ENGINEERS' FORUM
Volume 28 No. 1 March 2008

Head Impact Research

Also Inside:

- Engineers Without Borders
- Biomimetics
- Nuclear Engineering Coursework

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Engineers' Forum is Virginia Tech's student-run engineering magazine. Engineers' Forum is published four times during the academic year. The editorial and business office is located at:

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Blacksburg, VA 24061
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From The Editor

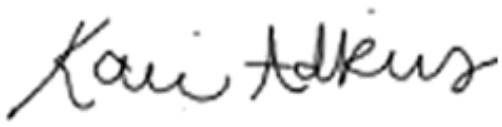
Dear Reader,

Welcome to the March 2008 Issue of the Engineers' Forum. I hope that your semester is off to a fabulous start and that you are enjoying all of your classes. Part of going to class and being in college is the friendships that we form. Some of these friendships are transient; others last a lifetime. Through the friends we make, we learn about ourselves, the world around us, and the other people who inhabit this world we call home. Cherish the friendships you have with your classmates, and make new friends. Growing as an individual is what college is all about.

This issue, we have several articles that I think are quite interesting. We have an update from the Formula SAE team, a fascinating look at head-impact research and its use in college football, and an article on the world of biomimetics. There is also an article on Engineers Without Borders, an organization that takes engineering outside the classroom and into the real world. The ESM department is preparing to celebrate its 100 year anniversary, and we have all the details.

As always, if you want to join our staff, please feel free to contact me. Have a great start to your semester and a wonderful spring break.

Respectfully,



Kari Adkins
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Inside

March 2008
Volume 28 No. 1

Driving by the Ware Lab late at night, you can sometimes here the distinct roar of a four-cylinder, Honda F4i motorcycle engine. You may think that some punk kid is just finishing up his late night studies and heading out for the evening, but in reality, a group of nineteen senior mechanical engineers are starting up their senior design project for a quick tune up. This year's team successfully got their car on the ground in November 2007, and started driving well before the December 1st, 2007 deadline. This is the earliest the team has ever had a running car. With the first round of manufacturing complete, and an operational car to boot, the team can now focus its energy on testing, tuning, and design validation.

This semester will follow a strict test schedule to finalize tuning of the engine and suspension and evaluate the durability of the drivetrain. Some parts require more testing and validation than others. Two of these so-called "risk-taker" parts include the three-lug wheel design and the turbocharger. The three-lug wheel design is a custom designed wheel engineered by two of the team's members. The wheel was analyzed and tweaked using different loading scenarios with ANSYS, a finite element analysis (FEA) tool. The current plan is to drive the car a minimum of three days a week and visually inspect the wheels after each driving day. Strain gage equipment has been donated to the team for testing this semester. The wheels will be fitted with strain gages to measure the amount of deflection and compare this data to the FEA results. The engine team will continue to tune the engine both on the car and on the engine dynamometer. Major tuning will halt March 15th to allow ample time for the driver's to get used to the power and torque of the motor before the first competition in April.

This year's team will compete in two competitions, the first at Virginia International Raceway (VIR) from April 23 to April 26, and the second at Michigan International Speedway (MIS) from May 14 to May 18. Each competition tests the team on static and dynamic events. Dynamic events include skid-pad, acceleration, autocross, endurance and fuel economy, as described in the November 2007 issue. The static events include cost analysis, mock sales presentation, and an engineering design presentation. Cost analysis is written in report format and details the expense of each part from raw material to machine time to final assembly. The mock sales presentation is given to a panel of judges who pretend to be from different aspects of industry-engineering managers, marketing representatives, and company CEOs. The audience's knowledge of the weekend autocross racecar ranges from basic to expert, so the presentation team must tailor their presentation to encompass

the understanding of the whole audience. The most important static event is the design presentation. The team must defend their design against experts in the automotive field from across the world and prove that they know the "whys" and "hows" behind each part of the car. Last year's team was the first team in Virginia Tech history to ever make it to the design semi-finals, and this year's team has high aspirations of following in their footsteps.

As the semester commences, the team will work towards its goals of having one of the quickest, best handling, and soundly engineered vehicles ever produced by a Virginia Tech Formula SAE team. Strict deadlines have been set for second iteration parts and final design binders. The team plans to put a minimum of 200 testing hours on the car before attending the VIR

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The 2008 Formula SAE team is pictured above with the competition vehicle.

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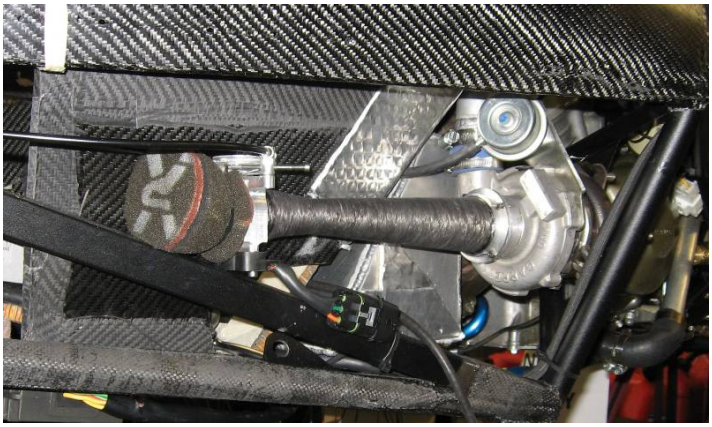
competition in April. Drivetrain team leader, Daniel Konapelsky says, "We want the car to break when we're testing in our backyard. We do not want to show up to competition after two years of preparation to have the car break right before we reach the finish line. This has plagued us the past two years, and we're ready to break this streak."

