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wisconsin engineer

NOVEMBER 2006 VOLUME 111, NUMBER 1

Mind over matter

Brain-computer connections p. 10

Wisconsin Engineer

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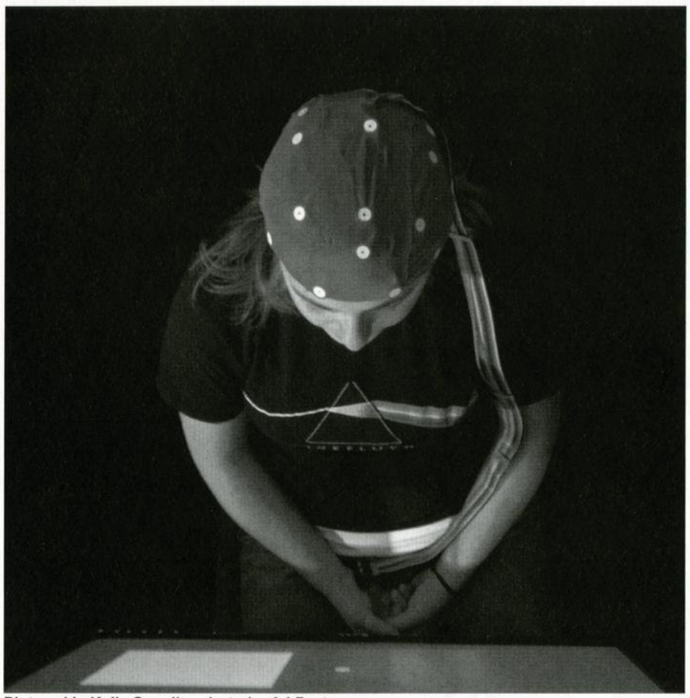
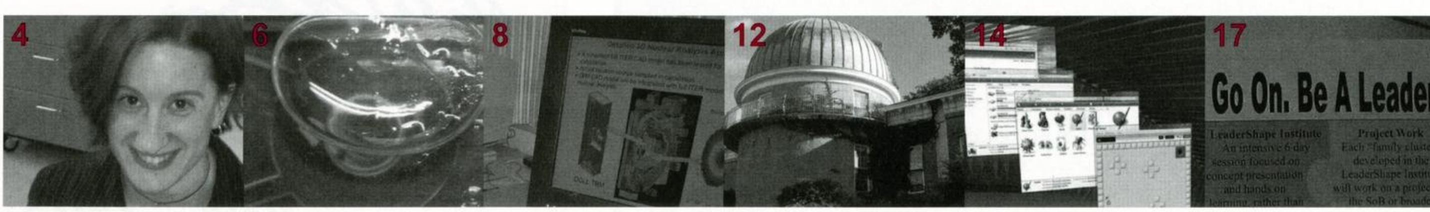
COVER STORY



Pictured is Kelly Scanlin, photo by AJ Portz

FEATURES



COMMENTARY

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Kyle Oliver
Writing Editor

Game, set, match

This is my seventh and final editorial for Wisconsin Engineer in the nine semesters I've been on staff. Indeed, when I graduate in December, I think it will feel stranger to no longer be writing for the magazine than to no longer be an undergraduate. But you know what feels even weirder to me? The fact that Andre Agassi is no longer playing professional tennis.

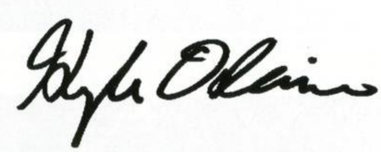
You don't have to have been much of a tennis fan to perceive that things have changed now that this ubiquitous icon—who's been playing professionally since most of us seniors were like two or three years old—has retired. Sure, there are other athletes who have played this sport or others for as long. But Agassi was, in my opinion, as much a presence as any of them, a true touchstone figure in the American cultural (not just athletic) landscape. The hair, the wives, the outfits, the personal growth, the grand slams, the commitment to philanthropy...the camera commercials from back when MC Hammer still had a cartoon show—weren't we all tacitly aware of this stuff, even if we weren't tennis fans?

It's hard for me to answer that question for myself with much objectivity, because over the past two years I have become a tennis fan. A pretty serious one. "Strangely obsessed" my roommates might say. I went as Agassi for Halloween, if that gives you some idea—Agassi circa 1999, mind you, so I could shave my head but spare my beard. I've now read and thought so much about Agassi that I can have no real sense of what impact he had on my life even just nine semesters ago when I started school at UW-Madison.

So why am I writing about all this in Wisconsin Engineer? Well, to be perfectly honest, my reason isn't very good. You see, I've often made a bit of a game out of trying to write my editorials on topics pretty far afield from engineering only to bring them back around to some kind of relevance at the end, and an early draft of this editorial did exactly that. In this draft, I had come up with what I thought were some interesting points to add to David Foster Wallace's discussion of tennis equipment in his recent article "Federer as Religious Experience." The whole thing was very cute and had a couple of good jokes and an evolution analogy, and I ended it with the observation that technology can change our lives for the better in totally unexpected ways, such as partially enabling Agassi's power-baseliner style of play. This draft made for a good sign-off, I thought, because when I first started writing editorials for Wisconsin Engineer I was more likely to apologize for technology than to praise it. How better to top off my time at the magazine and as an undergraduate than to reflect on how those experiences have changed me? (Plus, this draft was an implicit shout-out to my friend and former editor-in-chief Karen Mandl, who also wrote her final editorial about sports.)

But that's not really why I wanted to write about Agassi. I wanted to write about Agassi because sign-offs tend to be as much about what we'll miss as what we've learned. As I sat down to write my last editorial, I thought about how much I miss Karen and her goofy game-day cape. About how much I miss Emily Kleiber, my friend from the lakeshore dorms who taught me how to play tennis. And about how much I will miss my roommates of two years, Matt Waldron and Dan Campbell, with whom I watched Agassi's otherworldly (second-to-)last stand against Marcos Baghdatis in August from the comfort of Lucky's Bar & Grille, the place where the three of us always go to watch sports and grumble about classes.

Well, I haven't quite needed shots of cortisone to get through four-and-a-half years of undergraduate engineering training, and neither my tennis game nor my editorials have earned me legions of fans. Still, it seems as if the best way to reconcile my inclination to reflect on both what I've learned and what I'll miss is to take a page from Agassi and use this final opportunity just to say thanks you—in my case, to everyone who's supported me as a writer, as an engineer, and as a person during my time at UW-Madison. I hope you know who you are. Thanks, and God bless. WE



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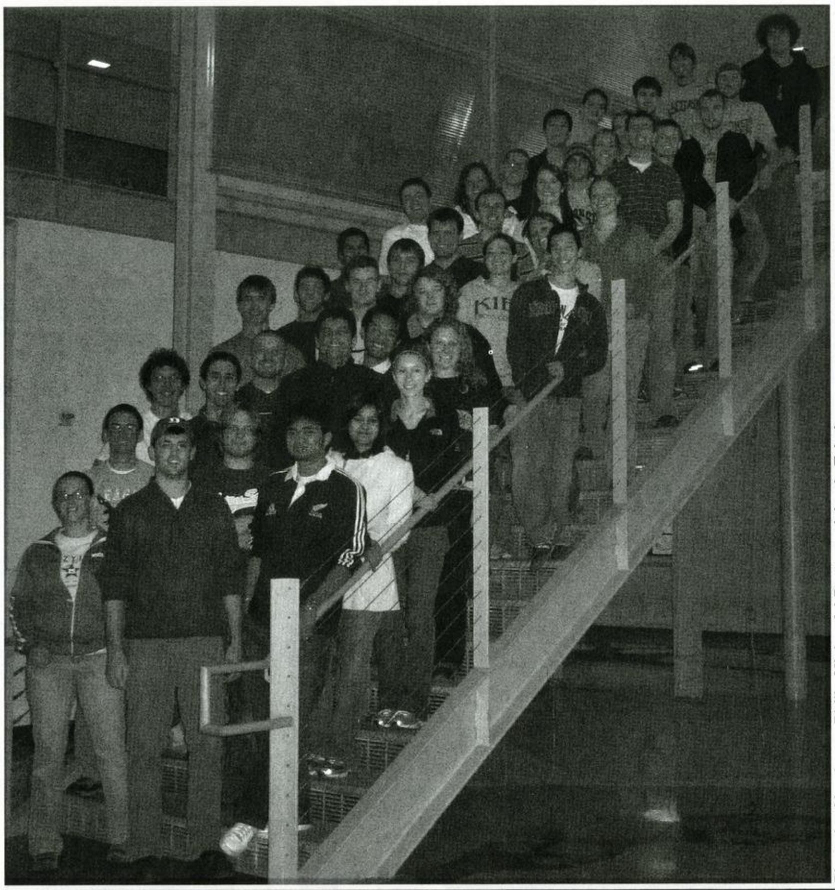


Photo by Alex Long, Philip Micha, AJ Portz, and Jamie Tabaka

BME professor stresses world beyond microscope

Photo by Steve Ng and Pete Penegor

Kristyn Masters specializes in biomaterials and tissue engineering.

