Department of Aerospace Engineering and Mechanics

AEM Update

2000-2001

Chairman's Corner

I hope you like the new AEM Update. We decided to go to a glossy format in order to make your newsletter easier to read.

This has been an exciting year for us at the University of Minnesota. Personally, I hope we don't have another one like it. For those of you who reside outside the State and haven't heard, Governor Ventura and the Legislature reached an impasse and we were within three hours of a shut down of State Government before the last bills were signed into law allowing Government operations to continue. The University of Minnesota requested an increase of $220 million to its base for the biennium, the Governor recommended one fourth of this, and the Legislature provided $110 million. Student tuition was increased by about 13% for each year of the biennium. The students understood the reasons for the increase and were supportive; although of course, they were not happy about it. With the new increases in tuition, Minnesota will be in the middle of the Big 10 so far as tuition goes. Education at the University of Minnesota is still an incredible value compared to private schools, but is it unfortunate that so much of the cost falls on the backs of our students.

The situation that we experienced in Minnesota this year is far from unique. In fact percentage wise, state support for higher education has been declining throughout the country and the University of Minnesota fared relatively well compared to many other state universities. This is due in large part to the support of our alumni and friends who contacted their Legislators and the Governor on our behalf. You have the heartfelt thanks of all of us in the University community.

The Department added two new faculty members this year, Dr. Ashley James from Georgia Tech and Dr. Krishnan Mahesh from Stanford. Both James and Mahesh are computation fluid mechanists. James works in simulating the fluid mechanics of droplets and Mahesh studies high-speed turbulent flows. Both are making a fine start in teaching and research. We are about to began renovation of space for a new computational lab for James' and Mahesh's students. We are searching for another new faculty member in the Aerosystems area. This is an ongoing search which was started last year and when filled will enhance our teaching and research in aerospace vehicle dynamics and control.

Dr. Richard (Dick) James is our new Russell J. Penrose Professor (see page 17) and Dr. Mehran Mesbahi received a NSF Career Award. This is a very prestigious award for young faculty members. Mehran is building a new lab in Akerman Hall to support his research in satellite formation flying. In addition, we completed a new state of the art Aerospace Systems Lab in the basement of Akerman Hall. This

Percentage wise, state support for higher education declined throughout the country; the U of M fared relatively well compared to many other state universities. This is due in large part to the support of our alumni and friends who contacted their Legislators and the Governor on our behalf.

What's Inside

lab is described later in the newsletter. When you are in the Twin Cities area, drop by and we will be glad to give you a tour of the Department. I think that you will be impressed with the improvements that have been made in our venerable building – now if we could get air conditioning, new windows, new roof ….

Another exciting event that occurred this year was the participation of two groups of AEM students in the NASA Reduced Gravity Program. Briefly, this program gives students an opportunity to perform an experiment in a zero gravity condition. This was achieved on board a NASA KC-135 which flies a parabolic flight path producing zero gravity for about 30 seconds as the plane is at the top of the parabola. This was a once in a life time experience for our students. Not only did they have an opportunity to experience zero gravity, but they also had to go through a realistic engineering experience in writing a successful proposal, designing and building their experimental apparatus, satisfying NASA flight safety regulations, arranging transportation for themselves and their equipment to Houston, and finally writing a final report. This was an expensive undertaking which we would not have been able to do if not for support from a gift given to us by Richard and Shirley DeLeo and the NASA funded Minnesota Space Grant Consortium.

AEM students are already planning to participate in this program again.

This next academic year we will be visited by ABET (Accreditation Board for Engineering and Technology) as part of the regular evaluation cycle. The faculty has been working hard to prepare for the visit. As I discussed in previous newsletters, we now have a process in place to assess how well we achieve desired objectives and outcomes and use the results of these measurements to improve our program. This past year, based on inputs from students, faculty, our advisory committee, and alumni, we tweaked our objectives and outcomes slightly. The new versions are given in this edition of the Update. In addition we have enclosed the results of an exit survey which we gave our graduating seniors this spring (see page 10). We appear to be doing most things well but there is room for improvement. Some of the changes we have made as a result of our evaluation processes are described later in the Update. We welcome your inputs. The best way to communicate is via e-mail sent to me at garrard@aem.umn.edu. I hope to hear from you.

The State provides very little funding for scholarships and student projects such as the reduced gravity experiments. We hope that you will consider giving to one of the many funds that support our programs. We depend upon you.

Bill Garrard

Academics: Where Are We Now?

AEM Graduate Program

The admissions faculty of AEM reviewed a total of 113 applications for graduate program entry in 2000-2001. Fifty-seven of these applicants were admitted. Thirty financial aid offers were made from among these admitted students and seventeen were accepted. All seventeen students enrolled in the fall. One student enrolled with funding by his employer in another country. Therefore, the Department enrolled 18 new students into the Aerospace Engineering and Mechanics graduate program last year. Five of these students were from the United States, five were from India, and six were from China. The other students came from Malaysia and Venezuela.

During the past year the Department awarded 7 Masters (4 in aerospace engineering and 3 in mechanics) and 2 Ph.D. degrees (1 in aerospace engineering and 1 in mechanics). Two of our Master's graduates remained for the doctoral program, 2 returned to their homeland and 1 gained employment out of state. One of our Ph.D. graduates gained out of state employment and 1 continued in employment within the state.

Gordon S. Beavers
Director of Graduate Studies

AEM Undergraduate Program

This has been a year of recovery from the transition to semesters that occurred last year. Everything is going smoothly. The BAEM program is being reviewed by ABET (the Accreditation Board of Engineering and Technology) in the fall and much of this year was spent preparing the report that must be submitted prior to the site visit. As you will read elsewhere in this newsletter, the ABET criteria changed starting in 2000, so we had to completely redo our documentation. This change also requires that we develop a written process for the regular review of our courses and program. Many of you will see more surveys as part of this process. Graduation from an ABET accredited program is a requirement for taking the Professional Engineer (PE) exams, thus it is important that we successfully complete this time consuming task and that you help us by completing the various surveys we send you. We will try to keep these to a minimum.

The BAEM program is being reviewed by ABET (Accreditation Board of Engineering and Technology) in fall 2001; much of this year was spent preparing the report.

We had a very active group of seniors this year, including two groups of four and five students respectively that developed experiments that were flown on NASA's vomit comet, the KC-135 that flies parabolic paths to simulate the free fall of spacecraft in orbit. This exposure to research seems to have stimulated our students interest in graduate school and we have nine of our own undergraduates who are continuing on in our graduate program. While many of our students go on to graduate school, it is more typical that only one or two continue in our program. We plan to continue sponsoring a microgravity group each year. Some of our juniors are already planning their experiment for the fall.

The Department also started a database project this year. One of the goals of the project was to provide students with a web-based advising system. Because the central University system does not check prerequisites for a course when a student enrolls, we have problems with student's taking courses out of sequence. We hope to solve this problem with our own database that includes students grades in past AEM courses. Thus the advising system will know if a student is ready to take a given course. This will also make access to advising information easier and give advisors simple access to student records. Another part of this project is the development of an Alumni database. We would like to keep in touch with you and now you can update your address information on the web. The URL for this is http://www.aem.umn.edu/alumni/Alum_Network.html. You can also submit your e-mail address if you would like to be contacted that way, and in the near future you will be able to search our records for information on your classmates.

