

AME Highlights

Department of Aerospace and Mechanical Engineering

August, 2003

Letter from the Chairman

I would like to take this opportunity to extend my greetings to you and to introduce this initiative by the Aerospace and Mechanical Engineering Department, to provide regular updates to alumni and friends concerning our activities, accomplishments and aspirations. I know you periodically receive University publications, including the very fine *Engineering Insights* prepared by the College of Engineering, but we in AME would like to take this opportunity to let you know a bit more about the people and programs in the Department. It is my hope that we can provide you with a snapshot of the previous academic year in this annual bulletin called *AME Highlights*. One may question the need for a printed newsletter, as we will be posting the *AME Highlights* along with other information about AME on the Department's web site www.nd.edu/~ame, but in the near-term we will continue to use a variety of media to tell our story.

Currently the AME Department is comprised of 25 teaching and research faculty, 5 special professional and research faculty, an administrative and technical support staff of 10, approximately 95 graduate students and over 275 undergraduates - sophomores through seniors - as well as numerous visiting faculty and post-doctoral fellows. Last year the faculty presented over 60 graduate and undergraduate courses, published and presented hundreds of papers, and our research program expenditures exceeded \$2.75M. While these are the "statistics" that one might use to describe the Department, what we do is much more than just these numbers. We are fortunate to have the opportunity to work with young people anxious to learn and to join the engineering profession. The faculty are also working to develop new knowledge that can have lasting, positive influences on many sectors of society. In *AME Highlights* we will try to keep you apprised of some of these activities and accomplishments.

Now for your "homework" assignment: after reading *AME Highlights*, please take a few minutes and let us know some of your "highlights" since leaving ND. Send us, via snail or e-mail (nmee@nd.edu), a note about your professional or personal accomplishments, and in future *AME Highlights* we will include a section on alumni news briefs. Also, if you have questions or comments on any of the items you see, please don't hesitate to contact us. As part of our ongoing assessment program, we would appreciate hearing from former students with their observations on our program and its effectiveness in preparation for their professional careers.

Best wishes, and I hope you enjoy sharing these highlights with us.

Stephen Batill, Professor and Chair

Significant Accomplishments during the 2002-03 Academic Year

Three faculty members were elected to the grade of Fellow in professional technical societies.

Dr. Eric Jumper, Fellow, American Institute of Aeronautics and Astronautics.

Dr. John Renaud, Fellow, American Society of Mechanical Engineers.

Dr. Thomas Mueller, Fellow, Royal Aeronautical Society of London (the first Notre Dame faculty member to be so recognized).

A number of faculty received awards in recognition of outstanding accomplishments in research and teaching.

Dr. Bill Goodwine received the 2003 Outstanding Teacher Award from the Illinois/Indiana Section of the American Society for Engineering Education.

Dr. Thomas Mueller received the 2003 Aerodynamics Award from the American Institute for Aeronautics and Astronautics.

Dr. James Mason received the Calgary Award in Orthopedics at the IV World Congress on Biomechanics in August 2002.

Two faculty members authored textbooks that will influence the educational development of many engineering students.

Manufacturing Processes for Engineering Materials, 4th Ed., by S. Kalpakjian and **Steven Schmid**, published by Prentice-Hall, 2003.

Design of Aircraft by **Thomas Corke** published by Prentice-Hall, 2003.

Drs. Ryan Roeder and **Glen Niebur** were awarded a National Institutes of Health grant for their research in bone damage detection. This is the first NIH grant received by the Department as part of its new initiative in bioengineering and it is an important milestone for that program.

Dr. Robert Nelson received a Fulbright Scholar Award to lecture and perform research at Deutsches Luft-und Raumfahrtzentrum in Gottingen, Germany from August, 2002 to May, 2003.

National Recognition for AME Students

Eric Shearer (ME '02) won First Prize in the ASME Student Mechanisms Design Conference in Fall 2002 in Montreal, Canada. This work was supervised by **Dr. Michael Stanisic**.

Casey Korecki (ME '03) won the Second Place Award (out of 17 finalists) at the ASME Bioengineering Symposium, June 2003 in Key Biscayne, Florida. This work was supervised by **Dr. Glen Niebur**.