By Bryan Fosler

Kristyn Masters is stirring up a lot of press over her research and teaching at UW-Madison. Her work on heart valves is not only groundbreaking but also helps the medical community learn about heart valve disease, a highly understudied subject. In addition to her research, Masters teaches a one-of-a-kind course on global issues involving politics, ethics and social implication of technology that pushes students to develop a universal perspective on biomedical engineering issues.

Coming from a chemical engineering background, Masters is one of the newest members to join the biomedical engineering faculty at UW-Madison. She began her research as a sophomore at the University of Michigan after winning a summer research scholarship. When the end of summer rolled around, Masters's advisor asked her to stay with the lab. Masters eagerly accepted and continued to work in the lab until she graduated. As she became more experienced, she was eventually assigned other undergraduate students to work under her.

"By the time I had done undergrad research for about a year, I knew that I wanted to stay in academia" -Kristyn Masters

"By the time that I left that lab, I was more senior than the graduate students there," Masters says. "I never really felt like an undergrad in that lab."

Although Masters has both her bachelor's degree and doctorate in chemical engineering, her true interests lie in the biological applications of engineering. When Masters was choosing her major, the biomedical field was disorganized and the curriculum varied from school to school, prompting her to start in chemical engineering. Even though all of her classes were strictly within chemical engineering, her research had always been in biomaterials and tissue engineering.

"I would have access to more students with similar interests to my research if I was in a bio-related department," Masters says of her reasoning for teaching biomedical instead of chemical engineering.

Just one year into her undergraduate research, Masters decided to pursue an engineering career in academia. Masters says the reason she decided to teach was because of "great mentors."

"By the time I had done undergrad research for about a year, I knew that I wanted to stay in academia," she says.

Here at UW-Madison, Masters teaches BME 510, which reviews biomaterials and cell biology while teaching students how to combine living cells with others materials to engineer tissues. Masters also teaches BME 601, currently a special topics course exploring the political, ethical, social and global issues in biomedical engineering. A striking theme in the course was the "evolution of thought and ideas."

"Everyone came out with a different opinion or a different view of at least one topic

Kristyn Masters rock climbs as a way to unwind.

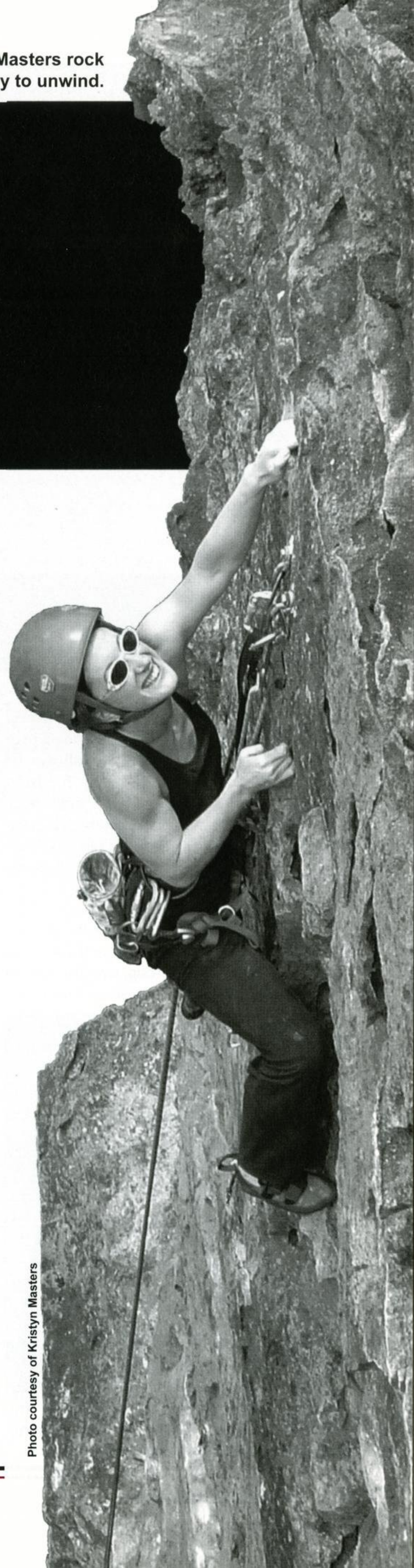


Photo courtesy of Kristyn Masters

[redacted]

that we talked about," Masters says. "Making people more aware of ethical and political issues makes me feel like I am doing something worthwhile."

Masters believes that her scientific, rather than philosophical, standpoint separates BME 601 from other similar courses on campus.

Despite Masters's hectic schedule, she still finds time to participate in her share of activities. In fact, before beginning her position at UW-Madison, Masters and her husband spent nearly a year rock climbing around the world. From Australia to New Zealand, Thailand and Mexico, her experiences abroad sparked an interest in starting BME 601. Masters says that the social and economic differences between the United States and the countries she visited were astonishing.

In addition to teaching, Masters also researches how cells interact with biomaterials. One application for this work is engineering cardiovascular tissues.

Masters has received press attention for her research in heart valve tissue engineering. She explains that this research is important because it is highly understudied, and it has the ability to teach researchers more about heart valve disease. Masters studied heart valves in her post-doctoral research and decided to revive the task for a Zoology 152 student's independent study.

"One of the first experiments that we did, [which] I thought was a simple little thing, turned out with these results that were really striking…it evolved into so many different projects," Masters says. She didn't mean for the heart valve research to take over her lab, but it did anyway.

Masters has a few tips for aspiring engineers. She encourages students to study abroad not only to grasp cultural differences, but also to gain global perspective. Pay attention to social implications of technology on the world, she advises. Also, Masters reminds students that "research is education" and is the simplest way to gain real-life understanding of course material.

But she reminds students that course material shouldn't be the only priority in a student's life.

"Unwinding is a necessary part of succeeding in school," Masters adds. So when you can, relax and take time to calm down from all the pressures of school. After all, it worked for Professor Masters. WE

Author bio: Bryan Fosler is a sophomore majoring in biomedical engineering. He has an interest in tissue engineering and stem cell research.

Getting in focus:

Photo by Muhamad Asyraf Yahaya

High-tech lenses give "lab on a chip" its perspective

By Matt Stauffer

Nature tends to provide a useful guide to simplify complicated processes. The human eye allows us to perceive our surroundings by focusing incoming light through an adjustable lens. This biological photodetector, which is hard wired to our brain, is where the light stimulus is decoded to an image, thus allowing us to see.

Engineers at UW-Madison have, in essence, replicated the sensory and self-focusing functionality of the human eye for use in special sensory lenses. These autonomous lenses are being used in a diagnostic tool known as "lab on a chip."

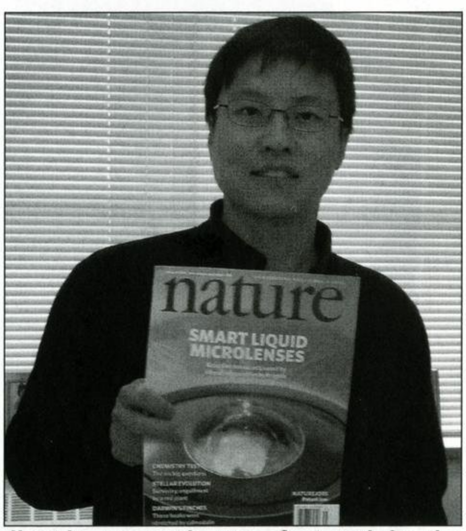


Photo by Muhamad Asyraf Yahaya

Jiang's research was featured in the August 2006 issue of *Nature* magazine, Volume 442.

The goal of lab on a chip research is to have a portable device capable of doing diagnostic tests such as genetic analysis, drug screening and water sampling. Lab on a chip is also capable of chemical synthesis of fluids. The analysis of a sample is accomplished using a light source, a receptor and revolutionary lenses that are responsive to their environment. Amazingly, these handheld laboratories are made in about an hour, for a quarter of the cost of a comparable piece of lab equipment.

A lab on a chip is produced by adhering a polycarbonate gasket called a hybriwell to a glass slide. To do so, channels must be created on the slide to direct the flow of fluids through the device. These microfluidic channels are made by covering the slide with a photopolymer and a mask placed where the channels should be. Exposing the chip to ultraviolet light causes the exposed photopolymer to solidify, forming ridges, and leaves the masked portion unaffected. This fabrication process is patented through the Wisconsin Alumni Research Foundation by David Beebe, a UW-Madison professor of biomedical engineering.

Lenses are not a new technology; they have been used for years in many applications including microscopes and diagnostic probes. Traditional lenses are focused using external control systems that tune the lenses. External lens systems have historically been large and bulky, and some include electronic components that are not capable of being submerged in liquid.