The Alumni database lets you update your address information on the web. The URL for this is http://www.aem.umn.edu/alumni/Alum_Network.html.

Thomas Shield
Director, Undergraduate Studies

Undergraduate BAEM Program Evaluation and Improvement

Changes That Have Been Implemented to Further Develop and Improve the Program

In the fall of 1999, the University of Minnesota changed from quarters to semesters. This resulted in all engineering programs making major modifications to their programs. Based on inputs from students, employers, alumni, and faculty members, the following major changes were made:

1. The required course in computer science was changed from Fortran to C/C++. This change was made because of the increased importance of C and C++ in engineering practice and the use of C as the programming language in the new Instrumentation Laboratory.
2. The laboratory sequence was changed. The first laboratory course is the Instrumentation Laboratory that concentrates on instrumentation techniques and computerized data acquisition. The second laboratory course is the Aeromechanics Laboratory that concentrates on experimental design and analysis of results. This course requires extensive report writing.
3. A full year of capstone design is now required. Previously, a three-quarter capstone design sequence was offered, but only the first two courses were required. Most, but not all, students took the third course. This meant that some students did not participate in the final realization of their design projects. In our current sequence, all students are involved in the complete design cycle. Both design courses require extensive written and oral reporting.
4. A new required course, Space Flight Dynamics, was added. This change was made in response to criticisms that there was not enough emphasis on aerospace topics in our program.

As a result of feedback from faculty, student, and alumni surveys, reports of the Professional Advisory Board, the External Visitor Program and the faculty review process the following changes were made and will become effective for the fall 2001 term:

1. In response to student concerns, Mechanics of Flight was modified to increase the amount of time spent on MATLAB. This was done by removing some material on design and static stability. The static stability material will be covered in Flight Dynamics and Control. The above solution is short-term as Mechanics of Flight already contains too much material. As a long-term solution, the possibility of adding a new course which addresses computer methods was discussed; however, due to the extremely crowded curriculum in the first two years, this will take considerable planning at the Departmental level and is currently being studied. In response to faculty and student desires for more space-related material, it was decided to add some simple satellite/space craft altitude stabilization and control to Flight Dynamics and Control.
2. The number of lecture hours per week in the Instrumentation Laboratory has been increased from 2 to 3 as of spring 2001 semester. This allows for a better pace in the lectures.
3. Based on student and faculty comments on the senior design sequence, it was decided to investigate integration of computer programs used in other courses into the senior design sequence. It was recommended that the appropriate subject committees consider the possibility of introducing the programs used in the design sequence in required courses earlier in the curriculum. Involvement of additional faculty members in the design sequence is being implemented this year.

BAEM Mission, Objectives, and Outcomes

Mission

The Mission of the Bachelor of Aerospace Engineering and Mechanics (BAEM) Program at the University of Minnesota is to produce graduates who are prepared to enter and sustain the practice of aerospace engineering and related fields, or to pursue advanced studies. This Mission is consistent with the Mission of the University of Minnesota in Learning and Teaching; with the Mission of the Institute of Technology to provide a rigorous and stimulating education for its undergraduate majors, and to provide programs of instruction in engineering that meet nationally accepted standards for practice of the profession of engineering.

Objectives

The educational objectives for students graduating from the Department of Aerospace Engineering and Mechanics at the University of Minnesota are:

1. To produce graduates with a broad background in aerospace engineering and mechanics, including fluid mechanics, structural mechanics and aerospace systems.
2. To produce graduates who can apply their knowledge of aerospace engineering and mechanics to achieve success in the aerospace industry, related government agencies, and other engineering industries.
3. To produce graduates with skills in the essential tools used in aerospace and other industries. These include experimental methods, problem-solving techniques, computational methods and engineering design.
4. To produce graduates with the ability to both seek out assistance when needed and to learn new skills throughout their careers.
5. To produce graduates with the oral and written communication skills needed to successfully work in a modern multidisciplinary environment.
6. To produce graduates who can be successful in graduate level work in engineering, as well as in other professional schools.

Outcomes

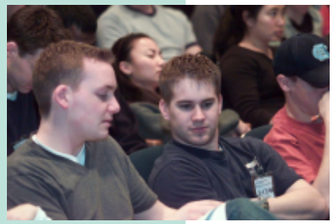
A student completing the BAEM program will acquire the following:

1. A solid foundation in mathematics, science and engineering and the ability to apply this knowledge.
2. An ability to design and conduct experiments, as well as to analyze and interpret data.
3. An ability to design aerospace systems and components in collaboration with others in a professional and ethical manner.
4. An ability to identify, formulate, and solve engineering problems.
5. An ability to communicate effectively.
6. A broad education necessary for the understanding of the impact of solutions of engineering problems in a global and social context as well as a knowledge of contemporary issues.
7. A recognition of the need for and the ability to engage in life-long learning.
8. An ability to use the techniques, skills and modern engineering tools necessary for engineering practice.
9. Knowledge of aerodynamics, aerospace materials, structures, propulsion, flight mechanics, stability and control, orbital mechanics, rocket propulsion, space structures and other space related topics.

AEM Students Take A New Spin on Their Education

For several years NASA and the Texas Space Grant Consortium have sponsored an opportunity for students to participate in reduced gravity flight experiments (see http://www.tsgc.utexas.edu/floatn/).

This year two AEM student groups got the experience of a lifetime by participating in these experiments in the "Vomit Comet" Program at the NASA Johnson Space Center February 7-16, 2001. The students traveled to Houston, Texas, to undergo training and perform their in-flight experiments aboard NASA's KC-135, better know as the "Vomit Comet" or the "Weightless Wonder".



The KC-135 aircraft is used for astronaut training and experiments requiring short periods of reduced gravity. The aircraft flies in series of parabolas, typically 30 per flight in a designated area over the Gulf of Mexico. The climbs and dives are similar to a roller coaster and each parabola contains a 25 second float time at the top of the curve. On the way down, students must catch their stomachs and make sure a barf bag is close at hand because of the sudden increase in gravity.

The students' preflight training modules covered physiological training to familiarize them with effects they would feel and included time in an altitude simulation chamber. In the chamber, they were exposed to the periods of hypoxia at high altitudes where breathing air with reduced oxygen content affects athletic performance and general health. The training also included KC-135 protocol.

Team Members: William Hambleton, Dakri Nelson, Jeffrey Rollings (team leader), Tim Jackson and Nick Velander. Professors William Garrard and Thomas Shield (missing in photo) mentored this team.

The two experiments which the students performed are described:

Nitinol Vibration Damping in Microgravity

Topic Area: Materials Science

This experiment was intended to determine the vibration damping properties of the shape memory alloy, NiTi or Nitinol, in microgravity and compare it to the same experiment done under normal earth gravity conditions. The data from this research will provide a better understanding of the value of Nitinol for vibration damping, and will determine if it performs well enough to be used in a microgravity environment.

Nitinol has excellent pseudo-elastic properties that damp out vibrations quickly and it was hypothesized that these characteristics hold true in a zero-G environment as well. The testing was done using a cantilever beam made of aluminum; a sheet of Nitinol was then stretched out and secured to the aluminum beam. A strain gage was attached to the top of the beam and connected to a microprocessor.

Team Members: Eric Euteneuer, Travis Schauer, Christopher Teeuwen and Cecilia Ortiz. Professor Ellen Longmire mentored this team.

