Over the past three years, Cedarville engineering students have worked to provide a solution to the problem of high-cost medicine faced by missionary hospitals. Missionary surgeons in Third World countries often face the challenge of treating many patients with limited equipment.

Tenwek Hospital in Kenya, Africa, uses an intramedullary (IM) nailing procedure as its preferred choice for fixing femoral shaft fractures. After learning about the high cost of femoral nails, Cedarville mechanical engineering students sought a solution to lower these costs.

To ensure the nail’s safety for patients, the team evaluated every design modification for its effect on the strength of the nail by running a stress analysis on a computer model.

The team came to a cost estimate of just above $200 per nail, well below the $1,000 cost of each existing IM nail.

In addition to working on manufacturing new nails, students also worked to remanufacture nails that had been donated to the program. In fall of 2009, Cedarville engineering students were given 160 nails, 80 of which were too long for most of the African patients.

The long process of remanufacturing those nails culminated in 2011. “I located, established business relationships with, and subcontracted four manufacturers in the Dayton area to remanufacture the IM nails,” Pernicano said. “As a result of my work, we were able to remanufacture the nails at a low cost.”

The task of remanufacturing the donated nails was completed in July 2011 when nails were sent to Tenwek Hospital to be used by the missionary surgeons there.

“Tenwek Hospital’s orthopedic department is most grateful for the efforts of Cedarville biomedical students who have invested their time and energy to this project,” Galat said.

“Our patients, for the most part, are coming from homes where subsidence farming is the source of life and income,” Galat said. “These inexpensive implants, which only require small incisions and promote faster bone healing, are similar in design and placement to implants that are being used in the developed world even today.”

While previous teams made significant progress, Leah Pernicano ’12 and Erik Kane ’12 made up the team that was finally able to achieve success and bring the nails to manufacturing during 2010–11.

The team asked possible manufacturers for design modifications with the potential to lower production costs, analyzing these modifications, implementing them if possible, and reiterating on those designs.

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“The remanufactured femoral nails provided by the Cedarville engineering students give us the opportunity to offer less invasive and fairly contemporary techniques for treating femur fractures at Tenwek Hospital,” said Dr. Dan Galat of Tenwek Hospital.

Recently the teams learned that the reengineered nails were put into use. Galat used the first Cedarville nail on a young man named Cornelius.

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Combining engineering knowledge with a competitive spirit, Cedarville’s solar boat team navigated its way to a record sixth win in the Solar Splash Intercollegiate Solar Boating competition.

The team, advised by Timothy Dewhurst, Ph.D. and Gerald Brown, Ph.D., was made up of Jesse Bierer ’11, Jill Conway ’11, Aaron Hensler ’11, Daniel La Croix ’11, Tyler Smidt ’11, Andy Koch ’12, and Joel Dewhurst ’14.

The 2011 challenge, held in Cedar Falls, Iowa, lived up to its reputation for providing tough competition. A hard-fought duel in the endurance race and a solid run in the sprint competition sealed the victory for Cedarville.

Solar Splash provides the competitive environment for students to apply their research and coursework to design a boat that harnesses renewable energy while withstanding the rigors of racing.

During the event, 22 teams from around the globe earned points in seven categories. Boats are scored on their appearance and construction through technical reports, visual displays, and workmanship. The pinnacle of the competition begins by testing each boat’s operation and performance where it counts — on the water.

Events on the water begin with a sprint and a maneuverability qualifier. The Solar Slalom is next, requiring the boats to weave in and out of markers so the driver can showcase the boat’s speed and maneuverability. The final days of competition are focused on endurance and sprints.

The endurance race tests efficiency and consists of two two-hour heats, with the goal of traveling as far as possible. The sprint event is a 300-meter dash, designed to test speed. Cedarville finished third in the sprint event. They also placed first in the qualifying event and in the technical reports competition, as well as third in slalom and second in visual display. The team also received the outstanding workmanship award and sportsmanship award.

Much of Cedarville’s success comes from building on the work from previous years. “Each year we don’t start from scratch,” Dr. Dewhurst said. “We always ask ourselves, what can we do that will really improve our boat?”

This year’s success came as a direct result of the work from the previous year’s team. The 2009–2010 team began developing a custom motor for the boat, but never succeeded in getting the motor to work completely. The 2011 team took the concepts and work already put into the motor and finished its development. This work, according to Dr. Dewhurst, contributed to Cedarville’s success at the competition.

