EMBRY-RIDDLE AERONAUTICAL UNIVERSITY
DAYTONA BEACH, FLORIDA

ENGINEERING NEWS

MAY 2005

Dean's Message

As the 2004-2005 academic year comes to a close, the College of Engineering concludes another successful year. Over the course of the year 198 students received their Bachelor degrees from the College of Engineering and 15 received the Master's degree. The College experienced a growth in academics through adding of undergraduate degrees, expanding faculty, and expansion of courses to meet the needs of the students. Faculty have also expanded their research and articles in this newsletter highlight the visit to racing facilities with a focus on the new Mechanical Engineering degree and its focal area of high-performance vehicles.

This newsletter highlights some of the accomplishments of students and student projects. ERAU students are very active in university, college, and professional organizations and the entire faculty is proud of their dedication to the school. Part of the curricula of every degree is the capstone senior courses. Projects from the different degrees are expanded in this newsletter and have been a success because of the hard work of students and faculty.

By Dr. Ray Mankbadi

Embry-Riddle's Visit to NASCAR Research Center and Roush Racing

In connection with the Mechanical Engineering program, the University President Dr. Ebbs, the Dean of the College of Engineering Dr. Mankbadi, and faculty members Dr. Hagar, Dr. Nakhla, and Dr. White visited the Research and Development Center of NASCAR and Roush racing facilities in Concord, North Carolina. The visit aimed to look for new opportunities and research projects for students and to strengthen the view of racing business of the Embry-Riddle engineering programs.

During the visit to the NASCAR Research Center, Gary Nelson, the Vice President of R&D, introduced the regulations imposed by NASCAR on racing to ensure safety and fair competition among racers; the future of NASCAR and the direction the racing sport is headed; and how to facilitate projects and training for students who are interested in working in racing and receiving applied engineering experience.

NASCAR's driver safety and restraining system aims to reduce the crash forces on the driver. Research and innovations in the new safety helmet, and shoulder and neck restraints were successful in reducing the load on the driver during the crash.

NASCAR's goal is to keep competition dependent on the driver's skill in controling the vehicle and pushing it to optimum performance. A special monitor device developed by the NASCAR research group monitors the engine's rpm and transmission ratio to the tires to ensure that all cars comply with the regulations.

After the NASCAR visit, the ERAU group headed to Roush racing where they met with the president and owner, Jack Roush, the general manager of the racecar manufacturing plant, and a crew of leading engineers. The discussion focused on how to build a winning team that would able to compete in such a highly competitive sport as racing, where driver, mechanics, engineers, and crew leaders have to work together to form a successful team. The engineers talked about the skills that can help in forming a successful field engineer and about their personal experience in other engineering programs.

The manufacturing plant toured includes a fabrication site for the racecars of three teams. The sites include structural frame setting and welding, the body shop, assembly of interior components, and testing of steering systems, shocks, engines, and transmission. The design of each car has to fit the driver and the track where the car will be driven and comply with NASCAR regulations. Each stage of building the car has a scheduled procedure to track the component testing, quality control, and lifetime of the component for each car before getting to the race.

The visit was productive in addressing industry needs and the skills required by the new graduates from the engineering programs at Embry-Riddle. Close connections with the industry and applied engineering plays an important role and should be pursued aggressively to link the engineering programs and students with industry.

By Dr. Hany Nakhla

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Embry-Riddle Senior Project Wins ASEE-SE Design Competition

A student team took first place in the multidisciplinary category of the ASEE-SE conference design competition with a robot system that controls vehicle movements at an airport.

Embry-Riddle's team of 14 Computer and Software Engineering undergraduate students and 19 other college teams went head to head at the American Society of Engineering Education Southeastern Section annual meeting and conference held April 3-5 at the University of Tennessee-Chattanooga.

The Embry-Riddle team demonstrated a robot vehicle that monitors and controls other airport vehicles - aircraft, gas trucks, and baggage trucks - to keep them safely separated from each other.

"This student project has tremendous potential for application in the real world," said Dr. Massood Towhidnejad, chairman of Embry-Riddle's Computer and Software Engineering Department and advisor to the team. "It could solve vehicle-separation problems not only at airports, but also on highways."

CSE Senior Project Team

Embry-Riddle's project involved collaborative work in three areas: software, hardware, and firmware. Firmware is software that runs on a piece of hardware embedded inside a system.

The students who developed the software were leader Chris Houdek, Lionel Amanfu, Steve Harvey, Sung-Wook Lim, Jose Lugo, and Caylyne Shelton. The hardware was designed by leader Jayson Bender, Jackson Doud, Adrian Drummon, and Tamara Flemming. Mike Potach, a lab technician in Embry-Riddle's Lehman Engineering and Technology Center, provided hardware tech support, and Edwards Air Force Base in California donated $1,500. The firmware was handled by leader Mike Vacirca, Jayson Clifford, You De-Riviere, and Jason Pipparo. Besides Dr. Towhidnejad, the other advisor to the team was Farahzad Behi, associate professor of computing at Embry-Riddle.