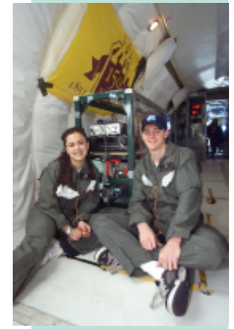
As the beam was vibrated, the microprocessor took the measurements from the strain gage and output them to an oscilloscope and computer where the vibration oscillations were observed and recorded. This data was also compared to a beam without NiTi in microgravity and in normal gravity.

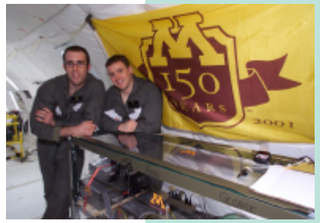
Study of Pinch-Off and Reconnection of Liquid-Liquid Flows in Micro- and Macro-Gravity Conditions

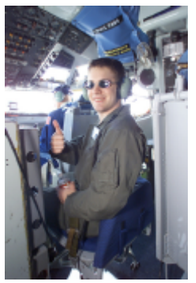
Topic Area: Fluid Dynamics

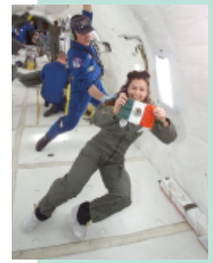
Topological transitions that occur in liquid/liquid flows with significant interfacial tension are found in many practical applications. For example, when crude oil is pumped from a well there exists an oil-water mixture. This mixture must in turn be separated before the oil is transported to a pipeline or tanker. However, current separation processes are hard to design without using expensive trial and error techniques. Because of this, numerical models for mixing and separation have been developed at the University of Minnesota. Preliminary experiments under normal gravity conditions were performed to serve as a foundation from which numerical techniques were developed. However, more tests under a variety of gravity conditions need to be performed so that the numerical model can be tested and made more applicable to a wider range of flows. Testing these viscous flows under gradient gravity fields will increase the accuracy of the model and thus lead to less complex and more cost efficient models for separation processes.

Financial sponsors for the student teams were: The AEM Richard and Shirely DeLeo Scholarship & Engineering Fund; the AEM Alumni Program Support Fund; The Minnesota Space Grant Consortium; the University Undergraduate Research Opportunities and the Institute of Technology Student Affairs Dean's Office. 3M donated some supplies for students to use in their experiment and University Relations at the University of Minnesota donated the banners displayed with the experiments.









Flight photographs courtesey of NASA

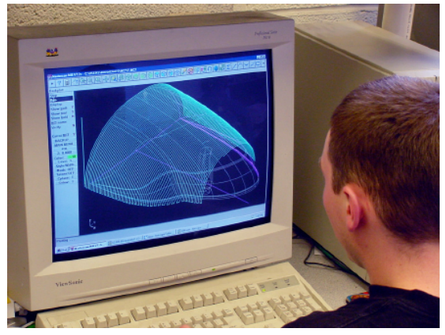
Senior Capstone Design Class

Life on Mars: Mission to Mars Rover

This year the spacecraft design students built a prototype of a rover to seek out life or water on Mars. The students' objectives were to make the rover capable of reaching its destination under all conditions and maneuver around or over all obstacles. This meant that the rover had to be durable, reliable, maneuverable and controllable. Based on these criteria the students built the chassis of the rover out of 1.25 by 1.25 inch hollow steel pipes that can resist more than 200 lb force. The rover was driven by three rechargeable batteries connected to four motors, which were coupled to a computer that instructed the rover where to move. The rover was equipped with computer programmed sensors, and ran under the Z-World "Little Genius" CPU, that allowed it to maneuver around large obstacles. In addition, each motor was set up to work independently allowing the Rover to turn on its axis and go in reverse.

Students this year added a new dimension to their learning experience. A group of students mapped out a timeline of the mission components and scientific experiments to be fulfilled and made it into a video presentation to provide supporting documentation for the need for the mission. Fall semester students used ProEngineer to make models of the physical components of the mission. This modeling included the launch transport, landing vehicles and the rover. In the Spring, students took the ProEngineer generated geometry and imported it into a program called Maya. Maya is capable of taking complex geometry and animating it into object and subobject forms. This allows the creation of a three-dimensional world. At the end of the year, students went through all the typical mission phases from the conceptual effort, preliminary analysis, definition, design, and development which are typical design considerations in any mission.

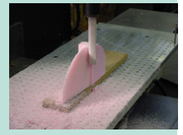
Spacecraft Design Team 2000-01: Back row, left to right: Tom Coy, Mike Travanty, Ryan Gosse, Brian Ulman, Phillip Boigenzahn, Kristin Grimlund, Ben Exley, Dan Jensen,Dakri Nelson, Mike Holtz, Terry Mulenberg, Alex Snyder, Chris Waino, Trung Dang. Front row, left to right: Cecilia Ortiz, Emily Grantski, Nick Velander, Kevin Hicok, Adam Timm



Forest Fire Fighting Twin Engine Aircraft

Students got a first-hand lesson in the complexities of aircraft and the stringent design requirements that need to be followed. Critical issues are strength and weight. Students built an R/C model to simulate a full-scale aircraft. This R/C model lets students learn how changing or modifying one or more elements ultimately affects the performance of the aircraft. Students used ProEngineer to model their aircraft.
They were then able to use Mastercam to mill the aircraft's structure in the Department's Shop using the ProEngineer models. Students made a number of visits to the Jensen airfield to test their model. Toni Riga from the Tri-Valley Flyers RC club volunteered again this year to help students pilot their radio controlled models.

Aircraft Design Team AY 00-01: back row, left to right: John Heidt, Nathan Berg, Travis Schauer, Paul Hannah, Tim Swanson, Jeff Craemer, Chris Regan, Chris Teeuwen, Steve Botts, Travis Chezick, Greg Kline, Robert Forcier, Adam Basalay. Front row, left to right: Scott Martin, Eric Euteneuer, Travis Drayna, Cristina Wurst, Jeff Rollings, Ricardo Camel



Exit Survey - Graduating Seniors 2001

In the Chairman's Corner section of this newsletter, Professor Garrard mentioned that the AEM department will be visited in the next academic year by ABET (Accreditation Board for Engineering and Technology) as part of the regular evaluation cycle. There are several things being done in the department in preparation for this visit and, provided in this section, is a summary of the results of an Exit Survey which was completed by our graduating seniors this past spring. The students were asked to respond to questions regarding their overall experiences in the BAEM program, both lower and upper division. Respondents were given a range of 1 (strongly agree) to 5 strongly disagree and a medium of 3 (uncertain) to check off. A summary of those responses follows:

Number of Surveys: 67

All but 10% of the students responding expected to received their degree in 2001 (90.0%)

The majority of these students checked either a 1 or 2, "strongly agree" in response to the question of whether their education has prepared them to:

— apply knowledge of math, science and engineering fundamentals (79.7%)
— design and conduct experiments and to analyze and interpret data (78.4%)
— design a system, component or process to meet desired needs (75.4%)
— identify, formulate and solve engineering problems (77.0%) and has
— provided them with the fundamentals for continued learning throughout life (68.8%)

There were some areas in this section that students felt were not as strong in their education preparation. They did not feel that they were as well prepared:

— to use modern tools (e.g., CAD) necessary for engineering practice (55.4%)
— with a good understanding of professional and ethical responsibilities: (49.3%)
— to communicate effectively in both oral and written form: (61.6%)
— an understanding of the impact of technology on society: (46.1%)

Regarding Liberal education/lower division experiences, the majority of the students (69.3%) responded negatively about whether their liberal education courses gave them an appreciation of the societal context in which engineering is practiced.