Heather Chemistruck is a Shocks, ARBs, Bell Crank Designer (FSAE) and a senior in Mechanical Engineering.



Pictured above is the turbocharger with throttle and restrictor used on the vehicle.

VT team takes third place $500,000 prize in DARPA Urban Challenge

VictorTango, a team of Virginia Tech engineering and geography students, has won third place and a $500,000 cash prize in the DARPA Urban Challenge.

On Saturday, Nov. 3, during the competition held on a former U.S. Air Force base in Victorville, Calif., the Virginia Tech autonomous vehicle, Odin, completed the 60-mile course — with no human intervention allowed past the starting line — in under six hours.

Odin crossed the finish line just behind the entry from Carnegie Mellon University (Tartan Racing), which won first place and $2 million, and the vehicle from Stanford University (Stanford Racing), which came in second for a $1 million prize.

During Urban Challenge qualifying rounds that began in Victorville on Oct. 27, DARPA (Defense Advanced Research Projects Agency) narrowed an original field of 35 entries down to 11 finalists. On Nov. 3, the final event vehicles were required to operate entirely autonomously, without human intervention, as they obeyed California traffic laws and performed maneuvers such as merging into moving traffic, navigating traffic circles, and avoiding obstacles.

The vehicles had to think like human drivers and continually make split-second decisions to avoid moving vehicles, merge into traffic, and safely pass through intersections.

"The urban setting added considerable complexity to the conditions faced by the vehicles, and was significantly more difficult than the fixed desert courses featured in the first two Grand Challenges," said Norman Whitaker,

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Urban Challenge program manager. "Tartan Racing, Stanford Racing, and Victor Tango all did a great job getting their vehicles to navigate the course quickly and safely despite the challenging conditions."

Only six of the eleven finalists finished the course. The other three were from Cornell University, Massachusetts Institute of Technology, and a collaborative team from the University of Pennsylvania and Lehigh University.

VictorTango converted an Escape hybrid donated by Ford Motor Co. into an autonomous vehicle by outfitting it with a "drive-by-wire" system, a powerful computer system, laser scanners, cameras, and a GPS (global positioning system), said Patrick Currier, a mechanical engineering (ME) graduate student. "The drive-by-wire system allows the computers to control the throttle, brake, steering, and shifting and to drive the vehicle," Currier said. "This system was custom developed by the team and is unique in that it is completely hidden from view, enabling Odin to retain full passenger capabilities."

TORC Technologies LLC, a company in Virginia Tech's Corporate Research Center founded by alumni of the university's robotics program, worked with VictorTango to develop the software for the vehicle's computer system.

VictorTango and TORC developed Odin's sophisticated navigational software, which is modeled on human behavior. "To successfully navigate in an urban environment, Odin processes all of the sensor information, classifies the situation, and then chooses a behavior, such as

The 2007 VictorTango team with Odin, an autonomous hybrid Ford Escape, used in the competition.

passing another vehicle, staying in the lane, or parking," Currier said.

Currier is one of 10 graduate students on the Virginia Tech team, which also has included as many as 50 undergraduates. The students were guided by four faculty advisers, three of them from Virginia Tech — professor Alfred Wicks and assistant professor Dennis Hong of the College of Engineering's mechanical engineering department, and professor Bill Carstensen, chair of the geography department in the College of Natural Resources.

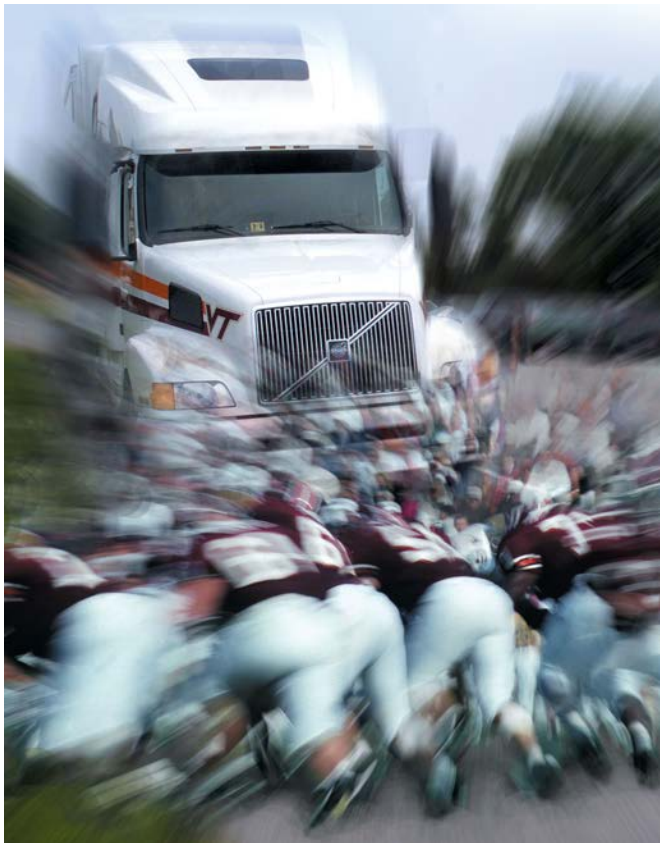
The team's founding adviser, Charles Reinholtz, a former Virginia Tech Alumni Distinguished Professor and now a department head at Embry-Riddle Aeronautical University in Florida, continued to work with VictorTango throughout the Urban Challenge.

Staff Reports

Dean Richard Benson of the College of Engineering with a member of the team and Odin.