Hongrui Jiang, a UW-Madison professor of electrical engineering, has developed and fabricated an entirely autonomous lens that requires no external control to change focal length. Through the use of hydrogel polymers, these lenses sense their environment and change focal lengths in response to different stimuli.

The hydrogel's chemistry can be specifically tuned to be responsive to predetermined stimuli including temperature, pH, light, electric field or, most importantly, specific proteins and antigens. The fact that the gels can be responsive to a single protein or antigen allows lab on a chip technology to be used in biochemical analysis.

The lens is made possible, essentially, by the intrinsic property of water and oil being immiscible, meaning they do not mix. The water is surrounded by hydrogel and capped by a glass slide with a hole in it. The hole is the lens. Above the lens is oil, and below it is water. The interface of water to oil forms a meniscus (a crescent-shaped surface of liquid) that can bulge up or bow down in response to changing water volume. The microfluidic channels on the chip allow fluid samples to come into contact with the hydrogel.

When the gel comes in contact with the stimuli it is set to detect, it contracts or expands, applying pneumatic pressure to the water it encapsulates. This action changes the focal length of the lens. The hydrogel therefore functions as both a sensor and an actuator. Hydrogel can change its volume by as much as a factor of 1000.

"Smaller is not always better," Jiang says. Visible light has an amplitude of just less than one micron. If the lenses get too small, the physical laws governing the refraction angle of the lens break down. The lenses are now about one millimeter in diameter. Jiang hopes to be able to effectively produce lenses of about 10 microns in diameter. This is thought to be the "ideal" size for the lens because the compound eye of a housefly is made of an array of lenses this size.

"If it is right for nature, it is probably right for us in the lab," Jiang says.

Using an array of lenses all employing the same hydrogel, researchers can get a sense of spatial distribution of an antigen or protein in the fluid channel, a capability that was not previously available. Prior to autonomous lenses, many probes much larger than the fluid channel itself would be needed to gauge a distribution.

Jiang's group is currently focusing its efforts on making the lenses smaller and producing them more efficiently. He hopes to develop this lens technology into an imaging system that would use three-dimensional spherical lenses to give a larger field of view and provide optical feedback. His ultimate goal is to produce an array of imaging lenses small enough to be packed into a biocompatible capsule that, when swallowed, could capture a series of pictures of the digestive track as the capsule passes through the body.

At present, labs on a chip and autonomous lenses are only fabricated in academic settings. However, the fabrication process is cheap, and the applications of the chip are expansive. It is only a matter of time before this process is industrialized to produce diagnostic tools that will be handy for users and lucrative for investors. WE

Author bio: Matt Stauffer is a junior majoring in materials science and engineering.

A CLOSER LOOK

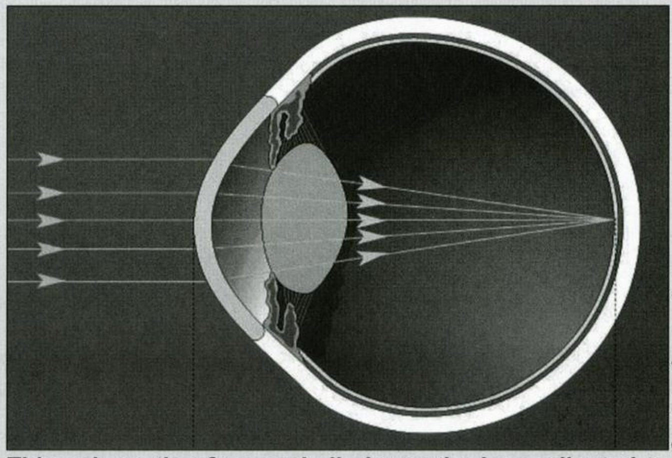
Visit http://mnsa.ece.wisc.edu/ for more information about the Micro-Nano Sensors and Actuators Lab.

Photo by Muhamad Asyraf Yahaya

This autonomous lens requires no external control to change its focal length; it senses its environment and changes its focal length in response to different stimuli.

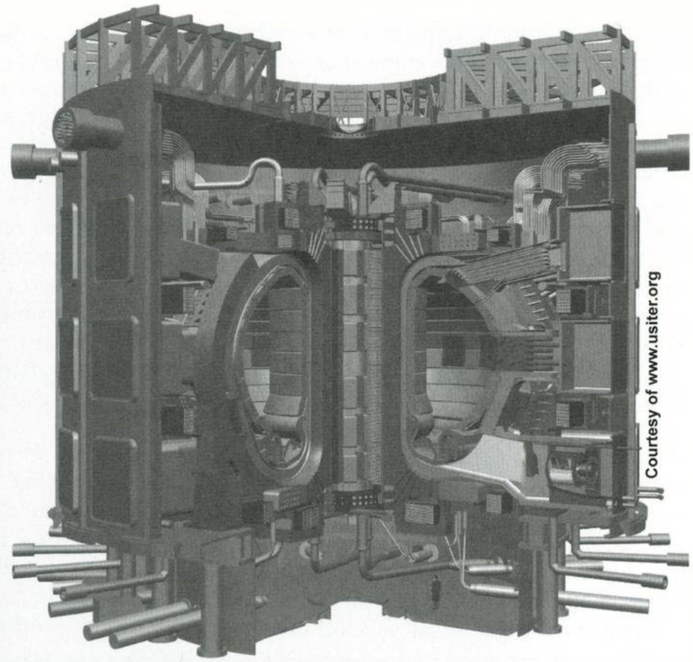
Photo by Muhamad Asyraf Yahaya

These gel capsules are the target size for the biocompatible capsules Jiang hopes to develop.



Courtesy of www.usiter.org

This schematic of an eyeball shows the lens adjusted to focus the incoming light. Jiang's autonomous lens (top photo) replicates the sensory and self-focusing functionality of the human eye.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Thinking Inside the Box

UW-Madison contributes to international fusion research

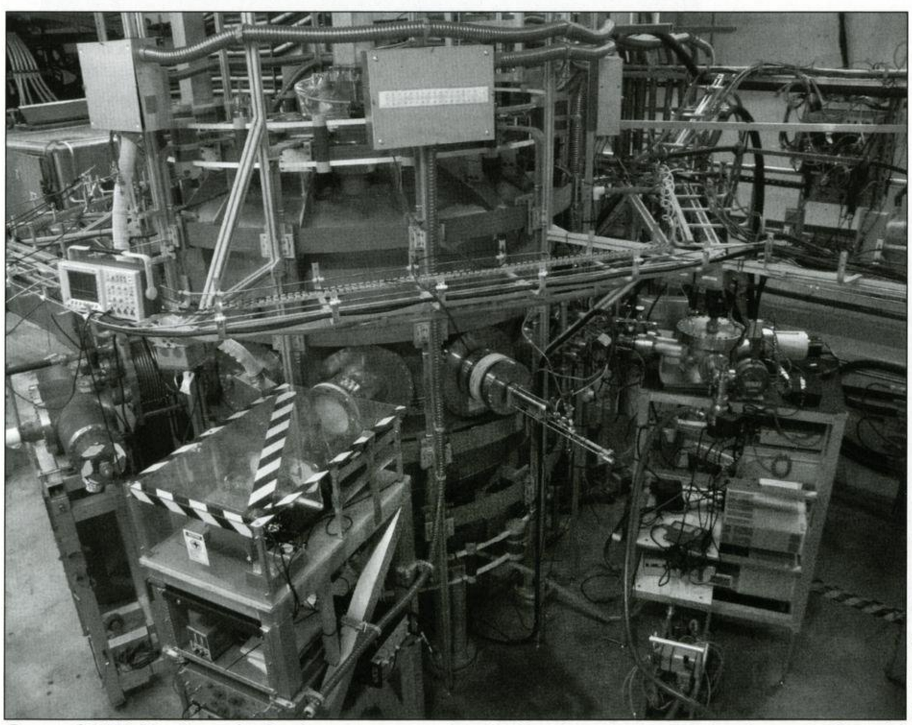


Photo by Dan Davenport

One of UW-Madison's fusion reactors is similar in shape to the International Thermonuclear Experimental Reactor.

By Paul Kamenski

Nobel laureate in physics Pierre-Gilles de Gennes once said, "We say that we will put the sun into a box. The idea is pretty. The problem is, we don't know how to make the box."

Researchers at the Fusion Technology Institute along with physicists and other engineers at UW-Madison are collaborating with scientists and engineers from Korea, China, India, Russia, Japan, the European Union and the United States on a fusion research project. This multibillion-dollar project aims to test technology that could be used to construct fusion-based power plants potentially operable in 50 years.

The "box" that researchers have been painstakingly designing, redesigning and testing to "hold the sun" is known as the International Thermonuclear Experimental Reactor (ITER). With construction beginning in 2007 in Cadarache, France, ITER will be the mecca for fusion research.