At the beginning of the year, students are assigned a particular aspect of the boat to focus on. The students must research and educate themselves, while completing regular progress reports. It is this rigorous work that will prepare these students for the job market.

“The whole school year is spent preparing for the event,” Smidt said. “Seniors devote the majority of their schedule to their senior design project, and for five of us, the solar boat was our job.” Work during fall semester is focused on planning, research, and other initial design work. Once spring comes, the students begin manufacturing prototypes for testing and design purposes, all the while looking toward the competition in June.
Department Chair Greeting

Greetings, and thank you for your interest in the Elmer W. Engstrom Department of Engineering and Computer Science at Cedarville University. We rejoice in the Lord for the many ways that He has blessed us again during the 2010–2011 academic year and are pleased to share some of our highlights with you.

To quote from our department vision statement, we “seek to honor the Lord Jesus Christ in every endeavor and earnestly desire to cultivate technical professionals who are committed to moral excellence, and who are exemplary in character, conduct, and skill.” As you read this newsletter, you will see how we live out our vision statement on a day-by-day basis. Whether setting the foundation through lectures, or putting engineering to practice in design competitions or laboratory exercises, we strive to provide our students with an excellent education founded on biblical principles and morals. The effort put forth is clearly paying dividends.

Although most people never give it a thought, it is hard to imagine our world without engineers and computer scientists. It is very easy, for example, to always expect the next cellphone or GPS unit to be better, faster, smaller, or “cooler” than the one before it. What is forgotten is that there is an army of engineers and computer scientists behind the design of every new gadget. From the electronics that enable the phone to communicate wirelessly, to the software that makes it “cool,” to the nifty sliding door that exposes a hidden keypad, each is a design masterpiece. Here at Cedarville, we offer majors in electrical, computer, and mechanical engineering and in computer science; the same disciplines that are most applicable to many of today’s marvels.

As you read this newsletter, you will not see our students designing cellphones, but you will see how well-prepared they are to tackle very difficult problems. From writing winning computer programs, to designing and driving cars that achieve over 1,400 miles per gallon, we believe that our students and graduates are some of the best-prepared engineers and computer scientists in the country. But don’t take our word for it; read through this newsletter and discover it for yourself.

Sincerely,

Sam SanGregory, Ph.D.
Chair, Elmer W. Engstrom Department of Engineering and Computer Science

Faculty
- Sam SanGregory, Ph.D. (Chair)
- Robert Chasnov, Ph.D. (Associate Chair)
- Gerry Brown, Ph.D.
- Timothy Dewhurst, Ph.D.
- Vicky Fang, Ph.D.
- David Gallagher, Ph.D.
- Hardy Hegna, Ph.D.
- Nan Jiang, Ph.D.
- Jay Kinsinger, M.S.
- Clint Kohl, Ph.D.
- Tim Norman, Ph.D.
- George Qin, Ph.D.
- Keith Shomper, Ph.D.
- Jeff Shortt, Ph.D.
- Thomas Thompson, Ph.D.
- Timothy Tuinstra, Ph.D.
- Tim Yao, Ph.D.
- Larry Zavadney, Ph.D.

Majors
- Computer Engineering (B.S.Cp.E.)
- Electrical Engineering (B.S.E.E.)
- Computer Science (B.S.)
- Mechanical Engineering (B.S.M.E.)

Minors
- Biomedical Engineering
- Computer Science

Special Programs
- Cooperative Education Program
- Engineering Honors Program

Internships
Cedarville’s career services staff will help you prepare for your career through discipline-related experiences, or internships. You will have an advantage in a competitive job market because of real-life, hands-on experience. Students in our department have enjoyed internships with organizations including:

- BAE Systems
- Ball Aerospace & Technologies Corp.
- Boeing
- Brookhaven National Laboratory
- Burrus Logistics
- Caterpillar
- Cummins
- Dallas Semiconductor
- FBI
- GE
- Hawaii Electric Light Company
- Ingersoll Rand
- ITT Industries
- JPMorgan Chase & Co.
- The John Hopkins University Applied Physics Laboratory
- LexisNexis
- Lexmark International
- Lockheed Martin
- Northrup Gunman
- Otis Elevator Company
- Proctor & Gamble
- Raytheon Company
- Rolls-Royce Motor Cars
- SAIC
- Standard Register
- Westinghouse Electric Company