More of the students (66.1%) felt that the science component and (66.2%) that the math components had prepared them well for their major courses. They did not however, feel that lower division academic advising was good since (78.5%) of the students responded negatively to this question, (36.9%) who strongly disagreed.

Students were a bit more satisfied regarding whether computational facilities were available for their use (59.2%); that instructors provided adequate feedback on their class performance (61.6%); that instructors were available to discuss course related issues outside of class (72.3%); and that their courses included active learning experiences, such as discussion and team work (83.1%)

Regarding their upper division experience, (56.9%) of the students felt that the upper division academic advising was good. They were very positive in responding to their coursework. The majority of the students felt that their education provided them with:

— a good understanding of engineering materials (70.8%)
— a good understanding of aerodynamics (77.0%)
— a good understanding of aerospace structures (84.7%)
— a good understanding of aerospace propulsion systems (87.7%)
— a good understanding of atmospheric flight mechanics (76.9%)
— a good understanding of orbital mechanics and space flight (81.5%) and,
— a good understanding of flight dynamics and control (52.3%)

The balance of the survey asked the students to respond to:

a) whether they felt the design experiences provided throughout the BAEM curriculum were good (66.1%) responded positively.
b) whether the intern and/or work experience enhanced their education (62.3%) responded positively.
c) if they felt that the quality of the laboratory facilities provided were good (58.5%) of the students responded negatively.
d) if they felt that the quality of the computational facilities provided were good (64.7%) responded negatively.
e) whether the senior design courses improved their ability to work as part of a team (53.9%) responded positively and,
f) if the hands-on laboratory experienced provided them with a good understanding of how to conduct and design experiments as well as analyze and interpret data (58.5%) responded positively.

Although the majority of the graduating seniors were generally satisfied with their experiences in the BAEM program, others indicated areas where we need to direct more attention to. Addressing the areas that received a 3 or higher will be an on-going activity of the AEM faculty.

The actual Exit Survey instrument can be found on our web pages at

http://www.aem.umn.edu/info/update/2000-01/

Solar Car Project

The Department provided financial support to the Borealis solar-powered car project which draws students from a number of IT Departments. AEM students participating in the project this year were Ryan Gosse, David Kubat, Chris Regan, and Ryan Ingvalson. More information on this project can be found at: http://www1.umn.edu/umnsvp/index.html.

Minnesota Space Grant Consortium

Vomit Comet

The Minnesota Space Grant Consortium was one of many sponsors for the two University of Minnesota teams that won a NASA competition to conduct an experiment on board NASA's KC-135 aircraft, known as the "Vomit Comet." Read the story on our web site at: http://www.aem.umn.edu/msgc/north_star/spring01/#vcomet.

4th Annual Space Science Across the Curriculum Teacher Conference

Saturday, March 10, 2001 the University of Minnesota hosted the 4th annual Space Science Across the Curriculum Teacher Conference at the Science Museum of Minnesota. The conference included presenters from: the University of Minnesota, Science CentrUM and Center for Educational Technologies, Science Museum of Minnesota, Osseo School District, Circle of Life School, NASA, and Sheridan Elementary School. In addition to these presenters was astronaut John Bennet Herrington, this year's keynote speaker. Mr. Herrington has logged over 2,900 flight hours in over 30 different types of aircraft. He is currently assigned to the Flight Support Branch of the Astronaut Office where he serves as a member of the Astronaut Support Personnel team responsible for Shuttle launch preparations and post-landing operations.

Advanced STEPS for Girls

Science Technology and Engineering Preview Summer Camp for Girls (STEPS), is a response to the dearth of women entering the field of engineering. The program, in its first year in Minnesota last year, is a pilot for similar camps expected to be established in 11 other states in the next few years. "While there is an equitable ratio of men and women in the biological sciences, the field of engineering still has a large gender gap," said Susan Marino, one of the camp's directors. Nationwide, only about 20 percent of engineers are women - of that group, only about half are actually working in the industry. Marino adds "...this program is a part of the first statewide outreach to get girls in engineering. The idea is to take a coordinated, systematic approach in which we will track the girls to see if the outreach really works." STEPS, a partnership that includes the "U," the Bush Foundation, the Society of Manufacturing Engineers, NASA, and Medtronics, Inc., has a simple application process that emphasizes a participant's interest over academic standing.

More information on the Program can be found at: http://www.aem.umn.edu/msgc/.

Control Science and Dynamical Systems (CSDy)

Indepartmental PhD Program

The CSDy Indepartmental PhD Program provides an opportunity for interdisciplinary research in control science and dynamical system theory. The CSDy program coordinates scholarly and scientific activity of these areas within the Institute of Technology (IT) and the University and coordinates its activities with industrial firms in the Minnesota region. CSDy faculty are drawn from the Departments of Aerospace Engineering and Mechanics, Chemical Engineering, Electrical Engineering and Mechanical Engineering, as well as from the Departments of Computer Science, Mathematics and Statistics, all in IT, and from the Departments of Economics and Political Science. The Co-Directors of the CSDy Center are Professor Gary J. Balas (AEM) and Professor Tryphon Georgiou (EE). Professor Balas also serves as CSDy Director of Graduate Studies.

The CSDy currently has 8 Ph.D. students enrolled. Two new students were admitted to the CSDy program this fall, Andrew Barber and Tamas Keviczky. Tamas Keviczky is one of the first recipients of the Zoltai Graaduate Fellowship. This fellowship is for students admitted to, or currently enrolled in, any field in the University of Minnesota Graduate School who demonstrate a strong interest in and connection with Hungary or its culture. Another CSDy student, Matthew Montminy, was awarded a National Science Foundation Fellowship during the 2000-2001 academic year. For more information regarding Control Science and Dynamical Systems Program contact Kristal Belisle at (612)-625-3364 (e-mail: kristal@aem.umn.edu).

Aerosystems Laboratory Renovation

The Aerospace Systems laboratory underwent a major renovation this year. The laboratory renovation was made possible by University of Minnesota matching funds associated with a DARPA contract. This lab supports research in software-enabled control as applied to uninhabited aerial vehicles. Existing facilities include a flexible structure instrumented for experimental studies in structural control.

One of the key projects supported from this lab is Professor Balas' DARPA Program (managed by the U.S. Air Force Research Laboratory), An Integrated, Multi-Layer Approach to Software-Enabled Control (SEC): Mission Planning to Vehicle. The program will develop a software environment to demonstrate integrated control system technologies which enable the use of multi-unmanned combat air vehicles in strategic situations. Test case scenarios for splitting and merging of Unmanned Combat Air Vehicles (UCAV's) will be selected based upon concepts of operations. System requirements will include adaptation to subsystem malfunctions, imperfect models, system uncertainty and unknown battlefield characteristics to achieve all high-level mission objectives. A software architecture and framework for implementation of advanced integrated control algorithms will be developed. The software implementation provides and integrated multi-layer approach to provide autonomous reconfigurable vehicle control capability for UCAV's from top level multi-vehicle mission management to inner-loop vehicle control. This implementation will be demonstrated via real-life software simulation.