First and goal for *head impact* research

The Virginia Tech football team is among the first to test software specifically developed to monitor impacts to the head. The study started at Virginia Tech in 2003 and as of last year the study became funded by the National Institute of Health (NIH). Now the study has become a collaboration project with other universities which include Dartmouth and Brown. Although all the universities are measuring impacts received during football practices and games, Dartmouth and Brown are also measuring the impacts received from hockey games as well. The impacts are measured by placing sensors, which work by placing small accelerometers (like those used in car airbag systems), against the head. The sensors transmit real-time data to the sideline computer system that tracks the head-impact information for each player in terms of gravity (G) forces.



Football players usually receive 10-50 impacts per game. The majority of impacts range between 10 G's-40 G's while the highest have been recorded at more than 100 Gs—the equivalent to a serious car crash. The real-time data will alert doctors to impacts which may result in possible concussions. If a player receives an impact of 80 G's or greater they will be taken of the field and checked. The real time data is especially useful because when a player suffers a concussion they usually continue to play and the concussion remains undetected. This can be potentially dangerous as athletes may have difficulty in cognitive functions and be at risk for sleep disturbances, anxiety, and even depression. Second impact syndrome is also a major risk factor and this occurs when an athlete receives another concussion before being fully recovered from a previous concussion. Second impact syndrome results in massive swelling of the brain and is almost always fatal. Now with the aid of the specialized software athletes can be taken out of the games and receive treatment they need.

The real-time data received on the side line will not only create a database for Virginia Tech, but will also help build a national database. All the information on the sidelines is sent through a wireless system back to the headquarters of Simbex. There the data is synchronized with the data from around the country to be analyzed. This data will ultimately be used to reduce the concussions in football in addition to other contact sports.

The success of the research has depended on various individuals and groups. Leading the research is Dr. Stefan Duma (professor in the College of Engineering), Dr. Gunnar Brolinson (head football team physician and professor), and Mike Goforth (team trainer). The software used was developed at the Virginia Tech-Wake Forest Center for Injury Biomechanics and the monitoring system was manufactured by the Simbex, a research and development company. In addition the research project has collaborated with Riddell, a company that makes the majority of the football helmets used by colleges and professional teams, to ensure that a wireless system fitted inside the helmet would not interfere with the players.

So far the study of Virginia Tech's football players has turned up some interesting and useful data. Offensive and defensive linemen record the highest number of impacts—about 50 each game while quarterbacks receive the least. It has also been found that different positions incur different types of blows. Linemen usually sustain many low impact frontal blows while wide receivers receive fewer high impact blows. Dr. Brolinson thinks the data developed by the

instrumented helmets may lead to changes in football equipment. “One of the things that may come out of this research, as we start to understand the blows, is position specific helmets. A lineman may need a different helmet from a wide receiver,” he said. The research provides evidence to support this theory and considering quarterbacks and linemen wear different padding, shouldn’t their helmets be different as well?

“There’s great potential for prevention of sports-related brain injuries, if we can learn more about what happens to the brain at the moment of impact,” Duma says. “By collecting and evaluating a body of data, we can redefine injury limits for the brain. Also, in order to design better sports headgear, we need precise data on what types of mechanical loads and accelerations cause brain injuries.” Beyond athletics, the study may also prove useful to the military. Currently the military is interested in understanding injury to their soldiers either from direct impact or impact caused by IEDs. Simbex is also providing helmets with similar system to the military to further study the effects of IED impacts. Another application is applying the research to motor vehicle crashes. In many instances impacts to the head are similar in nature to whiplash experienced in a car accident.

-Sara Lu is a junior in the Industrial and Systems Engineering.

*Special thanks goes to Dr. Gunnar Brolinson for taking the time to be interviewed.

Dr. Stefan Duma, pictured above, is the lead researcher on the helmet research.

Virginia Tech hires key scholar for its Microelectronics Chair

Virginia Tech's College of Engineering has successfully recruited Marius Orlowski, a renowned international scholar who holds 59 patents with 28 pending. He will come to Blacksburg from his current position with the Crolles Alliance based in France.

The French based Crolles Alliance is comprised of STMicroelectronics, NXP, and Freescale. These three companies are considered global industrial leaders in the semiconductor technology industry.

"Dr. Orlowski is an excellent choice for the Virginia Microelectronics Consortium (VMEC) Chaired Professorship at Virginia Tech because of his excellent international reputation and his extensive industry experience coupled with an outstanding publication record. His vision for the future research opportunities for university research in the microelectronics field is exciting to the Virginia Tech research community, " said James S. Thorp, head of Virginia Tech 's Bradley Department of Electrical and Computer Engineering.

Prior to his position with the Crolles Alliance, Orlowski was a research scientist at The German Aerospace Center in 1983-84, and then joined Siemens in 1984 where was the project leader in process simulation and modeling. In 1989 Motorola Research labs in Austin, Texas recruited him, and in 1995 he became the director of the Motorola Moscow Research Laboratory. In 2002 he returned to the U.S. to be the staff manager for Advanced Device Development Group for Freescale in Austin Texas. He joined Crolles in 2006.

"The College of Engineering is extremely pleased that Dr. Orlowski has agreed to join our faculty. He is a pioneer in the microelectronics field and has more than 150 publications in scientific journals and conference proceedings. He has been the keynote speaker at a score of premier conferences, and he has received numerous honors from industry including innovation awards from Motorola and Freescale, " said Richard Benson, dean of the college.

Orlowski has his bachelor 's, master 's and doctorate degrees from Tuebingen University in Germany. He was an assistant professor at Tuebingen University from 1979 to 1981, a lecturer at Purdue University in 1982-83, and a research associate for a brief period at the Stanford Linear Accelerator Center.

VMEC, created in 1996 to serve the microelectronics industry in the Commonwealth, consists of the

following colleges and universities: George Mason University, Old Dominion University, the University of Virginia, Virginia Tech, and the College of William and Mary. A chair was awarded to each of the six universities.