Few universities — Christian or not — offer the modern facilities, extensive hands-on experiences, and one-on-one faculty interaction that characterize Cedarville’s programs. The rigorous classroom experience combined with a campus environment openly committed to Christ prepares our graduates to find jobs in a wide range of engineering and technology fields or to succeed in graduate school.
Cedarville Garners Honorable Mention in RoboBoat Competition

A group of Cedarville University electrical and computer engineering students charted new waters during the 2010–2011 academic year. The team built a robotic boat that was entered in the 2011 RoboBoat competition in Virginia Beach, Virginia.

The June competition required students to build a small, autonomous watercraft capable of navigating a water course consisting of colored buoys and channel markers. The competition is sponsored in part by the Association for Unmanned Vehicle Systems Foundation and the Office of Naval Research.

The competition requires students to build a computer-controlled boat that can make human-like decisions on its own. “Throughout this project we saw that what we take for granted, is actually quite a difficult thing to program,” project leader Timothy Swanson ’12 said. “Whenever we see a tree, we know it’s a tree and can tell how far away it is. With a computer it is much harder.”

Cedarville’s entry was a pontoon platform built out of PVC pipe. The boat boasted a high-end webcam for buoy detection as well as an electronic compass to keep the boat on course. All decisions were made by the onboard laptop computer, which was programmed by the students.

The students had to work quickly to solve a few problems that arose at the competition. On the day of the competition, Cedarville performed their first qualifying run on the course. This run was not counted since the boat was over the weight requirement by about four pounds.

The team had to work to shave some weight in preparation for a second early morning qualifying run the next day.

Each team is also required to remotely control their vehicle from the shore. When the Cedarville team had difficulty doing this, they had to act quickly to figure out the source of their problem.

“Many hours were spent troubleshooting when we finally found out that our remote control was on the same frequency as many other communication systems around Virginia Beach,” Swanson said.

This forced the students to work quickly to integrate a new spread spectrum radio system into their boat.

After a second qualifying run in which the boat successfully navigated through four gates autonomously, the team was awarded a Rookie Honorable Mention Award and a $500 cash award for their first-year performance.

“I’m very excited by the way that this team worked together while at the competition to solve a number of problems that came up. They gained valuable engineering experience that will help them next year and in their future careers,” team advisor Dr. Timothy Tuinstra said.

Engineers Develop New Concept in Engine Design

In 2011, the Internal Combustion Engine (ICE) Technical Division of the American Society for Mechanical Engineers (ASME) sent out a call for papers. ASME invited undergraduate mechanical engineering students working on internal combustion engines to describe their experience, work, or project. Cedarville senior Will Miedema, with the encouragement of advisor, Larry Zavodney, Ph.D., senior professor of mechanical engineering, responded with a 1,000-word abstract and 10-minute presentation submission.

Miedema and Zavodney have been developing a new concept in engine design — a reciprocating piston engine without a conventional crankshaft. Despite design challenges and setbacks they made enough headway to prepare a work-in-progress presentation, and as a result, Miedema was invited to speak at the ICE conference. The presentation was one of three projects chosen internationally. Today, engine development continues with plans to build and test a prototype.
Robotics Competition Gives Underclassmen Unique Opportunity

The American Society for Engineering Education’s (ASEE) robotics competition provides an opportunity for underclassmen to get involved in an engineering competition early in their academic career. Clinton Kohl, Ph.D., advisor to Cedarville’s team, said the students must just be willing to try. The competition is unique because it is only open to freshmen and sophomores and forces the teams to work with an economical $450 budget.

The 2011 event took place in Vancouver, British Columbia, Canada, and had a logging theme.

The competition called for students to design an autonomous robot that could “harvest” six red dowel rods that represented dead trees, while leaving six green dowel rods that represented live trees. The rods were set up in a random pattern, so the robot had to be able to recognize the color of the dowel it was approaching. To emphasize consistency, the robot had to make four runs along the track.

These runs made up the team’s testing score. In addition, the team had to make a presentation before a group of judges, along with a written report.

According to Kohl, reliability is key. “It’s better to be consistent than it is to go fast and miss one.” Even one bad run can take a team out of the top group.