"ITER is a necessary, major step in demonstrating the feasibility of producing power from fusion energy," Mohamed E. Sawan, UW-Madison research professor of engineering physics and associate director of the Fusion Technology Institute, says.

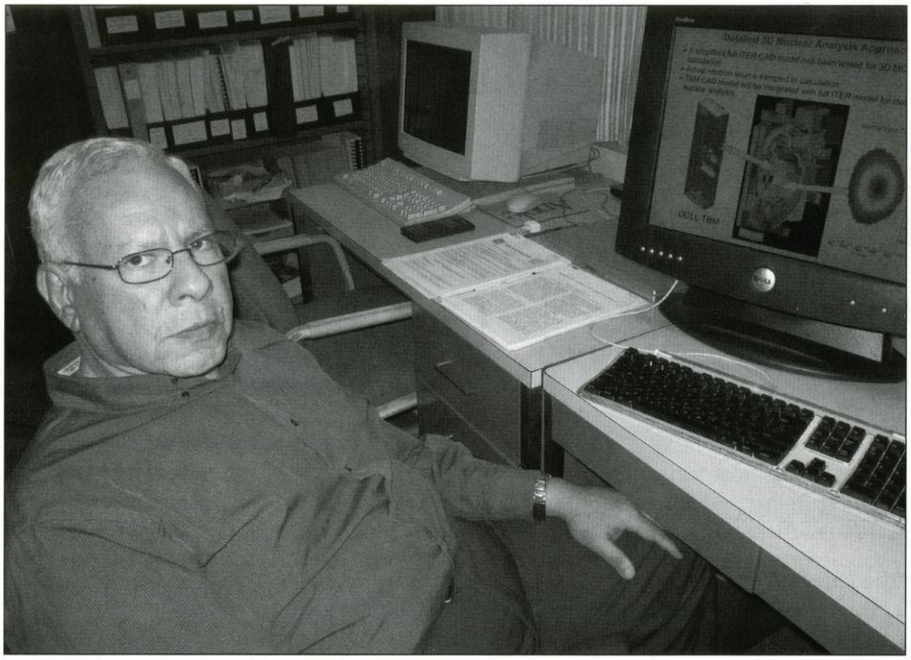


Photo by Dan Davenport

Sawan displays a UW-Madison-created analysis approach, which uses CAD drawings and computer simulations to test components to be used in ITER.

Fusion basics

Fusion is a process where nuclei combine, releasing tremendous amounts of energy. The nuclei being fused at ITER will include two types of hydrogen, one with a single neutron (deuterium) and one with two neutrons (tritium). Although tritium is not readily available, future reactors will ideally be self-sustaining, producing as much tritium as is consumed within the reactor. The fusion reaction will take place in plasma, the same material which makes up the sun.

"Plasma is a combination of ions and electrons," Sawan explains. Even at low densities, the high energy—and consequent high particle velocities—makes collisions probable. Those collisions are necessary for fusion to occur. Typical operation of a reactor would include first "initiating" the plasma source. Once initiated, researchers are hoping to sustain the release of energy from the plasma for a 400-second pulse. Energy from the fusion reaction could then be absorbed into an energy blanket containing excitable lithium. Finally this energy could then be converted to electricity in future power reactors. Considering the time necessary to recharge the system, the reactor will be in actual operation only 20 percent of the time, at best.

"We say that we will put the sun into a box. The idea is pretty. The problem is, we don't know how to make the box."
- Pierre-Gilles de Gennes

A 400-second pulse from the reactor would mark the longest (terrestrial) sustained fusion reaction to date. Although ITER is a step toward producing commercial fusion power plants, it will not be used to produce electricity. The ITER project, in a way, is a test of how to make de Gennes's box. With extreme conditions beyond those of any current experiment, ITER will test the reactor design, materials selection and various forms of diagnostic instruments, all of which could be employed in a future demo nstration of a fusion power plant. Testing the design of the reactor and its components through computer simulations has been the main focus of UW-Madison's involvement in ITER.

On Wisconsin

"We developed a unique capability here [at UW-Madison], in which we can take the CAD model of any component and perform neutronics calculations in the CAD model as is," Sawan says. Components are first designed using CAD (Computer-Aided Design) anyway, so the ability to streamline design and simulated testing has vastly improved the turnaround time for analysis.

The previous difficulty was that analytical mappings of all the reactor's components needed to be inputed by hand for each simulation. This tedious geometrical challenge required many hours of work and was difficult to completely overcome. Design groups from all over the country are developing the U.S. portion of the components to be used in ITER, and because of UW-Madison's newly developed software, many of those CAD designs are being tested right here.

Testing performed on campus of the inner wall of the reactor is nearly complete as the 2007 construction date approaches. Further tests are being run on diagnostic instruments that are to be placed in various experimental ports built into the reactor wall. In addition to analyzing diagnostic instruments, UW-Madison researchers are working on designing blanket prototypes to absorb the reactor's energy, which will also be tested in the experimental ports of the reactor.

In addition to UW-Madison's research contributions to ITER, professor of engineering physics Raymond Fonck was appointed chief scientist for the United States ITER Project Office in May.

Fusion Future

When asked if he is convinced that fusion will someday play a role in producing commercial power, Sawan says, "yes, eventually, but maybe not in my lifetime." With much materials testing to be done, theories to be proved or disproved and designs to be checked, commercial fusion power plants have many bridges to cross. Still, if all goes well, by 2016 ITER may create a little bit of sun here on Earth. WE

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

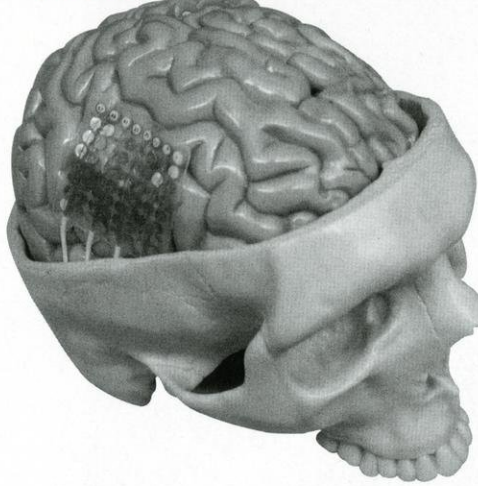


Photo by AJ Portz

Mind over matter:

Researchers forge brain-computer connections

By Marshall Stringfield and Victoria Yakovleva

The Jedi and Sith from Star Wars, Jean Grey from X-Men and Matilda from the Roald Dahl book of same name all possess a similar capability: the power to move objects with their minds. Though once considered mere science fiction, the ability to use thought to move objects is now approaching reality.

Justin Williams, UW-Madison assistant professor of biomedical engineering and head of the Neural Interface Technology, Research and Optimization (NITRO) lab, has been working with his team of graduate students to help people with "locked-in syndromes." These are "people whose brains are just fine, but for whatever reason they have no way of getting information out," Williams says. Such people include patients who have endured amyotrophic lateral sclerosis (sometimes called Lou Gehrig's disease), spinal muscular atrophy or stroke. To help such patients gain back their independence, the NITRO lab has been developing technology to connect the human brain to a computer.

Simple tasks such as turning on lights, answering yes-or-no questions or working on a computer are completely overlooked by the average person. However, for a locked-in patient, the ability to perform such tasks is a remarkable feat. Thus, Williams's group has been working with a variety of patients to help them use their thoughts to accomplish such tasks.

One ideal research group is made up of intensely epileptic patients whose seizures cannot be controlled by medication and who must have the problematic portion of their brains surgically removed. As it turns out, the equipment used to prepare for this procedure can also be incorporated into Williams's research.

In order to detect the general location of overactive neurons, electrodes are first applied to the outside of a patient's skull. But even after determining the general location of the problem area, a neurosurgeon cannot simply start whittling away the brain.

"There is a lot of valuable real estate up there," Williams says.

In order to pinpoint the exact location for the final procedure, doctors surgically plant an electrode grid directly on the brain. This grid—a rectangular array, slightly smaller than a playing card, comprising 64 sensors—also happens to be an ideal tool for Williams' research, which requires sensitive monitoring of a patient's brain signals. With the electrode grid in place, the doctors wait for the patient's next seizure.

"The key is to be able to get the information back to them to let the brain do what it does really well, that is, learn," - Justin Williams

As the patients are monitored while waiting for a seizure, Williams's team engages them in a variety of tasks to stimulate the portion of the brain covered by the electrode grid. For example, if the electrode array covers the auditory cortex, patients may be asked to imagine their cell phones ringing. As they imagine this sound, each sensor on the grid measures electrical activity. These measured brain signals are translated into computer cursor movement by laboratory software.

This movement can be used to play a game best described as reverse Pong. A ball-shaped cursor moves from left to right across a screen at a steady rate. By controlling the vertical movement of the cursor, the patient tries to hit a stationary target on the right side of the screen. At first, patients may struggle to manipulate their mental imagery to control movement but, with practice, are able to develop their own strategy.