Support for start-up funds for this unique cooperative venture was granted by the 1998 Virginia General Assembly when it agreed to provide $4 million in the 1998-2000 biennium to the Virginia Semiconductor Educational Endowment.

In July of 2007, Forbes.com listed Virginia at the top of its "Best States for Business" list for the second straight year, and its microelectronics industry is key to this recognition.

Staff Reports

Biomimetics:

Nature has long been a source of fascination and study for man. The incredible strength of spider silk, the beauty of a bird in flight, even simple things like bones and shells can all be inspiring to just about anyone, from artists to engineers. Biomimetics is essentially trying to mimic living things and objects found in nature by using design and technology. It is more than making robotic insects, to give a rather extreme example. It is also about studying biological materials, such as spider silk, that often have significantly better mechanical properties then we can synthesize. In addition, these biological materials are made more efficiently in terms of energy consumption, and with no need for dangerous byproducts and solvents that are a concern for today's industry.

This summer, Dr. Paul Gatenholm of Virginia Tech's Materials Science and Engineering (MSE) department will be offering a course in biomimetics entitled "Biologically-Inspired Materials - Biomimetic Design and Assembly". The course will be held in Switzerland, at the Virginia Tech Center for European Studies and Architecture (CESA), and will include students from around the world in addition to those Tech students who participate. The course will be open to advanced undergraduates as well as graduate students.

I had the chance to speak with Dr. Gatenholm about the course, to learn more about it. Since the course is only for a week, the course will be a very intense one, and that is one reason that the course will be held at the Villa Maderni at the CESA. It is a two hundred fifty year old restored villa which contains the Center's offices, classrooms, a library, a computer lab as well as residential facilities for 24 students, according to the CESA's website. According to Dr. Gatenholm, having the small number of students will also allow for students to really get to know one another and socialize. About half of the students will be from Tech, the other half will be from universities around the world.

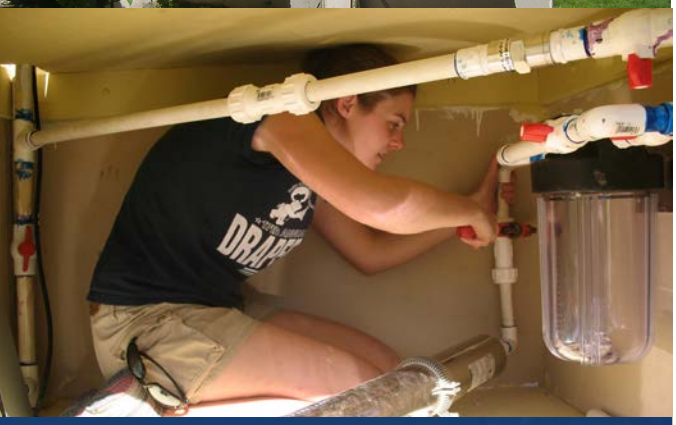
The course is based off of the Gordon Research Conference idea, where scientists from all disciplines

where nature and technology meet

and backgrounds come together for a week to have intense discussions about cutting edge research on topics such as electrochemistry or medicine, according to the Gordon Research Center's website. The biomimetics course will be taught by renowned researchers in the biomimetics field from Tech and other universities world-wide. Some of the topics covered include the viscoeleastic properties of biological materials and using biomimetics to support replacement of human organs. The course will be very interdisciplinary, with students having backgrounds not only in materials science, but also in chemistry, wood science, geology, and medicine.

For the students, the course will entail work both before and after the week-long class, and about 30 hours of instruction will be provided during the week of the class. This was done in order to make the course three credits and to allow both undergraduates and graduates attend the class. Prior to the class, students will be required to prepare a poster for a poster session at the beginning of the course. Graduate students may present their own research, or may also present a poster based on selected papers that will be sent to them prior to the class. After the class has finished, graduate students will be required to complete some form of project, while undergraduates may continue their studies and take some form of an exam. For the graduate students, the idea is for them to be able to use Tech's new Nanoscale Characterization and Fabrication Laboratory (NCFL) at the Institute for Critical Technology and Applied Science (ICTAS). Dr. Gatenholm is also in the process of applying for a grant from the National Science Foundation (NSF) in order to help students to pay for the travel overseas.

Danielle Willgruber is a senior in Materials Science Engineering.



Thinking outside the box: E takes learning out of the cla

Are you looking for an experience, unlike most others, where you get the chance to make a difference both locally and internationally? Through Engineers Without Borders, an experience like this is within reach. Engineers Without Borders (EWB) is a national organization with chapters at universities around the United States that works with underprivileged communities to "improve their quality of life through implementation of environmentally, equitable, and economically sustainable engineering projects, while developing internationally responsible engineers and engineering students through education, encouragement, and experience," according to their website.

EWB-VT has three major branches: local service projects, community outreach, and international projects. Local service projects include Project Home Repair and Habitat for Humanity. Organization members also participate in community outreach by going to K-12 classes in Montgomery County to increase awareness about engineering and teach them about international issues as they relate to engineering. EWB-VT is also involved with international projects. International projects require months, if not years, of planning. According to Meredith Herrmann, the current president of EWB-VT, "international project teams work on their specialized project whether it is in water sanitation and distribution or power supply. International project teams assess are concepts for improve the projects in the

The organization just international project, Republic, over the win members installed a U water filtration system, on the water storage tar clinic. Herrmann said, undergraduate student truly make a difference of the people working a purified water, which is granted every day." In in the Dominican R working on projects in G In Guatemala, Virginia College are working tog storage tank, spring bo water from the spring b This part of the syst summer. There are still to do before this project connecting the storage t the tank is to be used "partnering with EWB-U and Uganda Rural Fu the Hope Integrated A orphans and has an technical skills," said H be returning to Uganda implementing their plan.