Preparation for the event began early in the academic year. The team was broken up into four groups, each focusing on a specific aspect of the robot. After working for the entire year, three team members flew to Vancouver where their work would be put to the test.

According to James Smyly ’13, the team’s captain, the team was anxious to see what they were up against.

When it was time for Cedarville’s robot, CedarJack, to compete, it did well and completed its four runs as designed, earning a fourth place finish.

The competition allows students to get a feel for what being on an engineering competition team involves. “It’s a great way to get our freshmen and sophomores involved in design to compete right off the bat, developing that expertise,” Kohl said.

According to Kohl, that experience pays off. “It’s often my ASEE teams that are the captains of our junior and senior competition teams,” he said. “It’s really a feeder program for our full-fledged senior design projects and other engineering competitions.”

The competition gives students the chance to solve real-world problems in a realistic environment. Preparation for the event requires students to work in coordination with each other to solve problems quickly and efficiently.

“It was about doing something with what I’m learning in class,” team member Malia Amling ’13 said. “In class you learn about ideal situations, but the reality is sometimes different. It’s important to be able to model things for the robot mathematically like we do in class, but then to step back and try it and see the other factors that we can’t calculate and adjust for them.”

Kohl has his eyes set on a victory with this year’s team, which will focus on the speed of the robot. The 2012 competition will require two robots that can complete a lap around a track and then pass a ball off to another robot that will complete another lap before passing the ball back to the first robot, and so on. Undoubtedly, Cedarville’s team will be up to the challenge.

A Peek Inside Student Labs

- 1 Computer Numerically Controlled (CNC) Lathe
- 1 CNC Milling Machine
- 1 Wind Tunnel with 18-inch testing chamber
- 1 Solder Reflow Oven
- 1 Surface-mount Electronic Part Placing Machine
- 1 Heat Treating Oven
- 1 Front-surface Microscope
- 1 Fully Equipped Woodshop
- 2 Vibrations Test Benches
- 3 Engine Dynamometers
- 3 Material Tensometers
- 4 Electrical Machines Test Benches
- 6 Microwave Trainers
- 10 Feedback Control Trainers
- 15 Programmable Logic Boards
- 40+ Signal Generators
- 60+ Oscilloscopes, Multi-meters, and Breadboards
- 75+ Power Supplies
- 100+ Computers
- Unlimited Lessons and Adventures
Engineers Develop More Fuel Efficient Vehicles

The Shell Eco-marathon competition provides the Cedarville University Cedarville University’s High Efficiency Vehicle (HEV) team with opportunities to address the real-world issue of fuel efficiency. The goal of the competition is not to see who can build the fastest car, but to see whose vehicle can consume the least amount of fuel over a set distance. The competition featured schools from the United States, Canada, and Mexico.

“We’re developing new ideas,” Lawrence Zavodney, Ph.D., team advisor, said. “We’re developing technology. We’re developing cars and engines that are more efficient”

Cedarville’s team submitted three vehicles, Gold Lightning II (GL-II), Slipstream, and Sting in the competition’s prototype category, which focuses on efficiency and reducing drag.

The Preparation
Several new technological developments were made to Cedarville’s HEV fleet, including in instrument display technology. Computer engineering and computer science majors used Android tablets and cellphone technology to link the cars to a server back in Cedarville. The team can then download that data in real time to keep track of the cars and monitor onboard systems wherever they are on the track.

Students designed a new carbon-fiber chassis, an all-electric drive train powered by lithium batteries, and a new steel front-end chassis, which relocated all steering and braking components inside the wheels to reduce drag as part of their preparations.

Students also developed a second-generation hybrid-electric drive train. This system uses an internal combustion engine to drive a generator which produces electricity to power an electric motor to propel the car.

The Competition
Once the team arrived in Houston, it was time to put everything they had worked to the test. Safety inspections must be completed before the driver and the vehicle are allowed to race.

Just as the team was about to take Slipstream in for inspection, they encountered a problem: they had damaged a DC-DC converter, a critical component used to control the voltage coming out of the generator. Since the team did not have any spares, they asked competition officials if they could convert their combustion-engine category vehicle to the all-electric category. After Shell allowed the switch, the team went to work converting the vehicle.