"A patient can learn to use almost any part of the brain to be able to control [the cursor]," Williams says. The team has been impressed by the speed with which patients have been able to learn to control sensory areas such as the auditory portion of the brain without any external presence.

"The key is to be able to get the information back to them to let the brain do what it does really well, that is, learn," Williams explains.

The advantage of this surgical implementation is that the electrodes are located closer to the brain, the source of the electrical activity. However, the disadvantage is the limited availability of patients with the surgically implanted grid. With only three or four candidates per year, Williams's group has turned to a non-invasive form of interfacing technology that keeps the electrodes on the outside of the skull.

An electrode cap, which looks like a loose-fitting swimmer's cap, is strapped onto a patient's head. Once in place, conductive gel is injected with a blunt-tipped syringe into an access hole for each electrode. For one-dimensional tasks, such as moving a cursor left and right, only two of the 10 to 20 electrodes are used for picking up electrical signals; the rest are used as filters.

Although much safer and more accessible, the electrode cap is not without problems.

One such problem is that "the skull essentially is a big filter" that distorts the signal's quality and strength, Williams says. The cap also only detects the firing of large groups of neurons. Despite this drawback, Kelly Scanlin, a previously epileptic patient who has been working with Professor Williams's group for nearly two years, thinks the electrode cap is much easier to work with than the electrode grid procedure she had previously experienced.

"As long as you can concentrate, it's pretty easy once you get the imagery down," Scanlin says. Patients just have to think about which way they want to move the ball. Since the testing is non-invasive, patients' performances can also benefit from their being tested in a lab rather than a hospital full of distractions.

However, Scanlin is no Luke Skywalker, and that kind of control involves more than Jedi mind tricks; it's also limited by the current state of the technology and its application.

"It's not like it's just magic how we have them think about their left and right hand and suddenly it works," Elizabeth Felton, one of the graduate student researchers, explains. As part of the screening process, the team asks patients to create different mental images in response to cues on a computer. The team then analyzes the brain's electrical activity in order to determine which electrodes would be most appropriate for detecting the strongest signals. When patients think about the imagery, these electrodes detect a spike in the amplitude of the signal. This change is then translated into movement.

The collected data is also used to help pick out which imagery works best to control the cursor. With Scanlin, for example, researchers selected the electrodes over the motor cortex because thinking about left- and right-handed imagery produced the strongest and clearest signals.

In order to actually monitor the small (5 to 50 millionths of a volt) amplitude changes in the electrode signals, the wires from the electrode cap are connected to an amplifier specifically made for recording neural signals. The team then uses a specially designed neural analysis software package, which Williams describes as a "Windows for neural signals," called BCI2000. Adam Wilson, the graduate student who writes most of the lab's computer software, explains that BCI2000 is used to read the signals, digitally process them, transfer them into a command (i.e., move the cursor up or down) and display all results in real time.

Among the remarkable software the team works with is a text-entry program called Dasher. This program was originally developed by David MacKay, a physicist at the University of Cambridge's Cavendish Laboratory. It enables locked-in patients to type by moving a cursor through a display of letters using only one-dimensional thought. As the cursor moves onto a letter, the display zooms into a variety of other letters that could complete the word. Using language prediction, letters that are more likely to follow take up more space than letters that are less likely. Although the patient who has been practicing Dasher in Williams's lab was only able to achieve a couple of words per minute, this is a dramatic advancement for people who are otherwise incapable of typing on their own.

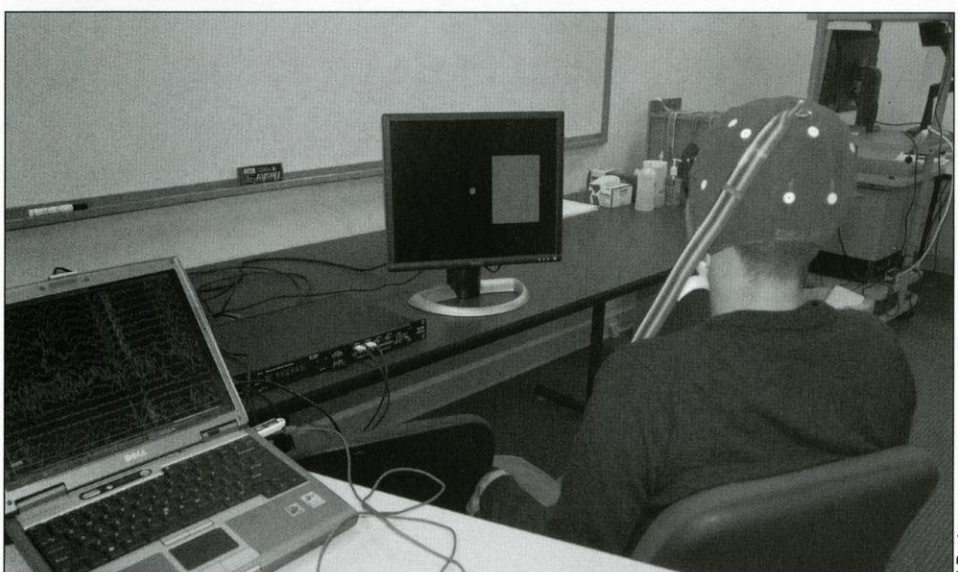


Photo by AJ Portz

Justin Williams uses his thoughts to move a circle on the screen toward a target. Computer in the foreground shows the brain input.

The project continues to amaze even the researchers. The adaptability and progress of the study patients has forced the team to constantly develop ways to make the tasks more challenging and engaging.

"If they get 100 percent all of the time, it gets boring [for the patients]," Williams says. Even by changing the size of the targets, their distance from the starting point and the speed of the cursor, reverse Pong becomes relatively easy for most patients. In order to keep the experiments challenging, patients like Scanlin perform the tasks in two dimensions and are asked to hold the cursor in one spot.

As research progresses, Williams's group is hoping to apply their findings to help the lives of immobilized patients. As of now, it is not practical for people to have an electrode grid implanted onto their brain with wires sticking out of their head. Basic implementation of an electrode cap-type device, however, is not far off.

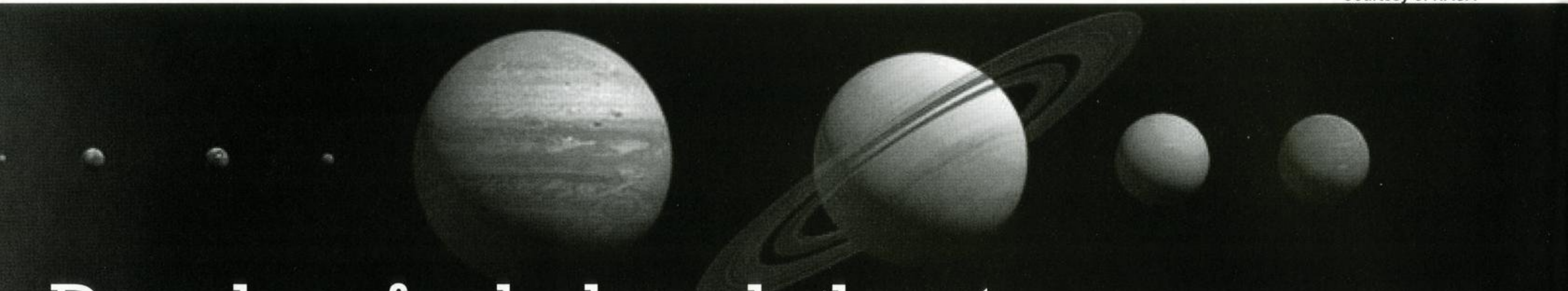
"It may not be able to replace your mouse," Williams says, "but a patient who is completely locked-in may be able to type out simple sentences."

Adapting the process to real life and its many distractions is still a major challenge. One of the future aspirations of the NITRO lab and similar groups is to have a tiny wireless electrode that can be permanently implanted inside the brain to effectively detect brain signals and transfer them into computer commands or even artificial limb movement.

Until then, we'll have to leave telekinesis to the superheroes. we

Author bios: Marshall Stringfield is a senior at UW-Madison who is currently majoring in industrial engineering. Victoria Yakovleva is a freshman who intends to major in biomedical engineering.

Courtesy of NASA



Dog days for beloved planet: PLUTO GETS DEMOTED

By Katie Klescewski

Our solar system shrank by 1,400 miles in August when the International Astronomical Union (IAU) voted Pluto out of the elite family of planets. Pluto's title is now "dwarf planet," a sad demotion, many feel, after 76 years of planet status.