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This semester the group
hopes to start working on a project in Haiti.

EWB-VT is part of a much larger organization, EWB-USA. The national organization offers advice for local chapters that are planning international projects, and also approves all of the project plans before they are implemented.

It is really easy to become involved with EWB-VT. The organization has meetings every other week on Tuesdays in Randolph 331 at 7 pm. The meetings began on January 22, 2008 and will end on April 29, 2008. Students can work on local projects as well as international projects. Herrmann became involved when she "saw a flyer hanging up in an engineering building one day explaining some of the activities that EWB provides, such as a K-12 program and at the time an international project in the Dominican Republic. I thought it would be a great experience to do hands on engineering work."

When asked about what students can gain from becoming involved in EWB-VT, Herrmann mentioned several things. First, "it gives them life experience that cannot be taken from what someone learns in a classroom. Students learn how to interact with professional engineers through fundraising, design work, or chapter collaboration," said Herrmann. Secondly, "students are able to first hand see the need in the world and have the ability to help both

Continued on page 24

Engineering Science and Mechanics to celebrate centennial

Virginia Tech's Department of Engineering Science and Mechanics (ESM) will celebrate its 100th anniversary during 2008. As part of its celebration, the department is hosting a two-day mechanics conference on May 29 & 30 at The Inn at Virginia Tech and Skelton Conference Center.

Virginia 's senior land-grant university, today the Virginia Polytechnic Institute and State University, more commonly known as Virginia Tech, was founded in 1872, and just 36 years later in 1908, mechanics became an identifiable separate entity in the college of engineering. During its 100-year history, the department housing mechanics, like the University itself, underwent several name changes, and today it is known as ESM.

"ESM is one of the few departments of its kind in the U.S. and has a distinguished history, " said Ishwar Puri, professor and department head of ESM, adding that a 2005 review by a blue-ribbon panel concluded that ESM has a "longstanding record of excellence as a key element of the College of Engineering with national visibility."

Ranked eighth in its research area by U.S. News and World Report, ESM has almost 30 faculty members who have backgrounds in engineering mechanics, the principles on which most areas of mechanical, aerospace, ocean, civil, materials, and perhaps even chemical and mining, engineering are based on, and in engineering science, covering applied mathematicians and physicists. Some also have interests in aspects of electrical and computer engineering, computer science, and the life science.

To participate in the anniversary conference, all interested mechanicians are invited to submit one-page abstracts related to any aspect of fluid mechanics, solid mechanics, materials, dynamics and control, and biomechanics, as well as emerging areas in mechanics.

In addition to the parallel sessions of the conference, there will be a banquet on May 29.

The deadline for one-page abstracts is February 15, 2008. One must

register for the conference by May 16, 2008. The deadline for cancellations is May 1, 2008 at 5 p.m.

For updates and more information, please refer to this website: http://www.esm.vt.edu/
Conference registration will occur at: http://www.cpe.vt.edu/mcesm/
A block of lodging rooms is being held at The Inn. The lodging rate for this conference is $103 plus applicable taxes. Participants are responsible for making their own lodging arrangements. Lodging reservations should be made by May 1, 2008. Lodging:www.TheInnAtVirginiaTech.com

For additional information, please contact Professor Ali H. Nayfeh with the Department of Engineering Science and Mechanics at: (540)231-6871; fax: (540)231-2290; or email: sallys@vt.edu.

Staff Reports

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locally as well as internationally." EWB-VT opens students' eyes to problems in the world today and gives them a chance to help change the world for the better. Thirdly, after graduation, the national chapter of EWB can put a member's resume in their resume book which is given to donors, and help them apply for graduate school or become with other volunteer organizations, such as the Peace Corps.

Engineers Without Borders at Virginia Tech is a growing organization that is always looking for new members with fresh and innovative ideas. If you are looking for an activity that is full of excitement, learning, and giving back to the community, Engineers Without Borders is the place for you.

Kari Adkins is a junior in Industrial and Systems Engineering.

Wireless communications groups win *top awards* at international competition

Graduate students from Virginia Tech's Bradley Department of Electrical and Computer Engineering took top honors during the 2007 Software Defined Radio Forum conference in Denver, Colo., on Nov. 5.

Student teams representing the university's Center for Wireless Telecommunications (CWT) and Mobile & Portable Radio Research Group (MPRG) participated in the inaugural Smart Radio Challenge, an international engineering competition.

Virginia Tech was the only school with two teams among the final 10 competitors in the challenge. Teams came from schools in France, Malaysia, and Sweden, as well as the United States. Each team had to design, develop, and test a software defined radio (SDR) in a way that would solve one of three specific problems.

The Virginia Tech CWT team won the competition's grand prize by developing a software defined radio capable of finding available spectrum within a pre-defined band, rendezvousing with an intended receiver, and transmitting data with a pre-determined quality of service in urban conditions. The team of eight graduate students was awarded cash prizes totaling $6,000.
The nine graduate students on the Virginia Tech MPRG team won the Smart Radio Challenge award for best SDR design.

"Virginia Tech has a long tradition of excellence in wireless, and these young men and women are very much in that mold," said Charles Bostian, Alumni Distinguished Professor of electrical and computer engineering and faculty adviser for the CWT team. "We graduate innovative engineers who can design and build real radios."

Software defined radio devices use software rather than traditional dedicated hardware to define and modify the way they perform signal processing for transmission and reception. This technology is used in two-way communications devices by tactical military forces

and emergency responders, as well as in the development of wireless networks that provide Internet services to rural areas.

The Virginia Tech CWT has been selected by the Software Defined Radio Forum to send a team to the 2008 competition.