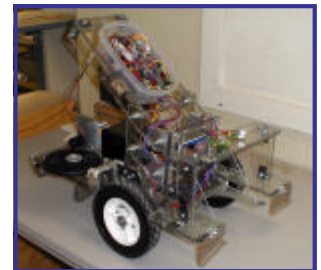
Martiqua Post (PhD student) received the Second Place Award at the Regional Student Paper Competition - Graduate Level, of the AIAA, April 2003 in Paducah, Kentucky. **Dr. Thomas Corke** is her research advisor.

Shawn Gano (PhD student) received the Third Place Award at the Regional Student Paper Competition - Graduate Level, of the AIAA, April 2003 in Paducah, Kentucky. **Dr. John Renaud** is his research advisor.

University Awards for the Class of 2003

David Schatzman (AE '03) received the Zahm Prize for Aeronautical Engineering.

Jennifer Spanbauer (ME '03) received a Rev. Thomas A. Steiner Award.



Spring 2003 ME Senior Design Project

Notre Dame 2010 - A Quest for Leadership

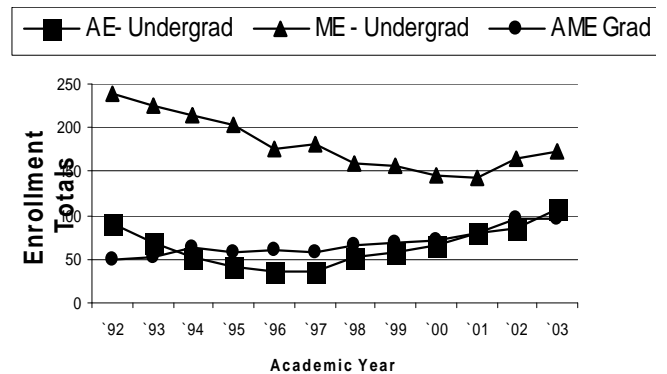
During the past 18 months the University has been involved in a strategic planning process to assist in focusing our goals for the next decade. The departmental and college plans have been integrated into a vision put forth by Father Malloy in a document, *Fulfilling the Promise: Notre Dame 2010*. In this report Father Malloy challenges each department to:

- Provide a premier undergraduate education experience,
- Achieve an acknowledged position among leading American research universities,
- Maintain its role as a Center of Catholic intellectual life,
- Renew ND as a diverse and international academic community.

The AME Department is working aggressively to meet these challenges while being responsive to changes in current practice in academia and to the needs of industry and society. We hope to use *AME Highlights* to keep our alumni updated on our activities as we strive to achieve these goals.

Undergraduate and Graduate Enrollment

Enrollment in the Department has been strong with a 33% increase in undergraduate enrollment and a 30% increase in graduate enrollment since the 2000-01 academic year. The following illustrates the enrollment trends during the past decade and indicates the growth of the past few years. The AE program has experienced fairly consistent growth since the 1997-98 academic year and it has almost tripled in size since that time. The recent increases in enrollment in the ME program lag the growth in the AE program by a couple of years, but it too has increased recently with the ME class size approaching 70 for the class of 2005. The AME Department currently enrolls 38% of the upper-class students in the



College of Engineering.

Developments with the Undergraduate Curriculum

During the past year new curricula have been introduced in both Aerospace and Mechanical engineering programs for the Class of 2005. A number of key steps related to the implementation during the past year were:

- All the mechanical engineering students now take the course AME230, Introduction to Mechanical Engineering, in the fall of their sophomore year. This is the first time that ME students have been exposed to the many facets of the mechanical engineering profession in their sophomore year. This course was presented in the Fall 2002 by **Dr. Steven Schmid** and was very well received by the students. The course includes a number of case studies and hands-on activities.
- During the Spring 2003 term a new, 4-credit hour AME238 Mechanics of Solids class was presented for the first time to the aerospace, mechanical and civil engineering students. This course includes a laboratory element developed by **Drs. Glen Niebur** and **Ryan Roeder**. This is one of a number of new or revised courses where experimental activities are being integrated directly into the more traditional "lecture" environment.
- As part of the Department's efforts to integrate topics in intelligent systems and automation across the curriculum, **Dr. Mihir Sen** presented for the first time an upper-level elective course in Intelligent Systems. This course development has been supported by a recent National Science Foundation Action Agenda grant and involves the use of the new Intelligent Systems and Automation Learning Laboratory (ISALL) developed on the 3rd floor of Fitzpatrick Hall.
- The ISALL facility has been utilized extensively by a number of undergraduate courses including AME230, Introduction to Mechanical Engineering, and the AME470, Senior Design Project, along with a number of independent study and undergraduate research projects. This facility is also being prepared in order to present the laboratory component of EE224, Introduction to Electrical Engineering, for the Spring 2004 offering. This course involves extensive use of microprocessors and is a required course in the new ME curriculum. In this course the ME students will gain important hands-on elements that they can then benefit from in future AME courses.
- Under the direction of **Dr. Steven Skaar**, Associate Chair, the Department initiated a procedure for course assessment and feedback. A series of curriculum assessment tools have been developed and are now in use in AME, providing an ongoing critical assessment of our academic programs. Dr. Skaar (ME) and **Dr. Robert Nelson** (AE) will coordinate this process in preparation for the fall 2005 accreditation visit by the Accreditation Board for Engineering and Technology, ABET.
- **Dr. Steven Skaar** has provided service to the Department for the past 4 years as the Associate Chair and will be leaving this position in August to return to full-time teaching and research. His primary responsibilities have been in the area of undergraduate program administration. This role will be filled by **Dr. Mihir Sen** who will serve as the Director of Undergraduate Studies beginning in Fall 2003. Dr. Skaar's efforts have been very influential in the development of the new undergraduate curriculum.

Research and Graduate Program

The Department's graduate program has undergone marked growth in recent years. The number of first-year graduate students enrolled in Fall 2002 was the highest in the history of the AME program. This pushed total graduate student enrollment to near 100, the target value set in our strategic plan. The number of Ph.D. students graduated had remained relatively constant for the past few years with a running average of about 8 students per year, but 2003 will also represent a considerable increase with 17 Ph.D. degrees granted. With the increases in enrollment and the emphasis that is now being placed on admission to the Ph.D. program, we are optimistic that we can achieve our desired average of 15 Ph.D. graduates per year within the next few years. The following items highlight a number of other issues related to the graduate program.

In Fall 2003, for the first time since 1995, the number of U.S. graduate students in the Department will exceed the number of international students. Achieving an appropriate balance between these two populations, consistent with all the external influences on recruiting and admission, is a goal of the Department. Recruiting the best graduate students for our program is an ongoing challenge, and the faculty have made a significant effort to interact with colleagues from other universities to promote interest in and applications to our program from other research institutions.

The research funding in the Department has continued to grow and the research expenditures per faculty member have more than doubled in the past 5 years. The research expenditures for the Department exceeded \$2.75M for the 2002-03 academic year. The increase in research funding since 1999 can be attributed to development of significant research collaborations in two of the research focus areas in AME, bioengineering and flow physics.

In the late 1990's **Drs. James Mason** and **Steven Schmid** embarked on the development of research programs in the area of orthopaedics and biomechanics, attracting significant funding in that area, in particular from the State of Indiana 21st Century Fund. Research in the bioengineering area has been enhanced by the addition of **Drs. Glen Niebur** and **Ryan Roeder** to the faculty, and by the contributions of **Drs. John Renaud** and **Timothy Ovaert**. **Drs. Mason** and **Niebur** recently participated in a committee established by **Dean Frank Incropera** to develop a College-wide response to developments in the area of bioengineering. Sustained and significant investments by the College of Engineering and collaborations between the Colleges of Engineering and Science will be needed to continue to grow our programs in this area. It will be necessary for the AME Department to develop courses and other infrastructure elements in order to establish research programs and attract the very best faculty in this highly competitive area.

The growth in the level of research funding has also been influenced by the efforts of the Center for Flow Physics and Control, under the direction of **Dr. Thomas Corke**. The Center has a number of very active AME participants, including **Drs. Atassi, Dunn, Goodwine, Jumper, Morris, Mueller, Nelson** and **Thomas** who have established a very promising "business" plan for the Center that bodes well for continued growth in its research activities. Many of the Center's activities are focused in the Hessert Laboratory for Aerospace Research.

Dr. Thomas Corke has served as the Department's Director of Graduate Studies since 2001. **Dr. John Renaud** will assume that role in the Department in January 2004. Additional information on the research programs can be found on the Department's www site and the AME Highlights will contain short synopses of selected research activities.