Pluto's exile came after the IAU decided to create a definition of a planet, a task that surprisingly had not been taken up sooner, given the hyper-precise definitions used in the sciences. A group of about 2,500 astronomers gathered in Prague for a week-long meeting. The astronomers proposed that a planet must be in orbit around a star, must have enough mass to assume a nearly round shape and can be neither a star nor a satellite of a planet. By this definition, our solar system contains 12 planets, counting Ceres, Charon and Xena.

At the end of the week, only 400 astronomers remained for the final vote. They added another condition for an object to qualify as a planet: it must have cleared its orbit of other objects. This means that planets do not cross paths with other objects such as rocks or other planets; the planet's gravitational pull should either draw such objects to its surface or eject them from its orbit.

"It's like the socks under the dresser," Linda Sparke, UW-Madison professor of astronomy, explains. "Once they're under the dresser, they don't move any more." Unfortunately for Pluto, its orbit takes it through a whole mess of loose socks known as the Kuiper Belt, a U-shaped region of rocks on the outskirts of the solar system.

A technicality, some might argue, but one that astronomers apparently agreed on and are happy with. The astronomers at Harvard are probably the most excited about the change. At the time when hobbyist-turned-Lowell-Observatory-astronomer Clyde Tombaugh found Pluto, Harvard was the predominant observatory in the United States, and yet it failed to make the discovery.

Hard feelings are tough to shake, especially when "a hick from out west," as Sparke affectionately calls Tombaugh, was the one to find one miniscule dot out of billions. No one will disagree that it's tough to take when a person outside the establishment does the job better. Of course, hard feelings can't be documented, so nothing's certain, but if you listened closely, you may have heard a faint cheer from the east when Pluto was assigned its asteroid number.

True, the definition of dwarf planet is only technical; Pluto still exists. But many people are not happy, and old habits die hard. For instance, why not argue, since Pluto was considered a planet before the actual definition was created, that it should stay a planet? You wouldn't kick someone out of your family if you found out three-quarters of a century later he or she wasn't really related to you. However, technicalities matter more in astronomy than feelings of sympathy and nostalgia.

Maybe the decision should come down to aesthetics.

"Eight doesn't seem a good number," Sparke says. "Things ought to come in

Photo by Zachary Prefontaine

The Washburn Observatory was used by UW-Madison astronomers from the 1880s to 1954, but today it mainly hosts public viewings on the first and third Wednesdays of every month.

threes, fives, sevens or nines." After all, we have seven continents, seven deadly sins, three wishes, five fingers and, formerly, nine planets. There would be an uproar if a union demoted Australia to "dwarf continent" or if doctors decided our pinkie fingers were mere "nubbins." Eight planets just won't stick, some say.

This couldn't be more true than in Madison, Wis., where Alderperson Ken Golden proposed that the city adopt Pluto as its ninth planet. Not surprisingly, the city common council passed the motion. Pluto has lived to see another day, at least in Madison. And who knows? Maybe Ann Arbor, Mich or another college town will choose to adopt Ceres or Xena, although Badger fans will surely agree that it's far better to be a dwarf planet than a wolverine.

With all the debates and disagreements, maybe our planetary counting system should resemble the way we keep track of vowels in the English language: Mercury, Venus, Earth, Mars, etc. … and sometimes Pluto. WE

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

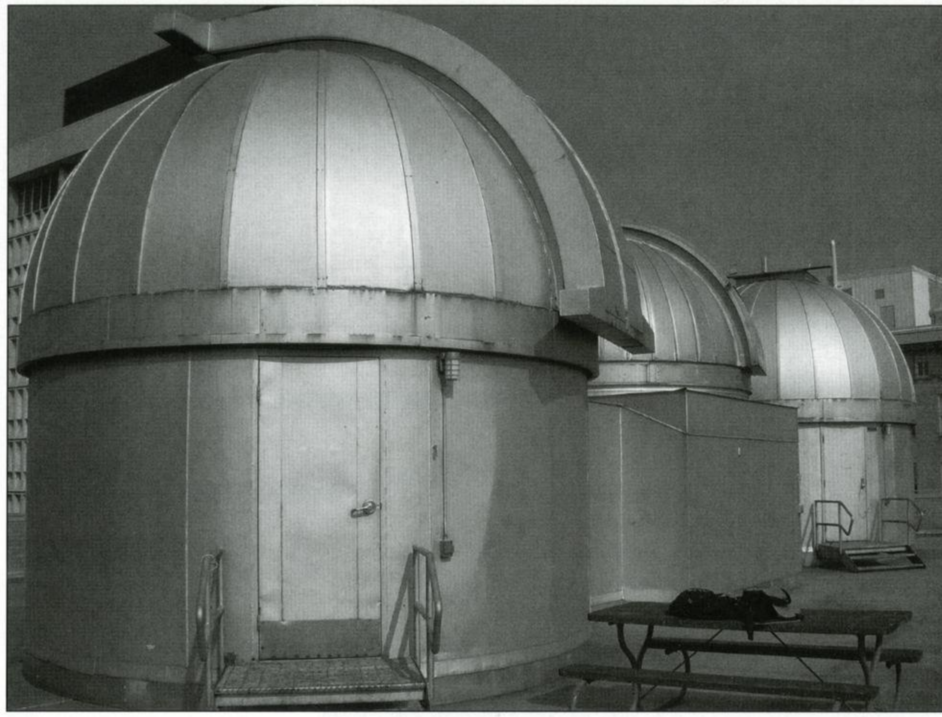


Photo by Luke Melchior

The two telescopes, housed in these three observatories on the roof of Sterling Hall, are used by the UW-Madison Department of Astronomy.

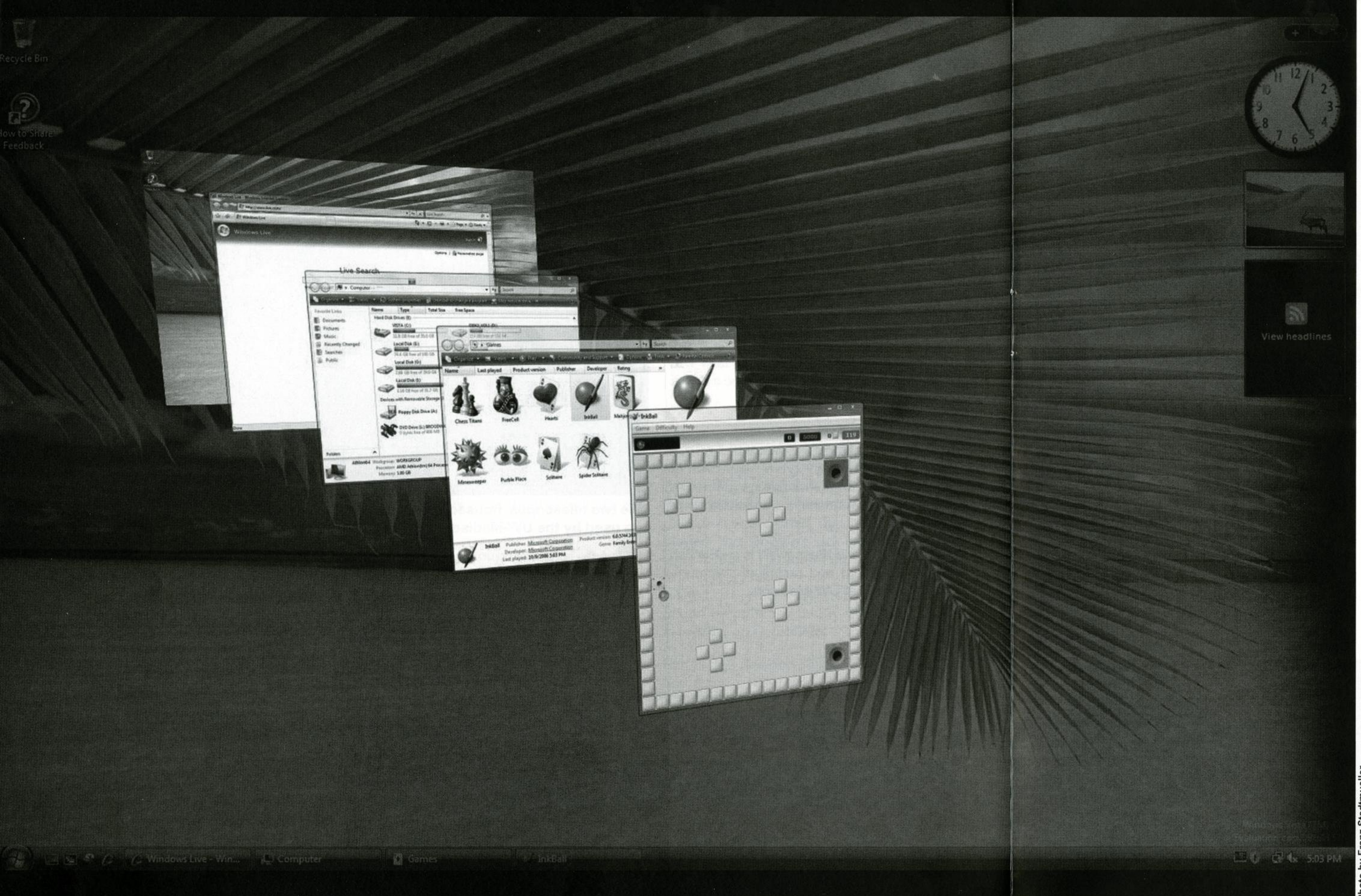


Photo by Franz Stadtmueller

Windows Vista™

Hasta la Vista, XP

By Jared Campbell and Matt Treske

Unless you've been living under a rock for the past few months you've undoubtedly heard about Microsoft's latest and highly anticipated new operating system and software package, Microsoft Windows Vista.