After working quickly to make the conversion, Cedarville took third place overall with Slipstream, but first among the university teams with 154 miles per kilowatt-hour.

Sting was disqualified when it went over the time limit on its run. A master cut-off switch near the driver’s shoulder was accidentally tripped during the race, shutting off the motor, which caused the vehicle to come in a few seconds over time. Zavodney said this run would have placed second at the competition because it consumed half the energy of Slipstream.

The new engine in GL-II the team’s poster vehicle, had not been completely tuned before the team left for the competition. Because the team had spent all year building this engine, they decided to enter it into the competition anyway. GL-II made a successful run in the competition but only achieved half of the mileage (743 miles per gallon) the previous year’s team had achieved with the old engine.

The Future
The future is bright for the HEV team. As the team continues to look at the fuel efficiency issue, they continue to see opportunities for improvement. “There’s a lot of energy in gasoline,” Zavodney said. “The problem is your engine only converts about a fourth of it into useful work.”

Recognizing this problem, Zavodney and the team are working on a new engine design which he believes will achieve 15-20 percent more fuel efficiency.

Team member Todd Bouws ’13 said, “Everything we do, whether a simple task that we conquer alone, or a large task which we complete with others, is all-important in achieving our goal of attaining better fuel economy, and hopefully winning.” The Cedarville HEV program provides unique opportunities to all involved.
Two decades of success allowed the Cedarville University Aero Design Team to compete and place in the annual Society of Aeronautic Engineers (SAE) Aero Design Competition. They placed third in their class overall, behind a graduate team from the University of Cincinnati and a team from the University of Sao Paulo, Brazil, placing them first among U.S. undergraduate teams.

The goal of the competition is to design, build, and fly a remote control aircraft within design and performance requirements set by the SAE. There are three divisions: open, regular, and micro class. Micro class requires a lightweight, efficient flight, whereas regular class requires a primary focus on maximum lifting capability. A winning score requires points from each category: flying, presentation, and a design report.

Each year Cedarville’s team has built on the success of previous teams. The Elmer W. Engstrom Department of Engineering and Computer Science has entered the competition with teams stretching back to 1991. Each year the team has progressed on the work done the year before to get to where they are today.

This year’s team competed in the micro class division, in which the goal is to design and build a remote-controlled aircraft that can lift the highest payload fraction. This is determined by dividing the total filled weight of the plane by the empty weight of the airplane. The team needs to build an airplane that is light but still powerful.

In addition, the plane must be as light as possible because the empty weight of the plane has a multiplying effect on the flight score. Also, a flight repeatability score is an additional factor that goes into the final score. Cedarville’s plane had 100 percent flight repeatability, the best for the competition.

Fortunately, the team had brought enough spare parts to build two other planes in case of a breakdown.

“We were able to pick up our plane, replace these parts, and then make a successful flight before the round was over for full credit,” Ormsby said.

The competition is designed to provide students with exposure to the kinds of situations that engineers face in the real world. The team spent several hundred hours working together on this project throughout the year.

The future looks bright for the competition. “Interest in aeronautical engineering at Cedarville is growing,” Norman said. “This year, a large number of our freshman engineering students are interested in aero design.”
Discovering the Call to Serve

Eight Cedarville engineering students traveled to Elkhart, Indiana, to volunteer at the HCJB Global Technology Resource Center.

The resource center serves as a support base for missionary radio stations around the world. The center provides quality equipment for Christian media ministries as well as ongoing repair and training services for that equipment.

One of the main services the center provides is assembling radio transmitters to send to communities that do not have them. The center sends the completed transmitters with an engineer who also serves as a missionary. Not only will the community receive a radio transmitter, they will also receive an opportunity to hear the Gospel.

According to Jeff Shortt, Ph.D., the team’s faculty advisor, the center gets many requests for equipment and service each year but can’t fulfill all of them. When the center put out the call for spring break teams from colleges and universities around the country, Shortt put together a volunteer team to answer that call.

The students worked on various projects ranging from refurbishing a high power shortwave transmitter, working in a machine shop, and designing a power protection test fixture. One project had students work with staff engineers in circuit replacement and other tasks to make sure the equipment was ready to use in Third World countries.

These projects allowed the students to work with advanced equipment and engineers in their desired field. They found unique opportunities to learn while serving in a real-world environment.