The CWT and MPRG are both affiliate organizations of Wireless @ Virginia Tech, which is one of the largest university wireless technology research groups in the nation.

The Software Defined Radio Forum, a nonprofit international industry association dedicated to the development and deployment of SDR systems, has about 100 member organizations worldwide.

Staff Reports

Winners of the 2007 Software Defined Radio Forum conference accepting their award.

Students' research could give the Beach Boys a new surfing song

Surfers in Hawaii had better beware. Four Virginia Tech engineering science and mechanics (ESM) students have completed "Surf Green" for their senior design project, and conclude that they can technically improve the surfboard's performance.

The Beach Boys may have sung about surfing but this team of ESM students decided to "quantify the feel of surfing," something only engineers would try to do.

Michael Porter and Stephanie Salmons, both of Virginia Beach, Va., Matthew Dunham of Pleasantville, N.Y., and Nandan Shah of Midlothain, Va., worked with their faculty adviser, Jack Lesko, professor of ESM, for a year, submitting a final report at the end of 2007.

"Mike Porter lead the effort and completed most of the work this summer while living out of his van and driving up and down the east coast this summer in search of waves," Lesko smiled. He added that the project lasted beyond the spring semester because the surfboards were in his lab in Norris Hall and inaccessible to the students for weeks after the Virginia Tech tragedy last April.

"So, beyond the very good technical work, there is a good bit of character and fortitude exhibited by these students that I would like to acknowledge. I am just honored to be a small part of the lives of these talented students," he added.

The students focused on three different surfboard constructions of the same shape and size to compare the affects of material composition on the mechanical performance of surfboards. For the comparison, the team said they followed "a theory of surfboard mechanics developed (that is) analogous to the beam theory of solid mechanics."

They attached strain gages to the surface of each surfboard to determine the response or material

deformation of each board while testing in and out of the water-surfing each board to establish feel, while static testing to verify mechanical properties.

The students decided it was a particularly appropriate time to study the composition of surfboards because Clark Foam, a California based manufacturer and distributor of nearly 90 percent of the world's materials for surfboards, ceased its production. "As a result, traditional polyurethane foam surfboards became scarce and new technologies began to emerge," the students said.

A wide variety of new eco-friendly surfboard constructions appeared on the marketplace, and consequently, surfers, manufacturers, and retailers are beginning to experience the pros and cons of the various material compositions.

"However, without numerical evidence to clarify the mechanical performance of these new materials, the future of the surfboard industry is reliant solely on word-of-mouth and marketing strategies," they added.

"We want to assist surf culture, providing the knowledge necessary for board selection and design," the engineering students said.

In their testing, they named the different surfboards Gnarly, Tubular and Righteous. Porter conducted various field tests with the equipment, "all in the interest of finding engineering solutions," his adviser Lesko joked. Each board "had" to be tested for roughly one hour to ensure at least two similar waves were caught.

With Porter riding the boards, he then developed plots of converted strain while he was surfing, duckdiving (the primary means used to pass through a crashing wave) and paddling. Although the latter is "not a very exciting part of surfing, anywhere from 50 to 90 percent of surfing is paddling. Paddling, especially in strong currents, big waves, or rough weather, is most responsible for depleting a surfer's energy," the team said. Thus, a board that enables a smooth, easy paddle is more beneficial.

The students also developed data for the jump from tensile strain to compressive strain. They learned which board experienced the most shearing strain or torsion when surfing.

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Virginia Tech to offer Nuclear Engineering coursework

Virginia Tech's College of Engineering is now offering graduate coursework that will lead to a Master's of Engineering degree in Mechanical Engineering (ME) with a Nuclear Certificate. Courses are now available and approval for the certificate is expected for fall semester of 2008.

"With the critical demand for energy by our nation and the world, we are pleased to revive our concentration on nuclear engineering," said Richard C. Benson, dean of Virginia Tech's College of Engineering. "We have strong relationships with a number of industrial and government entities, including AREVA, NP, Inc., Dominion Resources, Oak Ridge National Laboratory, the Commonwealth of Virginia, and the Department of Energy, that have shown support for our nuclear engineering program. I believe educating our very bright students in this area will be beneficial to them and to society."

"Our long term vision is to create an interdisciplinary program in nuclear science and engineering," said Ken Ball, head of the ME department, who has expertise in nuclear materials and engineering. "Our program would encompass the nuclear sciences and medicine as well as nuclear engineering and reach across three Virginia Tech colleges."

Virginia Tech is a founding member of the Southeast Universities Nuclear Reactors Institute for Science and Education (SUNRISE), of which Ball is a member of the Board of Directors.

SUNRISE is dedicated to enhancing the quality of nuclear education and research and other services in the region for the purpose of supporting the development of the next-generation nuclear workforce, nuclear technology, and advanced nuclear research.

Virginia Tech's nuclear coursework is also available to off-campus students. Since Virginia's Commonwealth Graduate Engineering Program (CGEP) approved the nuclear certificate from Virginia Tech, its network is hosting the graduate classes and will use the distance

education classrooms of Central Virginia Community College in Lynchburg as well as the Richmond Center and the Hamptons Roads Center.

Classes are simultaneously offered on the Virginia Tech campus and at the participating campuses around the state. The video teleconferencing of the classes is conducted with state-of-the-art fully interactive, multi-site two-way video and audio links.

Courses in this program can also be used as resources to fill the requirements of the master's of science and the Ph.D. programs in ME. Earning a master's degree in ME with a nuclear certificate requires satisfactorily completing a 30-credit hour program.

ME faculty members Eugene Brown and Mark Pierson are in charge of the initial planning of this new program.

For additional information about this new program, email Brown at efbrown@vt.edu, or Pierson at mark.pierson@vt.edu.