Vista is being hailed as Microsoft's most advanced and stable Windows version yet, and the release date for the consumer version is getting closer. So what does this Cadillac of ones and zeros bring to the table? What does Vista offer that Windows XP did not? Is upgrading worth cracking open the average college student's checkbook?

The release of Windows Vista will be Microsoft's first operating system release since Windows XP, which made its debut on Oct. 25, 2001. Once codenamed "Longhorn," Vista will provide PC users with hundreds of new features that they will access through new graphical user interface (GUI). Microsoft also claims that Vista will be the most secure, efficient and user-friendly operating system they have produced.

For many users, installing, configuring and learning a new operating system can quickly become a headache. Vista will offer user-friendly applications to aid in the installation and configuration of security devices, network devices and other new software and hardware. It's engineered to protect a computer from undesirable spyware, computer viruses and unwanted software better than any previous Microsoft operating system. Vista will also notify users when their computers may be at risk and how they can better protect them. The software will also expand on XP's idea of automatic updates by making them easier and less disruptive.

Microsoft's newest GUI will showcase a glossier and more refined desktop than its previous operating systems. A visually dynamic user interface known as Aero will provide a user with a clean and organized desktop. A "basic" setting will also be available in place of Aero for more entry-level machines.

Three promising features of Aero are Aero Glass, Windows Flip and Windows Flip 3D. According to Microsoft, Aero Glass will help users stay focused on desired content instead of the surrounding environment by featuring windows that are "truly translucent." This feature also keeps the desktop looking highly polished and professional.

Windows Flip will allow users to navigate through multiple open windows by displaying live thumbnails. Windows Flip 3D creates a view of open windows in a three-dimensional stack on the desktop. This feature expands on Windows Flip's multi-tasking tool by allowing the user to see larger, more sharpened representations of open windows. These features allow Aero, to offer a more precise and smoothly running GUI that presents desktop applications in a more brilliant and shimmering manner than its predecessor, XP.

Vista's designers did not neglect the concerns of media enthusiasts. Instead of forcing users to work inside of the system shell to organize photos, videos and music, Vista will have dedicated applications for organizing different types of media. Windows Photo Gallery, Windows Media Player 11, Windows Movie Maker and Windows DVD Maker will all receive makeovers. Media junkies will find it much easier to navigate through different media files, Microsoft claims.

The minimum specifications for running Vista are not insubstantial...anywhere from a current generation dual-core processor and one gigabyte or more of memory are desirable to run Vista optimally.

In addition to the already stated features of Microsoft's latest effort, Vista will showcase new applications such as speech recognition, an integrated search and Windows Ready Boost—an application that will allow users to use a USB 2.0 flash memory device to increase the performance of the PC.

Microsoft's suggested retail prices for the new software are $199 for Windows Vista Home Basic and $239 for Windows Vista Home Premium. Students will be able to purchase this software at a lower price.

The minimum specifications for running Vista are not insubstantial; it will require an up-to-date and modern computer. A current generation dual-core processor and one gigabyte or more of memory are desirable to run Vista optimally.

For a new "Vista Certified" computer, customers should be looking to spend at least $750 to $1,000 for a desktop computer and about $1,500 for a laptop. Couple the cost of a new system with the purchase of the operating system itself, along with the time to learn a new operating system, and one will

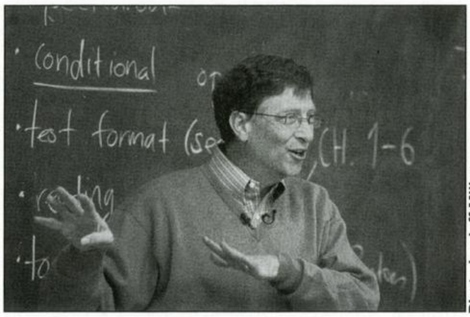


Photo by Jeff Miller

Microsoft chairman and chief software architect Bill Gates delivers a surprise lecture at UW - Madison.

find that Vista is going to be a large investment for any college student.

"In the long run, Vista will end up being a more stable platform than XP," Michael Layde of the UW-Madison Division of Information Technology's Data Center & Shared Computer Services says. However, according to Layde, "Microsoft will be supporting XP for quite some time."

It's easy to get sucked into the wide appeal of Vista's features, from speech recognition to razor sharp graphics and lightning speed. Trying to make an educated decision on buying Vista can suddenly turn into an attempt to escape Earth's gravity with nothing but a paper airplane and a rubber band. To shed a little light on the situation, we interviewed several students to see what Vista brings to the student on a budget.

"Actually, upgrading to Vista seems sort of trivial," says engineering student James Bridwell. "I don't see why I should pay a bunch of money for a couple of new features that I won't use with my computer." Indeed, one of Vista's most appealing features is support for 64-bit processor, which some users don't even have.

Microsoft also claims that Vista will be the most secure, efficient, and user-friendly operating system that they have produced.

"If I buy a new computer, I'll probably get Vista, but for right now I'm sticking with XP," says Bridwell.

However, fellow engineering student Alan Klein disagrees.

"Sure, I'm running an AMD 64 [processor], so Vista would speed my system up a lot; if it doesn't cost me an arm and a leg, it seems like a good way to get better graphics and performance," he says.

Their disagreement seems to be what the whole issue boils down to. If you're just looking for basic functionality to get through school, you might as well keep running XP and pick up Vista later when you buy a new system. However, if you're into computers and already have a nice system, upgrading to Vista might be an attractive option.

"As long as I'm spending time on it, I might as well enjoy what I'm looking at. I already have the hardware, so why not get the most out of it?" Klein asks.

Author bios: Jared Campbell is a third-year computer engineering student from Greenville, Wis. Matthew Treske is a first-year engineering student from New Berlin, Wis.

Photo by Anna Mielke

From left, Accenture partner John Leffin, business student Jesse Siegelman, and engineering student Daniel Reich promote the Accenture Leadership Center, a new program for engineering and business students to develop leadership skills.

Breaking out of the ENGINEERING BUBBLE

By Natalie Forster

Put away your graphing calculators, forget those energy balances and pop that engineering bubble. There's more to success in engineering than equations and calculations.

Thanks to a group of current and retired executives from Accenture, a company that provides consulting, technology solutions and outsourcing services to other businesses, students will have the opportunity to participate in a unique program that unites engineering, business and leadership.

"This is the ultimate leadership program," Daniel Reich, a junior electrical engineering student and the engineering liaison for the Accenture Leadership Center (ALC), says.

The ALC opened its doors this semester to business, pre-business and engineering students. The year-long program takes students above and beyond the classroom lecture environment by teaching leadership through hands-on activities, mentoring sessions and project work. Groups of students and mentors will work in teams to provide solutions to problems faced by the community and the university while learning about conflict resolution, team dynamics, and inter- and intrapersonal skills.

"Students will learn about leadership, practice leadership and learn from others in a safe environment," retired Accenture partner and ALC program director John Leffin says.

In the future, the program will begin with a six-day summer leadership session in partnership with the LeaderShape Institute, an experience that students will build on throughout the following school year. The first session of the Wisconsin LeaderShape Institute was held at UW-Madison in August 1997 as a collaboration between the College of Engineering and School of Business. Mark Mastalksi, director of the College of Engineering's Student Leadership Center, is the program coordinator for this session of the LeaderShape Institute which is celebrating its 10th year anniversary on campus. The ALC recommends starting out with the summer LeaderShape session. However, they won't turn away students who wish to join the ALC throughout the year.

The ALC believes that people aren't necessarily born leaders; with practice and help from other students and mentors, anyone can become an effective leader.

"We believe leadership can be taught," Leffin says.

Leffin stressed there is plenty of room for error at the ALC. Students will be placed in a safe, simulated real-world environment composed of a mixture of people with different experiences and backgrounds, where they can make mistakes without repercussions. The group wants students to feel comfortable trying something new during a presentation, taking a stand during a team-building session or voicing their opinions in front of others.

"Participants will have the opportunity to interact with students that think differently," Leffin says.

"It's an opportunity to break out of the bubble we're in, in engineering," Reich adds. "Get the mix now instead of later."