The University of Minnesota has teamed with UC-Berkeley and Caltech in the development, enhancement, and transition of integrated control and software technologies. This team possesses the key ingredients needed to achieve program goals. The strength of the university team members is in the area of robust system algorithm and tool development. The University of Minnesota team is working closely with Honeywell Laboratories and Boeing on the DARPA SEC project.

Aerospace Engineering & Mechanics Faculty 2000-2001

The Faculty and their Research Areas

Balas, Gary J., Professor.
Ph.D, Aeronautics, Caltech, 1989.
Aerospace control systems: experimental and theoretical.

Gordon S. Beavers, Professor and Director of Graduate Studies.
Ph.D. , Mechanical Science, Cambridge, 1963. Experimental fluid mechanics, rheological fluid mechanics.

Graham V. Candler, Professor.
Ph.D. , Aeronautics and Astronautics, Stanford, 1988.
Hypersonic aerodynamics, computational fluid dynamics, high-temperature gas physics, thermochemical nonequilibrium flows.

Dale F. Enns, Adjunct Associate Professor.
Ph.D., Aeronautics and Astronautics, Stanford, 1984.
Controls, dynamics, aeroelasticity, flight mechanics, dynamical systems.

Roger L. Fosdick, Professor.
Ph.D., Applied Mathematics, Brown, 1963. Thermodynamics and continuum mechanics at the applied and foundation levels, nonlinear material behavior using the methods of applied mathematics.

William L. Garrard, Professor and Department Head.
Ph.D., Engineering Mechanics, University of Texas at Austin, 1968.
Dynamics and control of aerospace vehicles, parachute systems.

Ashley James, Assistant Professor.
Ph.D., Mechanical Engineering, Georgia Institute of Technology, 2000.
Fluid dynamics, interfacial fluid flow and computational fluid dynamics.

Richard D. James, Professor.
Ph.D., Mechanical Engineering, Johns Hopkins University, 1979.
Thermodynamics of solids; phase transformations; micromagnetics; active materials, especially shape memory materials. Multiscale mathematical methods.

Daniel D. Joseph, Professor.
Ph.D., Mechanical Engineering, IIT, 1963.
Two-phase flow, rheology, fluid mechanics, stability bifurcation.

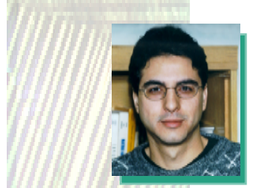
Yohannes Ketema, Temporary Assistant Professor.
Ph.D., Engineering Mechanics, Royal Institute of Technology, Sweden, 1992.
Dynamical systems, optimal control.

Perry H. Leo, Professor and Associate Department Head.
Ph.D., Metallurgical Engineering and Materials Science, Carnegie Mellon, 1987.
Phase transformations, micromechanics of defects in solids, biological materials, composites.

Ellen K. Longmire, Associate Professor. Ph.D., Mechanical Engineering, Stanford, 1991.
Experimental fluid mechanics, particle-laden and multiphase flow, turbulence, vortex dynamics microscale flows.

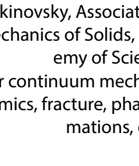
Krishnan Mahesh, Assistant Professor.
Ph.D., Mechanical Engineering, Stanford University, 1996.
Numerical simulation and modeling of fluid flows, plasma-assisted materials processing.

Ivan Marusic, Assistant Professor.
Ph.D., Mechanical Engineering, Melbourne, 1992.
Experimental and theoretical study of turbulent boundary layers.



Mehran Mesbahi, Assistant Professor.
Ph.D., Electrical Engineering, University of Southern California, 1996.
Multiple spacecraft formation flying, optimization, system theory and control.

Thomas W. Shield, Associate Professor and Director of Undergraduate Studies.
Ph.D., Mechanical Engineering, University of California at Berkeley, 1988.
Experimental solid mechanics, mechanics of materials, single crystal plasticity, shape-memory and magnetostrictive materials, fracture mechanics, elasticity.



Lev Truskinovsky, Associate Professor.
Ph.D., Mechanics of Solids, USSR Academy of Sciences, 1984.
Nonlinear continuum mechanics, thermodynamics, fracture, phase transformations, geophysics.

Andrew Vano, Akerman Professor of Design.
B.A.E., Aeronautical Engineering, Minnesota, 1963.
FAA DER (flight analyst, structures, systems and equipment, powerplant installation, and test pilot). Aircraft and spacecraft design, flight testing, project management.

Theodore A. Wilson, Professor.
Ph.D., Aerospace Engineering, Cornell, 1962.
Respiratory mechanics: modeling lung structure and deformation, respiratory flow, chest wall mechanics.

Yiyuan Zhao, Associate Professor.
Ph.D. , Aeronautics and Astronautics, Stanford, 1989.
Guidance/control, optimization, dynamics, air-traffic management, rotorcraft flight trajectories.

News About Our Faculty

Professor William Garrard was selected as one of three AIAA commissioners on the Engineering Accreditation Commission of ABET, the organization which accredits engineering programs.

Professor Ashley James gave a presentation at the American Physical Society Division of Fluid Dynamics conference in Washington, DC. She also gave an invited seminar at the School of Mathematics of the University of Minnesota.

Professor Richard James (with Hans Othmer and Mitchell Luskin of the School of Mathematics) received a "Focus Award" from NSF on biomedical MEMS (micro-electro-mechanical systems). They are exploring the use of magnetostrictive and shape memory materials, activated by a remotely applied field, for biomedical applications.

Professors Richard James and Tom Shield were awarded part of a new MURI project on "Multiferroic Materials." Using theory, experiment and synthesis they will explore the possibility of new materials that combine (in a single material) two or more of the effects of ferroelectricity, ferromagnetism and ferroelasticity. Such materials have the potential of changing fields of one type (stress, electric or magnetic) into fields of another type, or, in the ferroelastic case, into a shape change. These materials have lots of possibilities for applications to both sensors and actuators. To support this work, they are building unique quasistatic and dynamic magnets that produce a magnetic field that points in any direction in a plane.

Professor Daniel Joseph was recognized for his collaborative work with Syncrude Canada, Ltd. on bitumen froth pumping. Syncrude was able to incorporate this new technology into Canada's growing oil sands industry.

Professor Ellen Longmire presented invited lectures at BF Goodrich Aerospace, Medtronic, Purdue University, Union College, and at a workshop on Transverse Jets at the International Center for Mechanical Sciences in Udine, Italy. She was an invited panelist at the International Conference on Multiphase Flow in New Orleans.

Professor Ivan Marusic holds a McKnight Land-Grant Professorship and will spend Fall Semester 2001 at the Graduate Aeronautical Laboratories, Caltech. He will be collaborating with colleagues on theoretical issues related to the computation of turbulent flows.

Professor Mehran Mesbahi received a National Science Foundation, Career Award: "Distributed Space Systems Control via Graph-Driven Hybrid Systems and Matrix Inequalities."

Honors, Awards, and Presentations

Professor Gary Balas was promoted to Full Professor.

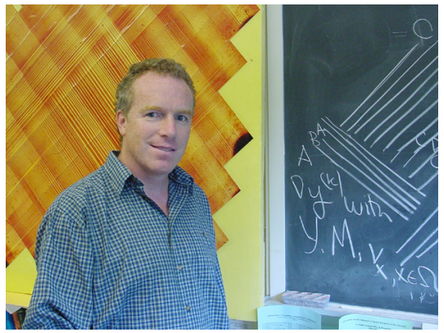
Professor Perry Leo was promoted to Full Professor.