Staff Reports

SEC Students meet with Dean Benson to discuss programs within the College of Engineering

The Student Engineers' Council (SEC) at Virginia Tech is one of the largest student organizations in the College of Engineering. The SEC, according to their website, "brings the engineering student body together not only to benefit their individual departments but also to combine their efforts for the benefit of engineering here at Virginia Tech." Each year the SEC is involved in many different meetings to attempt to better the experience for undergraduate engineering students. In this article, some of the projects the SEC is working on are showcased. Most know the SEC from its planning and execution of Engineering Expo every year, but few know of the other projects that the SEC works hard on throughout the rest of the year.

Every semester, the Dean's Committee of the SEC sets up one or two meetings with the Dean of the College of Engineering, Dr. Richard Benson. This year, the Dean's Committee is chaired by Angad Singh, a sophomore in Industrial & Systems Engineering. The purpose of these meetings is to get a chance as students to ask questions and give feedback to the College of Engineering. Topics are provided by the SEC in advance so that the Dean may invite colleagues who can provide better answers at the meeting. This past fall, Dean Benson was gracious enough to meet with the Dean's Committee twice to discuss issues on students' minds. In fact, Dean Benson is genuinely interested in hearing what students in his college have to say. Topics ranged from engineering fees to design team funding. Here is a brief review of some of the topics discussed.

Engineering fees are not new to many universities, just to Virginia Tech. Starting this past year, engineering fees are being charged per credit hour for freshman engineering courses. Because they are being phased in over four years, upperclassman should not be affected. However, students were curious as to where this money was going. Ninety-six percent of the fees will be spent upgrading labs while the other four percent is to assist with financial aid. Dean Benson wanted to ensure that 100% of the engineering fees went back to the

students who paid them, so the College of Engineering receives 50% of the fees to distribute while the other 50% is kept within the department that raised the funds. Furthermore, the Dean's Office has already matched the amount raised by the fees to give the first round of upgrades a head start. One of the first uses of the fee will go towards improvements on the tow tank in the basement of Norris Hall. In the end, the College of Engineering will get much-needed funding to upgrade labs.

In addition to discussing the introduction of engineering fees to tuition, the Dean's Committee also discussed the tablet personal computer (PC) initiative with Dean Benson. Warming up students to the idea of Tablet PCs was an undertaking for the College of Engineering when they first announced the requirement for upcoming freshmen two years ago. Now that students are in their second year of using these new gadgets, they want to be reassured that tablet PC requirements are enhancing and will continue to enhance their educational experience. Glenda Scales, the Associate Dean for Distance Learning and Computing in the College of Engineering, assured the Dean's Committee that the College is pushing for teachers to incorporate tablet PCs into their courses. Products like DyKnow and Microsoft OneNote

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The case of the missing genes ... and the subsequent search for a Genome Similarity Tree

ParaMEDIC, a general software-based framework for large-scale distributed computing developed by Argonne National Laboratory (ANL) and Virginia Tech, will have a significant impact on the study of genomics.

The GenBank® database, a collection of all publicly available DNA sequences, doubles in size approximately every 12 months. Yet the computational capability of a compute node doubles only every 18 months. Consequently, searching for similarities between new protein or nucleotide sequences with the database of known sequences is becoming increasingly difficult.

This problem becomes even more insidious when attempting a large-scale sequence-searching problem, like identifying missing genes, because solving such a problem oftentimes exceeds the computational and storage resources of any given supercomputing site. Thus, a team of researchers from ANL and Virginia Tech created a worldwide supercomputer called CompuMatrix and developed a novel framework called ParaMEDIC, short for Parallel Metadata Environment for Distributed I/O and Computing, in order to accelerate the speed of parallelized bioinformatics programs by an additional 27-fold when running over CompuMatrix.

ParaMEDIC achieves this performance by decoupling computation and storage in CompuMatrix. Pavan Balaji, post-doctoral researcher in the mathematics and computer science (MCS) division at ANL, and Wu-chun Feng, associate professor in the departments of computer science (CS) and electrical and computer engineering (ECE) at Virginia Tech, led the team of researchers who created ParaMEDIC.

With ParaMEDIC, a team of researchers led by Balaji and Feng embarked on two compute-intensive and storage-intensive tasks: sequence-searching all the known microbial genomes against each other in order to discover missing genes via mpiBLAST sequence-similarity computations (i.e., mpiBLAST, http://www.mpiblast.org/ at Virginia Tech); and generating a complete genome similarity tree, based on the results of sequence-searching the above microbial genomes, in order to speed-up future sequence searches.

These two tasks required more than 10,000 processors across six supercomputing centers in the U.S. and generated a petabyte of uncompress data in one month, which was then written in compressed format to a 0.5-petabyte filesystem in Japan.

With respect to discovering missing genes, João Setubal, associate professor and deputy director of the Virginia Bioinformatics Institute (VBI) at Virginia Tech, notes that most of the genomes completed to date have had their genes detected by gene-finder programs, which may miss real genes. “One way to discover these missed genes is by similarity computations,” said Setubal. “If enough computer power is available, every

possible location along a genome can be checked for the presence of genes. That is exactly what the ParaMEDIC team has done by leveraging the mpiBLAST sequence-search program."

In addition to discovering missing genes, the ParaMEDIC team also sought to restructure the microbial genome database by generating a complete genome sequence-similarity tree, thus enabling future searches to completion in just a fraction of time. "The sequence similarity tree can allow researchers to come up with better ways of structuring the database and more efficient algorithms to search specific portions of the data, instead of a brute-force search across the entire database as is currently done," said Balaji. "Biologists can quickly discard huge parts of the database without losing any useful information."