The students created the robot system as their two-semester capstone project, required to complete the B.S. degrees in Computer and Software Engineering at Embry-Riddle.

Schools represented at the ASEE-SE competition included The Citadel, Georgia Southern University, James Madison University, Mercer University, Mississippi State University, Tennessee Technological University, University of Alabama, University of Tennessee-Chattanooga, University of Puerto Rico, and Western Kentucky University.

Upsilon Pi Epsilon Inducts New Members

New Upsilon Pi Epsilon Members

The ERAU Chapter of Upsilon Pi Epsilon held its 2005 Induction Ceremony to honor students April 12. The ceremony was conducted by Robert Burkhead, Chapter President, Lionel Amanfu, Chapter Vice-President, and Scot Burzawa, Chapter Secretary.

The Iota Chapter at Embry-Riddle was chartered in 1997. Prof. Nick Brixius is the COE faculty advisor for the chapter.

Fifteen students majoring in Software Engineering, Computer Engineering and Computer Science were admitted to membership in Upsilon Pi Epsilon. The ceremony was attended by COE faculty, UPE members, and several of the inductees' family and friends.

Upsilon Pi Epsilon is an international honorary society whose membership consists of outstanding undergraduate and graduate students in the computing disciplines. The organization now consists of more than 180 chapters in colleges and universities in North America and overseas.

Dr. Nick Brixius

More information about Upsilon Pi Epsilon can be found on the Web at http://www.acm.org/upe/.

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Embry-Riddle Student Wins 2005 Florida College Student of the Year Award

Matthew Collier

Matthew Collier, a senior in aerospace engineering at Embry-Riddle with a 3.64 GPA, is the winner of the 2005 Florida College Student of the Year Award. Collier and 19 other students from colleges and universities across Florida will share $50,000 in scholarships and prizes. The ceremony was at the Capitol Building in Tallahassee. Collier appears on the cover of *Florida Leader* magazine and is profiled at www.floridaleader.com/soty. Collier was selected from 78 applicants in the annual scholarship program sponsored by *Florida Leader* magazine, SunTrust Education Loans, and Office Depot. The Florida College Student of the Year Award celebrates 18 years of recognizing outstanding Florida college students for their campus leadership, academic excellence, and financial self-reliance.

"I've learned that going to college is more than going to class," Collier says. The Student Government Association president's actions speak much louder than these words. Among other roles, he's a peer mentor, a member of the board of trustees, an Avion newspaper guest reporter, and is serving a two-year term as chair of the Independent Colleges and Universities of Florida Student Alliance, which he played a major role in founding. As a leader in all these roles, Collier has been focused on change. One of these lasting changes is the long-awaited construction of a modernized student union building, which is finally underway because of Collier's efforts. "A student union is the living room of a campus community," Collier says. "It's not only a building but also a program designed to enrich campus life and further the university's mission statement." With that logic, he pushed for a $150 student-activities fee to cover construction and maintenance costs and won the majority of the SGA's approval. The idea was also presented to 500 students, who generally saw the fee as an investment rather than a burden.

Civil Engineering Senior Design Project for 2005

Design Team with Shelter After Self-Constructing

The Civil Engineering senior design project for 2005 involves the development, design, and construction of a self-constructing emergency shelter called "SoloFab 1." The shelter will collapse to a size small enough to fit on a standard Air Force pallet and, once deployed via parachute drop, will automatically "build itself" into a shelter of specified dimensions. The shelter will be designed according to standard building codes (including wind and snow load criteria), and will include electrical, lighting, and forced-air ventilation capabilities. The students are also required to design a self-constructing lunar shelter based on the same self-constructing mechanism but with consideration of the lunar environment for material selection and other factors.

To introduce the students to the competitive nature of the engineering industry, the class was initially divided into three competing companies, each vying for the final construction contract. After a formal 30% design review of the three proposals, civil engineering faculty chose one of the proposals for the final contract. The students in the two firms not receiving the contract were "hired" by the winning firm. The combined group thus worked on developing plans and specifications for the SoloFab, and was required to construct the design for the 90% design review.

Senior Design Team with Shelter in Shipping Form

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Aerospace Engineering Faculty Awarded Summer Research Fellowships

Dr. Eric Perrell

For the second consecutive year, Dr. Eric Perrell, Assistant Professor of Aerospace Engineering, has been awarded a Summer Faculty Fellowship at NASA Marshall Space Flight Center, Huntsville, Alabama. Dr. Perrell will be working in the Advanced Concepts Office, Space Transportation Directorate, on a project titled "Multiphysics Tool."

The Multiphysics Tool is an open-source software package for designing deep-space transportation systems. The Tool will perform level-two (detail) analyses of all major vehicle systems, including structures, thermal management, power, and propulsion. The Multiphysics Tool will be an extension of PARSEC (Preliminary Analysis of Revolutionary in-Space Engineering Concepts), the current level-zero/one (conceptual/preliminary) design tool, also developed by the Advanced Concepts Office.