Professor Daniel Joseph's bullet highlighting his research activities was selected for submission to the Annual Bullet Competition of the U.S. Department of Energy, Office of Basis Energy Sciences (DOE/BES). Each research core area at BES was allowed to submit only four bullets and his was one of the four selected to represent the engineering sciences program.

Professor Mehran Mesbahi was recognized by the Jet Propulsion Laboratory at NASA for his innovation in Formation Flying Control of Multiple Spacecraft via Graphs, Matrix Inequalities and Switching.

Professor Mehran Mesbahi's presentation at the 2001 Automatic Control Conference was selected as the Best Presentation of the Session.

Richard James Honored as New Penrose Professor



Professor Richard James has been named as the new Russell J. Penrose Professor. His appointment began July 1, 2001 and will continue for a ten year period. The Russell J. Penrose Professorship in Aerospace Engineering and Mechanics was established on October 9, 1990, through a generous gift from Mr. Russell J. Penrose. This gift was matched by an equal contribution from the Permanent University Fund. The Professorship seeks to "obtain and retain distinguished faculty who are outstanding in their teaching and research capabilities. The Professorship is designed to provide the individual who holds this position with the title of this distinction as well as financial resources in recognition of the significant contributions which they are making to their fields as well as to the department."

Professor Richard James has been a faculty member since 1985. He has been a Distinguished McKnight University Professor since 1998 and in 1990-91 received the George Taylor IT Alumni Society Research Award. Professor James was the Rothschild Visiting Professor at Cambridge University in England in 1999 and member of the Institute for Advanced Study in Princeton in 1993.

Since he began at the University of Minnesota, Professor James has forged a vital research program on the behavior of "shape memory materials," one of a class of emerging materials known popularly as "smart materials." If a flat sheet of one of these materials is crumpled up into a small ball, it suddenly returns to its original shape upon heating. The materials are finding uses in such diverse areas as superelastic eyeglass frames, stents for heart-bypass surgery, "shrink fit" couplings for joining pipelines, orthodontic wires for braces and actuators in automotive engines. With Professor Thomas Shield, Professor James has recently developed a new family of shape memory materials that suddenly undergo a large change of shape under the influence of a magnetic field, such as when a bar magnet is brought close to the material. These are called ferromagnetic shape memory materials. The basic physics behind the ordinary shape memory, and the ferromagnetic shape memory, are that behavior is a reversible phase transformation. It is much like the phase transformation between ice and water, except that it is a transformation between one solid phase and another. Professor James has made pioneering discoveries about how these solid-solid phase transformations produce a change of shape.

Over the past few years Professor James has been looking at the behavior of these materials at smaller and smaller scales, and he initiated a program of research with Professors Graham Candler, Mitchell Luskin (School of Mathematics), Chris Palmstrøm (Chemical Engineering and Material Science) and researchers at Caltech, University of Michigan and Rutgers on the behavior of active materials (like shape memory materials) at small scales. This project involves the development of the techniques of microelectronics for the synthesis of active materials, and also includes aspects of aerodynamics appropriate to the small scale flight of a ferromagnetic shape memory "bug".

The funds from the Penrose Professorship will be used to support research on the discovery of new materials, particularly active materials like shape memory and magnetostrictive materials.

Professor James plans on using these funds in creative ways, that would not be fundable from other sources. In the short term, this means support of visitors and working groups that would forge a link between his research on materials and the behavior of living systems. He plans on expanding his research to gain a better understanding of the way biological systems produce motion and forces at small scales — the beating of cilia, protein motors, and the invasion of cells by viruses, particularly in the viral organism Bacteriophage T-4. The latter invades a cell by undergoing a "phase transformation" that is very similar to the one that occurs in shape memory materials.

Research Projects of AEM Professors for 2000-2001

Air Force Office of Scientific Research
Continuum and Particle Computations of Hypersonic Shock Interaction Flows
Graham Candler

Large-eddy Simulation of Turbulent Hydrosonic Flows
Graham Candler

An Integrated, Multi-Layer Approach to Software-Enabled Control: Mission Planning to Vehicle Control
Gary Balas and Yiyuan Zhao

Effect of Internal Energy Excitation on Supersonic Blunt-Body Aerodynamics
Graham Candler

Computational Tools for the Atomic/Continuum Interface: Nanometer to Millimeter Scale Aircraft
Richard James, Graham Candler, Mitchell Luskin, and Chris Palmstrøm

Simulation of Turbulent Hypersonic Flows
Graham Candler

Army High Performance Computing Research Center
High Performance Computation of Compressible Flows, Turbulent Flows
Graham Candler

Army Research Office
Stability of Liquid Filled Missiles (with Science Application International Corp.)
Daniel Joseph

Advanced Methods for Interceptor Flow Simulations
Graham Candler

Aerodynamic Break-up, Cavitation, and Rupture Fluids
Daniel Joseph

Design, Modeling and Computation of Active Thin Films
Richard James and Mitchell Luskin

Numerical Simulation of Atmospheric Pressure Air Plasmas (with Stanford University)
Graham Candler

Shock Tube Simulations of High-Altitude Breakup of Thickened Simulants (with Battelle Memorial Inst.)
Daniel Joseph and Gordon Beavers

Simulation of Non-equilibrium Rocket Motor Plums
Graham Candler

Simulation of TMD Flow Fields
Graham Candler

Department of Energy
Large-eddy Simulation of Gas-turbine Combustors
Krishnan Mahesh

Nonequalibrium and Structural Effects on Models of Interfacial Motion in Multicomponent Alloys
Perry Leo

Lubricated Transport of Viscous Materials
Daniel Joseph

Topological Transitions in Liquid/Liquid Flows
John Lowengrub and Ellen Longmire

National Aeronautics and Space Administration (NASA)
Advanced Models for High Enthalpy Flow Simulations
Graham Candler

Real-time Motion Path Planning for Autonomous Rotocraft
Graham Candler

Switching Control Laws for Constrained Formation Maneuver (with JPL)
Mehran Mesbahi

Comprehensive Computer Simulation of Air Traffic Systems
Yiyuan Zhao

Application of Linear Parameter Varying Control Methods to Aerospace Systems (with CalTech)
Gary Balas

Development of the Space-Time CE/SE Method for Large Eddy Simulation Supersonic Jet Noise (Glenn)
Graham Candler

Worst Case Analysis of the X-38 V201 Flight Control System (Johnson)
Gary Balas

Applications of Linear Parameter-Varying Techniques to Safety Critical Aircraft Flight Systems (Langley)
Gary Balas

Aircraft Scheduling and Conflict Resolution in Air Traffic Management (Ames)
Yiyuan Zhao

Application of Gain-Scheduled Multivariable Control Techniques to the F/A-18 System Research (Dryden)
Gary Balas

The Minnesota Space Grant College Consortium (Headquarters)
William Garrard

Nonlinear Feedback Control of Aircraft Propulsion Systems (Glenn)
William Garrard and Gary Balas