Successful engineers do more than solve equations; they know how to work in and lead teams. They innovate and create, and the best leaders also know how to initiate.

"Good leaders create a bold vision that people want to follow," Leffin says.

Accenture has a history of recruiting UW-Madison engineering and business students every year. In fact, many of the volunteers from Accenture were once recruiters and interviewers for the company. Through their mentorship, the volunteers hope students will receive the knowledge and experience needed to succeed in the real world.

"The mix of engineering students, business students and mentors is a recipe for success," Reich says.

Now that is an equation we can all understand. WE

Author bio: Natalie Forster is a fifth-year senior majoring in mechanical engineering. This is her first article with the magazine.

Letter to the Editor

Hi,

I was recently on campus in Engineering Hall and picked up a copy of *Wisconsin Engineer* magazine. As an alumni working both at UW and at an engineering firm in Madison where I'm involved in campus recruiting, I like to keep up-to-date with what's going on with student life.

I was disappointed when I read the "Just one more: The finest in eclectic humor" piece in September's issue (page 20). Humor is a great way to address many things, but it must be used with caution to avoid unanticipated impacts on others.

I am specifically referring to the two statements in the "Top 10 things that are impossible for engineering students to comprehend."

#2: "Why women aren't governed by first order linear ODEs." How might many women feel as they read this and feel objectified as something that can be "controlled" by someone else solving an equation?

#4: "Foreign TAs' accents." I'd be willing to bet that the TAs referred to have much better English than the vast majority of American students.

My answer to the question, "Why can't engineers comprehend these things?" is because we typically don't stop long enough to take the time to think about the implications of our words and actions on others. This is true for technical solutions that potentially have a detrimental impact on our environment. It is equally true for the potentially damaging impact we have on other lives when we choose to make public our biases, stereotypes, and ignorance of other cultures and ways of being.

I am in no way advocating for censorship in your magazine. Freedom of press is not the issue here. The issue is a need for us, as professionals (or future professionals), to be aware of the potential impact we have on our world and to make the most of our privilege of practicing engineering.

This is a real problem on our campus and nationwide. You are in a position to contribute to improving the culture of engineering rather than detracting from it. As small as it may seem, items like what I've pointed to above detract from the high quality and professionalism of the rest of your publication.

I am very interested to hear back from you and would be happy to talk with anyone interested in further discussion about this issue before the next issue of *Wisconsin Engineer* is published.

Thank you,

Chris Carlson-Dakes
Associate Director, Delta Program in Research, Teaching, and Learning

Dear Chris,

Thank you for your note. We here at *Wisconsin Engineer* are very serious about our responsibility to help improve the culture of the College of Engineering, and we sincerely regret that we failed in this mission when we published statements that may have hurt or offended some of our readers.

We've tried to learn from the experience to make sure that nothing like this happens again. It was an unintentional mistake on our part, one that we will work hard not to repeat.

We hope that you and all our readers continue to read and enjoy *Wisconsin Engineer*, and we hope to continue to get feedback on all aspects of our coverage of science, technology, and the UW-Madison College of Engineering.

Sincerely,

The *Wisconsin Engineer* editorial staff

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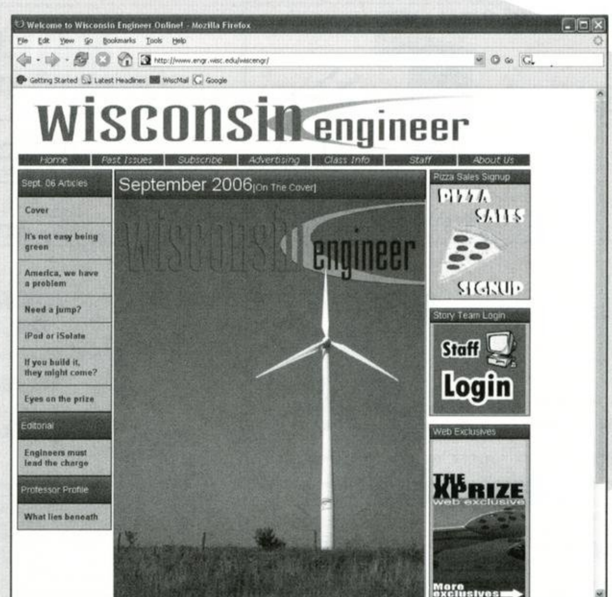


We dig deeper!

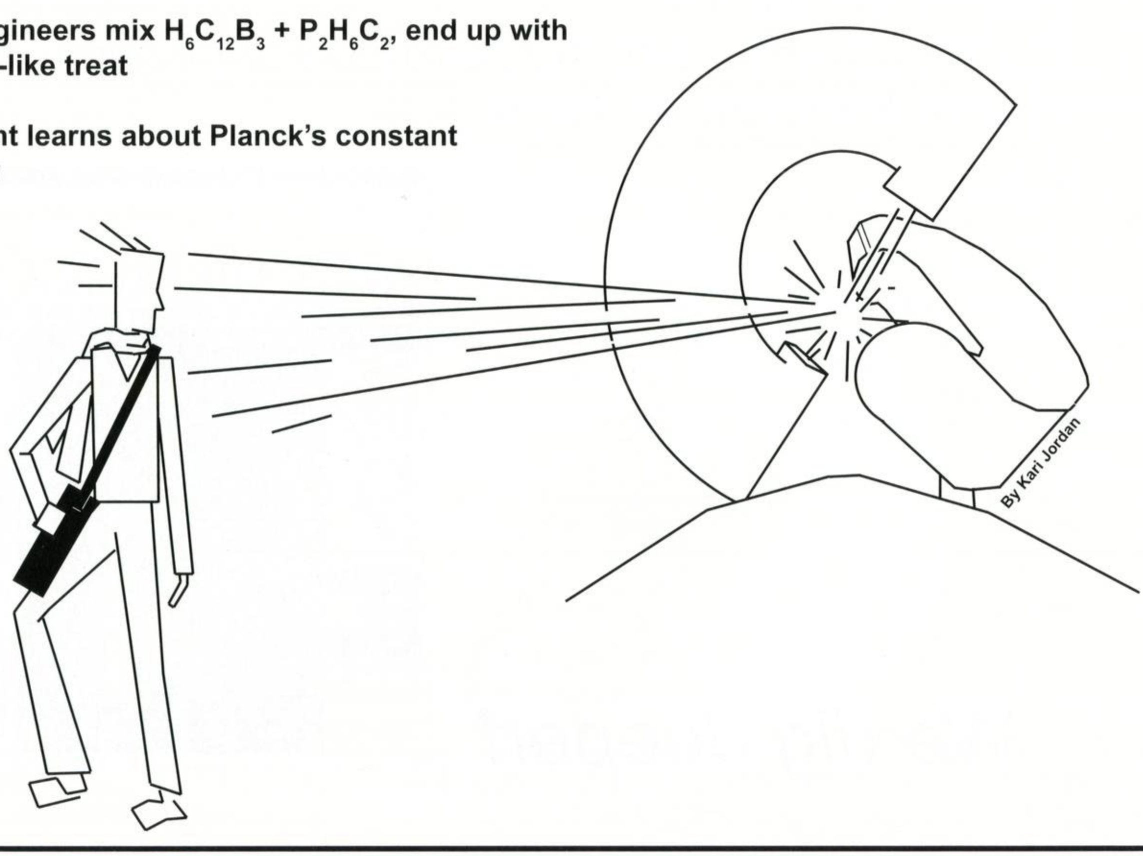
JUST ONE MORE

The finest in eclectic humor

By Kari Jordan, Robin Maly, Kyle Oliver, Nicole Rybeck, and Casey Weltzin

Top 10 stories that did not make the *Wisconsin Engineer*

1. **Escher woodcut actually inspired by Engineering Hall stairwells**
2. **Ace of Base: We did not see the sine**
3. **Freak UW-Madison reactor accident opens up real-life portal to World of Warcraft; UW-Madison gamers elated**
4. **Descendant's fountain reprogrammed to spray liberal arts students on command**
5. **Engineering student found in ECB after 16 days of continuous studying/cramming**
6. **Mythbusters celebrates 100th statistically insignificant result**
7. **Dwarf planet vote: Astronomers no longer scientists**
8. **College of Engineering changes name to "College of Nano- and Biotechnology"**
9. **Chemical engineers mix $H_6C_{12}B_3 + P_2H_6C_2$, end up with tasty Cheeto-like treat**
10. **Bored student learns about Planck's constant the hard way**



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Cross-Campus

Photo Contest

Amateur and expert photographers alike are invited to submit their best shots to our cross campus photo contest. In addition to being awarded prizes, winners will have their photos published in our April 2007 issue. *Wisconsin Engineer* readers will be able to vote for their favorite photos on our web site this February. We would like to encourage anyone and everyone to submit their work.

Wisconsin Engineer is always looking to recruit talented individuals for all of our departments. Thanks for reading, and good luck!

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