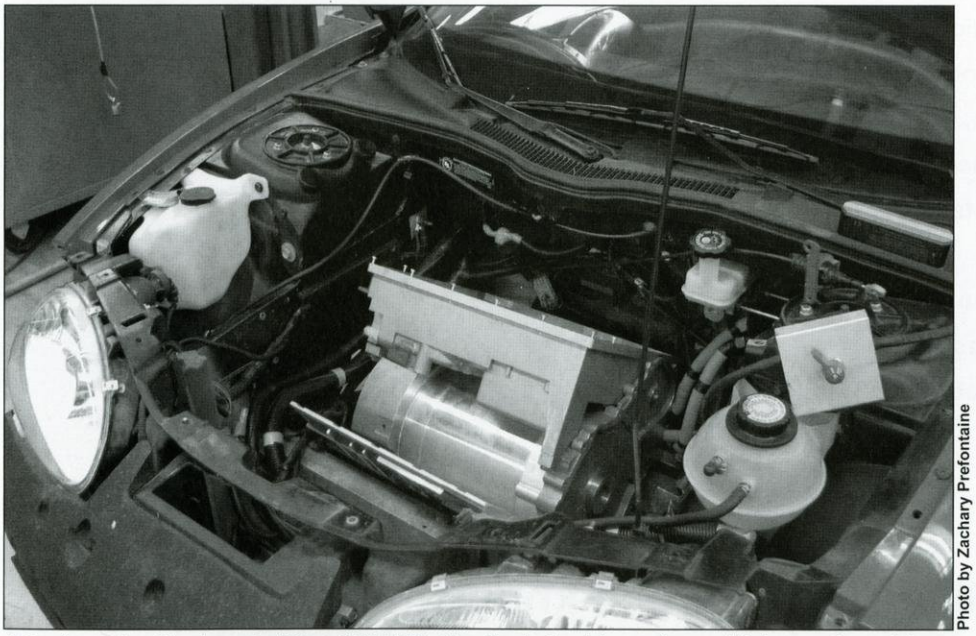


Photo by Zachary Prefontaine

A look under the hood of the GM EV1, the first electric motor vehicle produced by an automotive company.

JUST ONE MORE

The finest in eclectic humor

By Kari Jordan, Jamie Tabaka, and Casey Weltzin

FOUND: One overstuffed backpack. Probability of belonging to an engineering undergrad student, 99.87271828 %.

Contents include:

- 6 pack of Red Bull
- Table of trigonometric identities
- Philips screwdriver / mini screwdriver set / eyeglass screwdriver
- Soldering iron
- Spare pocket protector
- Cell phone with 2 megapixel camera, MP3 player, Bluetooth, text messaging... and a Beastie Boys ring tone
- A *balanced* checkbook
- Appointment book (LAN party at Steve's this Friday!!!)
- The power cord from an appliance you saw in the trash (who would throw that out?)
- Polyhedral dice set for upcoming D&D get-together
- New Dilbert comic to hang up at work
- 15 mechanical pencils, 2 of which actually have lead left in them
- $537 worth of unreadable engineering textbooks
- Black book of phone numbers....for study groups and pizza delivery
- More computing power than the first space shuttle...and the entire college of liberal arts
- 3 day old sandwich, which explains funny smell
- Roll of duct tape
- Alarm clock for nap in Union South
- Sharpie for labeling lab samples
- Collapsible ruler (measures metric and English units, and entertains like a Jacob's ladder)
- Hacky sack
- *Wisconsin Engineer* magazine

... If this sounds familiar please let us know, thank you.

~Wisconsin Engineer Staff

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