Numerical Simulation of Atmosphere Entry Flows (Ames)
Graham Candler

Optimal Takeoff Procedures for Category 'A' Helicopters (Ames)
Yiyuan Zhao

Robust System Identification and Validation for Control (Langley)
Gary Balas

Studies of Trajectory Synthesis Methods and Trajectory Sensitivity in Air Traffic Management (Ames)
Yiyuan Zhao

National Heart, Lung, and Blood Institute (NIH)
Respiratory System Mechanics (with Baylor College of Medicine)
Theodore Wilson

National Science Foundation
Mathematical Theory and Numerica
Mitchell Luskin

Comparative Theoretical and Experimental Studies of Breakup, Outgassing and Stress Induce Polymerically Thickened Liquid
Daniel Joseph and Gordon Beavers

Distributed Space Systems Control via Graph-Driven Hybrid Systems and Matrix Inequalities
Mehran Mesbahi

Dynamic Feature Extraction and Data Mining for the Analysis of Turbulent Flows
Ivan Marusic, Ellen Longmire, Graham Candler, Victoria Interrante, George Karypis, Sean Garrick, Vipin Kumar

Dynamic Performance of MEMS in Liquid Environments
Ellen Longmire and Sue Mantell

A Physical Modeling Approach to Wall Turbulence and Enhancing the Educational Experience through the Beauty of Fluid Motion
Ivan Marusic

Experimental, Analytical and Computational Study of Nematic Optical Elastomers
Richard James

Experiments in Particle-Laden and Buoyancy-Driven Flows
Ellen Longmire

Fundamental Fracture Mechanisms in Ductile Single Crystals
Thomas Shield

KDI: Direct Numerical Simulation and Modeling of Solid-Liquid Flows
Daniel Joseph

Mechanics of Systems with Bi-Stable Elements
Lev Truskinovsky

Numerical Methods for Very Large, Sparse Dynamical Systems
Daniel Boley (CSCI) and Gary Balas

Transitions and Defects in Ordered Materials
Richard James and Mitchell Luskin

Office of Naval Research
CHAP (with Mide Tech.)
Richard James

Investigation of Ferromagnetic Shape Memory in Heusler Alloy
Richard James

Basic Research on the Improvement of Magnetostrictive and Shape Memory Alloys
Richard James and Thomas Shield

DURIP-Magneto-Mechanical Testing Machine
Richard James and Thomas Shield

Exxon Mobil
Lubricated Transport Chad Oil
Daniel Joseph

Schlumberger Dowell
Model Experiments to Study the Cause of Proppant-Induced Wear of Valves and Valve Seats in FAC Pumps
Daniel Joseph and Gordon Beavers

Exchange Visitor Program

Toshio Funada, Professor and Dean, Department of Electronics and Control Engineering, Numazu College of Technology, Numazu, Japan, was invited for a return visit to work with Dr. Daniel Joseph conducting joint research in multiphase flows. He visited us for a short while in the fall of 2000 and again in spring of 2001. We always look forward to Dr. Funada's visits to the Department.

Nobuaki Ishii, Associate Professor of Systems Engineering, Institute of Space and Astronautical Science, Kanagawa, Japan, was sponsored by Dr. William Garrard to spend a year in the Department engaging in research on space mission analysis and orbital dynamics. Dr. Ishii arrived in Fall of 2000 and is accompanied by his wife and two daughters.

A.K. Mesbah Uddin, Professor, Department of Mechanical Engineering, at the University of Engineering and Technology in Dhaka, Bangladesh, was a Visiting Professor who was sponsored by Dr. Ivan Marusic to visit the Department in early January of 2001 to engage in teaching and research. Professor Uddin taught one of our service courses in the spring and was then hired as a senior research associate to work with Professors Candler, Marusic and Interrante on their NSF project until the end of the year. Dr. Uddin is accompanied by his wife, daughter and son.

New Departmental Postdocs and Other Academicians

Jozsef Bokor, a Research Director and Head of Systems and Control Laboratory at the Hungarian Academy of Sciences, was hired as a research associate by Professor Gary Balas. He is working on Dr. Balas' NASA Langley contract, entitled "Application of Linear Parameter-Varying Techniques to Safety Critical Aircraft Flight Systems" concerning control, fault detection and isolation of aircraft flight systems.

Marie-Claude Druguet completed her Ph.D. in Mechanics and Thermophysics from the University of Provence in Marseille, France. She was hired as a research associate to work with Professor Graham Candler's research project on the computational analysis of hypersonic flows. Her duties will include working on computational fluid dynamics methods, compressible gas dynamics and programming for parallel computers.

Heath Johnson completed his Ph.D. in aerospace engineering last summer at the University of Minnesota. He was hired as postdoctoral associate and is working with Professor Graham Candler's research project on the stability and transition of high-speed compressible flows. His work has included computational fluid dynamics methods, linear stability theory, parabolized stability equations, and programming for parallel computers.

George Papageorgiu completed a Ph.D. from the University of Cambridge, Department of Engineering in Cambridge, England. He was hired as a postdoctoral associate by Professor Gary Balas and is working on a research project concerning control, fault detection and isolation of piloted and autonomous aircraft. Part of his work will include the analysis and synthesis of linear, parameter-varying (LPV) flight controllers; development of fault detection and isolation strategies for aircraft, design of receding horizon controllers (RHC) for autonomous vehicles; development of analysis and design for LPV and RHC algorithms and programming algorithms in Matlab, C and C++

Krishnendu Sinha, completed his Ph.D. in aerospace engineering this past spring and was hired as a postdoctoral associate to work with Professor Graham Candler. Dr. Sinha is responsible for research on direct numerical simulation and large-eddy simulation of turbulent reacting flows, that includes performing large-scale simulations and programming for parallel computers.

M.G.A. Tijssens, completed his Ph.D. in Mechanical and Civil Engineering from Delft University, The Netherlands. He was hired as a research associate by Professor Richard James to work on a research project on the computational solid mechanics relating to large-scale computational studies of the fracture and failure of polymetric materials undergoing transformations. Dr. Tijssens is accompanied by his wife and child.

Special Sethna Lecture

Professor G.I. Barenblatt from the Department of Mathematics at the University of California-Berkeley gave the special Sethna Lecture on December 1, 2000 on "Turbulence: The last problem of classical physics; new approach and perspectives." Professor Barenblatt was the first holder of the G.I. Taylor Chair of Fluid Mechanics at Cambridge University. He is a Foreign Member of the American Academy of Arts and Sciences and a Foreign Associate of both the US National Academy of Engineering and of the US National Academy of Sciences. His other honors include membership in the European Academy, the Modesto Panetti Medal and Prize, and several honorary doctorates.

His talk centered on a new approach studying high-speed wall, bounded turbulent "shear" flows. This approach, based on a combination of incomplete similarity and vanishing viscosity asymptotics, was proposed in recent years by Professor Barenblatt and his associates. It revealed that the classical "logarithms" law, generally considered to be one of the cornerstones of the theory of turbulence is not quite correct: the seemingly plausible basic assumption that the influence of viscosity does not penetrate to the core of the flow but remains concentrated in a narrow vicinity of the wall, had to be reconsidered. A new "scaling" (power) law for the mean velocity profile, taking into account the overall influence of viscosity, was obtained. A detailed comparison with experimental data for turbulent flows in pipes and boundary layers demonstrated an instructive agreement. The results obtained suggest new possibilities for further studies of a wide class of flows such as turbulent jets, mixing layers, etc. The new approach also reveals certain general properties of developed turbulent flows.