"Unfortunately, generating these similarity trees require large amounts of compute power and fast disk storage. No single supercomputing center could provide both the needed computational and storage resources needed to complete the above two tasks," noted Feng. Thus, computations would have to be performed across a multitude of supercomputing sites and then petabytes of generated data (i.e., over 213,000 DVDs worth of storage) would need to be moved from the computational sites to another site for storage. "Such a model is clearly inefficient," Feng said.

ParaMEDIC solves this problem by converting the output generated to orders-of-magnitude smaller metadata at the computation sites, transferring the metadata to the storage site, and then converting the metadata back to the actual output at the storage site. The metadata corresponding to the output will be available at Argonne National Laboratory and Virginia Tech for free public download in the future.

"Simultaneously needing large compute and storage resources has been a big problem for many applications," said Ewing Lusk, director of the MCS Division at Argonne National

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Laboratory. "ParaMEDIC has provided a way to store relatively small metadata that can be used to guide future computations and regenerate the required portions of the actual output on-the-fly with very little computation. With the rapidly growing scales and sizes of applications, this model will be the wave of the future in a variety of compute- and storage-intensive applications," said Lusk.

Six institutions provided computational resources for the CompuMatrix worldwide supercomputer: Virginia Tech, ANL, the Center for Computation and Technology at Louisiana State University, the Renaissance Computing Institute, the University of Chicago, and the San Diego Supercomputing Center.

The Tokyo Institute of Technology with support from Sun Microsystems generously provided the massive storage resources and I/O compute servers for the CompuMatrix worldwide supercomputer.

The ParaMEDIC framework is also one of the finalists in the Storage Challenge competition at this year's IEEE/ACM International Conference for High Performance Computing, Networking, Storage and Analysis (SC/07).

For more information, please contact Pavan Balaji (630-252-3017 or balaji@mcs.anl.gov) at ANL, or Wu-chun Feng (540-231-1192 or feng@cs.vt.edu) at Virginia Tech.

Staff Reports

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allow students to participate in an interactive classroom and participate in collaborative sessions with others in the class using a common IP address. Rest assured that tablet PCs will be used beyond freshmen courses as plans have been developed for use in upper-level courses as well. Moreover, design teams will have the opportunity to use this technology outside of the classroom to increase their productivity.

Students are also concerned with the course evaluation system, administered at the end of every semester. Students get the chance to evaluate their professors, but never get the chance to evaluate their teaching assistants (TA). Since many TAs do not return to teaching the next semester, evaluations may be a moot point. To improve the quality of learning throughout the semester, more training needs to be financed for TAs so that students are getting the most out of their tuition dollars. Associate Dean for Research and Graduate Studies, Donald J. Leo, is curious as to what students believe makes a successful TA. The SEC has agreed to survey students and hopefully gather enough data to define what skills and attributes a "good" TA has. Once this information is gathered, Dean Leo will work with the SEC and use the survey results in order to improve classroom and laboratory TAs.

Funding is hard to come by this year for design teams, which is some of the best hands-on education available to engineering students at Virginia Tech. Dean Benson regrets that cuts had to be made, but decreased funding from the state tends to have an effect on everyone. The Dean's Office's budget was cut by the state just before school began and again mid-year. In turn, this cut affected how much money could be granted to engineering departments, which are responsible for distributing funds to design teams. Fortunately for design teams, the SEC started up a design team endowment last spring to provide more consistent funding year after year. The endowment now contains over $278,000 with plans to reach $500,000 by 2010.

The SEC would be grateful for students' suggestions on future topics to be discussed at meetings. If you would like to attend these meetings for direct interaction or to make a difference within the College, the SEC would encourage you to be on the Dean's Committee. To take advantage of these opportunities, send an e-mail to Angad Singh at sec@vt.edu.

Becky Wiggins is a student in Computer Engineering and the Director of Relations for the SEC.

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Based on their mechanical response findings, the students justified in their findings why each board may ride with more or less speed, stability, and response. They also predicted which boards are ideal for what types of waves and riding.

Gnarly performed best of the three in choppy and bumpy conditions because of its stability. Gnarly was the king of speeding through fast racy sections.

Tubular, on the other hand, managed steep drops better than the other boards. The students believed this was probably related to its superior longitudinal flex properties, since it is able to deform to fit the shape of the wave face. However, once the initial drop was made and the board was turned down the line, board Tubular lost speed.

The students concluded that Righteous performed fairly consistently in all surf conditions. It did not tend to bounce in messy surf; although, it would wobble from side-to-side some. Righteous did not tend to pearl or nose dive on steep waves; although, this could be related to its increased rocker. And, it did not seem to lose speed while pumping; probably because it flexes less lengthwise than board Tubular.

However, the major flaw of board Righteous, they added, was related to its poor torsional stiffness properties. When making turns, especially the first bottom turn, board Righteous tended to lose its edge and "slide out" from under the surfer.

As with most research, the students left open the idea that "more is needed" including the internal geometry, and they may have to ride a few more waves before they are completely finished with this project.

Staff Reports

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THIS IS A CLASSROOM.

SDI metallurgical engineers Jeremy Cronkhite (left) and Doug Rees-Evans, manager of technical services at the structural and rail mill

This steel mill was one of Jeremy Cronkhite's classrooms while studying undergraduate metallurgy: the Steel Dynamics structural and rail mill at Columbia City, Indiana. During two summer internships at SDI, Jeremy learned a good deal about steelmaking. Working with veteran SDI engineers, such as Doug Rees-Evans, Jeremy gained valuable hands-on manufacturing experience.

After earning a degree in Materials Science Engineering from Purdue University in 2005, Jeremy joined SDI full time as a rolling mill process metallurgist. Today, Jeremy continues his learning in this big classroom, with his knowledge and work experience already allowing him to make a solid contribution.

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