Since the inception of the project last summer, Dr. Perrell has been a principle member of the Multiphysics Tool Team, which also includes researchers from industry, University of Alabama at Huntsville, and NASA MSFC. An open-source computational fluid dynamics (CFD) code developed by Dr. Perrell has been adopted as the core element of the Tool's propulsion simulation module. The code, HYP, is engineered for parallel calculations of geometrically complex systems featuring hypersonic, chemically reacting, electromagnetic, and propulsive flow fields.

"What I like about the project is that it is very ambitious," reports Dr. Perrell. "The idea is to apply increasing amounts of computer power, and simulate more details of the actual physics, as the design is refined from level zero to two. We're looking at magnetoplasmadynamic thrusters, Hall thrusters, solar sails, high energy density chemical rockets, and neutronics."

The Multiphysics Tool project was initiated, and is led by Mr. Robert Adams, a Systems Engineer in the Advanced Concepts Office. Another team member is Ms. Caroline Liron, an AE graduate student also in residence at MSFC last summer. Ms. Liron will defend her M.S. thesis on her work on the project this spring.

Dr. Vladimir Golubev

Dr. Vladimir Golubev, who was recently promoted to the rank of Associate Professor of Aerospace Engineering, has received a Summer Faculty Fellowship award from the Air Force Research Laboratory. He will be working at the Wright-Patterson AFB in Dayton, Ohio with a group of scientists in the program "Computational Electromagnetics and Acoustics." Previously, Dr. Golubev received two such awards from NASA Glenn Research Center.

In his current position, Dr. Golubev will be working on the project "Parametric Study of Unsteady, Inviscid, High-Intensity Gust-Airfoil Interaction." In this work, a high-order prefactored compact Computational Aero/Acoustics (CAA) code will be employed to examine limits of validity for a linearized analysis, commonly used in unsteady aerodynamic, aeroacoustic, and aeroelastic applications. This study will elucidate nonlinar effects in unsteady fluid-structure interaction phenomena, critically important in various external and internal aerodynamic applications such as the unsteady wing loadings in aircraft maneuverings and vortex interferences of lifting surfaces, or unsteady rotor-stator interactions in propulsion systems. The study will also provide a convenient benchmark to test the performance of several new numerical schemes, boundary conditions, as well as the efficiency of parallel implementation for the state-of-the-art CAA technology.

This work will be the last stage of the CAA project that was initiated four years ago, and included collaboration with Dr. Crivellini (Univesity of Ancona, Italy), Dr. Mankbadi (ERAU), and Drs. Hixon and Scott (NASA Glenn). Ms. Claire Lessiau also defended her M.S. thesis on this project.

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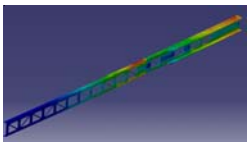
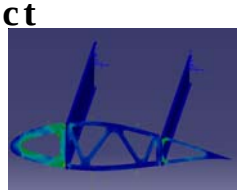
Aerospace Engineering Detailed Design Project



This drawing shows the design of a wing spar. The estimated loadings were applied in CATIA, and then Finite Element Analysis was run on it. The red areas show high stress concentrations, while the blue areas show little or no stress. This is a spar designed as a follow up to Preliminary Design, and is from the same aircraft designed in the previous class.



This image is a similar situation, except it is a wing rib. This was the the assignment completed before the spar design. CATIA was used to model the part and estimate the stress concentrations. Again, this is a design meant to fit into the aircraft designed in Preliminary Design.

Aerospace Engineering Senior Design: Supersonic Business Jet & Engine Design

CATIA Model of the AE 420 Design

Dr. Axel Rohde coordinated the design of a supersonic business jet by combining the efforts of two AE senior design courses, AE420 and AE440.

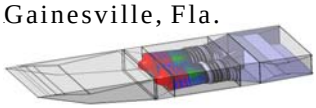
The motivation behind the project was an incentive among aircraft manufacturers to conduct preliminary market and design studies for a proposed supersonic business jet carrying 10 to 12 passengers at Mach 1.8 to 2.2.

After preliminary calculations, it became evident that such an aircraft would have a maximum takeoff weight of 50 to 60 tons of which about 50% would consist of fuel. To reduce wave drag at supersonic speeds, a delta wing was chosen by most AE420 design teams with a sweep angle of 65 degrees, which puts the wing leading edge just inside the Mach cone.

AE440 custom designed twin-spool turbojet engines were to be fitted under the wing. Engines were equipped with a 2-D inlet compression ramp and a variable geometry exhaust nozzle. It allowed the flow to be slowed down to subsonic speed through a series of shocks before entering the compressor, while minimizing stagnation pressure losses, which translates into higher thrust.

After the combustion gases leave the turbine, a variable geometry converging-diverging duct accelerates the flow to supersonic exhaust speed. Without the diverging section, the flow would be under-expanded, and a significant amount of thrust would be wasted, resulting in a much lower aircraft range. By perfectly expanding the flow to ambient pressure at 18km altitude, the aircraft was able to reach its target range of 4,000 nautical miles while remaining below 60 tons of takeoff gross weight.

The aircraft and engine CAD models shown here were presented at the recent AIAA student design conference in Gainesville, Fla.



CATIA Model of Engine Design

By Dr. Axel Rohde

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