New Research in Microparticle Dynamics

Research in microparticle dynamics at the Hessert Laboratory is headed in some new and exciting directions. The new projects encompass novel microparticle diagnostics for medicine and technology, home and office air filtration systems, and interplanetary dust samplers on board satellite comet chasers in space. **Professors Patrick Dunn** and **Raymond Brach (emeritus)** are the investigators. One project funded by industry involves the study of the resuspension of microparticles from surfaces into the boundary layers of flowing air. Detailed experiments and modeling are being conducted to elucidate the effects of flow acceleration, surface roughness and relative humidity on microparticle resuspension. This study has direct relevance to the resuspension of material contained within ventilation systems, such as tobacco-smoke-material carriers. Another project, in co-operation with the Technical University of Delft in The Netherlands, is the development of a micro-sensor, which is the size of a human hair, that simultaneously determines the volume, cross-sectional area and shape factor of a microparticle, such as a red blood cell or a micro-crystal.

Senior Design Projects:

During the past year the senior design projects in both ME and AE have addressed topics of immediate interest to industry and government. In the Fall 2002, the ME students worked on a project developed in coordination with the Whirlpool Corporation. They designed personal laundry systems that would operate in a dormitory. The project included collaboration with students from the Management Department in the Mendoza College of Business, and the Industrial Design program in the College of Arts and Letters. The students developed prototypes of systems ranging from mini-washers to automated clothes refreshers. The Spring 2003 ME project involved the development of a system for the retrieval of hazardous waste and it resulted in the design, fabrication and testing of fully-autonomous, robotic vehicles.

The Spring 2003 project in the AE program was motivated by the growing interest in the design and development of small unmanned aerial vehicles. These vehicles can perform a variety of missions related to surveillance and detection including video and IR surveillance, communication relay links, and the detection of biological, chemical, or nuclear materials. A unique concept being studied at Notre Dame as part of a funded research program is referred to as the Buckle Wing. The Buckle Wing configuration has a wing that can be separated into two separate wings, similar to a bi-plane, via an internal mechanism. Two aircraft were designed, fabricated and test flights conducted by the design class to evaluate the two "end states" of a Buckle Wing concept.





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Upcoming Highlights
 The 11th International Symposium on Flow Visualization will be held at Notre Dame the Summer of 2004. This event is held every two years and attracts some 300 researchers from around the world.
 For more information visit:
www.ode-web.demon.co.uk/11isfv

During the past year the Department formed an Industry Advisory Group (IAG) and held the first meeting of the group in April 2003.

The charter members of the IAG are (pictured from left to right):

- Dr. Paul M. Bevilaqua (AE '67), Lockheed Martin Aeronautical Corp.**
- Mr. John Kutney (AE '73), GE Aircraft Engines**
- Dr. Cheryl R. Blanchard, Zimmer Corp.**
- Mr. Jose Eguiguren, Ricardo, Inc.**
- Mr. Todd R. Taylor (AE '87), EDS**
- Mr. Thomas A. Mastaler (ME '79), DeWalt Industrial Tool Co.**



The first meeting focused on developing a charter for the IAG and a review of the Department's strategic plan. The members of the group met with representatives of the chairman's undergraduate student advisory group and with the Department's assistant professors. The group will meet on an annual basis and current plans call for an increase in membership to nine industry representatives. This Group will assist the Department in its ongoing assessment activities and provide an important perspective as we continue the development of both our academic and research programs.

For the first time this year the College Honor Awards were presented at departmental honor award ceremonies in which students, faculty and the honor award recipient were recognized. The AME Department recognized **Dr. Paul M. Bevilaqua** with the 2003 College Honor Award. Dr. Bevilaqua is a 1967 graduate in Aerospace Engineering. He has established himself as an international leader in the area of advanced aircraft propulsion systems. He received the Collier Trophy in 2002. The Collier Trophy is the premier national award in aeronautics in the US. Paul has been an active supporter of the engineering programs at Notre Dame. He has traveled to campus to participate in student design reviews and seminars. The photo shows Dr. Bevilaqua (center) receiving a Steuben bowl in recognition of the College Honor Award from **Dean Frank Incropera** (right) and **Dr. Stephen Batill** (left).