Alumni News

Edward Haupt, a 1958 AEM Alumnus, passed away on February 21, 2001.

Alexander Sowyrda, a 1944 AEM Alumnus, passed away on August 6, 2000.

Herman Seibert, a 1947 AEM Alumnus, passed away on April 18, 2001.

Alumni Highlights

Dr. Stuart Antman (Ph.D., Mechanics, 1965) has been named a Distinguished University Professor at the University of Maryland, Department of Mathematics. He is known worldwide for his research in mechanics and solid matter, specifically mathematical elasticity. In addition, he is a leading authority on problems involving rods, plates, and shells.

Jon Berndt (graduated 1986) is currently with Lockheed Martin in Houston, Texas. He is supporting the X-38 project, writing simulation software for the test facility that will validate the flight software.

Classes of 1951, 1961, and 1976

You're invited to a homecoming reunion weekend full of festivities, fun, and football!

The Institute of Technology class reunion weekend is October 19-20, 2001. Activities include tours of departments and research labs, reception and dinner with the dean, pancake breakfast, and homecoming parade and football game. Invitations will be mailed in August. For complete details, contact Kris Kosek at 612-626-8282 or kosek@itdean.umn.edu.

Alumni Dollars at Work

"The most important measures of excellence at the University are those that demonstrate the University's ability to transform lives. In many cases, private giving is the catalyst that makes this transformation possible."
—University President Mark Yudof

The Rose Minkin, Boeing, Richard and Shirley DeLeo and the Chester Gaskell Aeronautical Engineering Sholarship funds have allowed us to provide financial assistance this year to a number of our students. These scholarships have become more and more important to students because of the necessary increase in tuition. The AEM Program Support Fund provided core support for students to build experiments for the "Vomit Comet" program (see article on page 10). The AEM Lab Equipment Fund allowed us to install an audiovisual system in Room 227 of Akerman Hall. Room 227 is used by the department as the primary room for seminars and small classes. The Academic Excellence Fund supported the P.R. Sethna Lecture, given by Professor G. Barenblatt this year, and the John D. Akerman Memorial Fund continues to provide support for the Akerman Professor of Design who is the Instructor of our Senior Capstone Design Class. Private support makes a critical difference in the Department of Aerospace Engineering and Mechanics, in the research we are able to advance, the new programs we are able to create, and the talented students we are able to support. Your spirit of giving is a tremendous vote of confidence in our shared endeavors. We greatly appreciate every gift made to the Department, no matter what size.

Donations:
You Can Make a Difference

Donations can be made anytime during the year and sent to the University of Minnesota Foundation, Gateway Center, 200 Oak Street SE, University of Minnesota, Minneapolis, MN 55455.

Just designate the fund you wish to support. Checks should be made payable to the University of Minnesota. The funds to which you can contribute are as follows:

AEM Program Support:
Used as the main source of discretionary funds to support all funds. Fund No. 3739

Aeronautical Class of 1943 Wind Tunnel Fund:
Created by the Class of 1943 to defray costs of a new wind tunnel and instrumentation. Fund No. 3585

The Chester Gaskell
Aeronautical Engineering Scholarship Fund:
Used for undergraduate scholarships for outstanding first-year aerospace students. Fund No. 2898

The John D. Akerman Memorial Fund:
Supports the Akerman Professor of Design of our year-long capstone senior design course. Fund No. 3191

The AEM Laboratory Equipment Fund:
Used to purchase instructional and research equipment. Fund No. 2500

The AEM Excellence Fund:
Used to sponsor lectureships by distinguished individuals in aerospace engineering and mechanics. Please note that this fund also supports the Sethna Lecture. Fund No. 2281

The B.J. Lazan Fund:
Supports activities that promote faculty/student interactions and educational activities.

John A. & Jane Dunning Copper Fellowship in Aerospace Engineering & Mechanics.
Provides fellowships for AEM graduate students. Fund no. 5330

Lawrence E. Goodman Scholarship in Theoretical & Applied Mechanics.
Provides a prize to a graduating student with a baccalaureate degree from AEM who is deemed by the faculty to have achieved the best record in the field of theoretical and applied mechanics. Fund No. 5594.

Richard & Shirley De Leo
Scholarship & Engineering Fund:
Provides undergraduate scholarships to Aerospace Engineering students and provides discretionary funds to the Department of Aerospace Eng. & Mechanics. Fund no. 5470.

Robert H. & Marjorie F. Jewett Fund:
Provides supports program support to the Department of Aerospace Engineering and Mechanics. Fund No. 4810.

If you would like information about establishing a Unitrust with the University of Minnesota Foundation, contact the Institute of Technology Development and External relations, at 1-800-587-3884, and 1-612-624-5537.

Student Honors

Tim Jackson has been awarded an Astronaut Scholarship for 2001-2002.

Jaime Strandmark, AEM Undergraduate, received a Spring 2001 Co-op Flag Award for her outstanding achievement from the Johnson Space Center (NASA).

Kevin Hicok, AEM Undergraduate, was selected to address the 2001 Graduating Class at the Institute of Technology's Commencement Ceremony, on May 4, 2001.

2000-2001 AIAA Student Officers
President: Chris Regan
Vice President: Paul Hannah
Treasurer: Alexander Snyder
Secretary: Emily Grantski

Student Awards

2000-2001 Rose Minkin
Aerospace Engineering Scholarships
Ted Davis, Dean, Inst. Tech.

Ryan J. Wold
Jennifer A. Bonin
Bryan J. Henneman
William Garrard, AEM Department Head

2000-2001 Chester Gaskell
Aeronautical Engineering Scholarships
Ted Davis, Dean, Inst. Tech.

Richard Johnson
John W. Heidt (not shown)
Travis J. Schauer (not shown)
Timothy R. Jackson
William Garrard, AEM Department Head

2000-2001 Boeing Scholarships

Ted Davis, Dean, Inst. Tech.
Brian B. Naslund
Shirin Florence Salber
William Garrard, AEM Department Head

2000-2001 Richard and Shirley DeLeo
Engineering Scholarships

Ted Davis, Dean, Inst. Tech.
Eric A. Euteneuer
Travis J. Schauer
Christopher Teeuwen
Cecilia D. Ortiz
Will Hambleton
Dakri Nelson
Jeff Rollings
Timothy Jackson
Nick Velander
William Garrard, AEM Department Head

2001-2002 University of Minnesota,
Minnesota Space Grant Consortium Scholarships
Alberto Baez
Reynaldo Cantu
Charlene Knealing
Alexander Meoveo
Brian Naslund
Eve Skoog
Chargles Steidl
Patrick Tague
Ryan Wold
Julie Zogg

2000-2001 Kirby and Tonya Puckett/
Jackie Robinson Scholarship
Richard Johnson

2000-2001 Control Science
National Science Foundation Fellow
Matthew Montminy

Degrees Awarded 2000-2001

Bachelor of Aerospace Engineeirng and Mechanics

Abdullah Al-Ajaji
Steven Balistreri
Adam Basalay
Nathan Berg
Steven Botts
Ricardo Camel
Travis Chezick
Justin Cook
Thomas Coy
Jeffrey Craemer
Trung Dang
Eric Euteneuer
Robert Forcier
Bryan Fram
Ryan Gosse
Emily Grantski
Kristin Grimlund
John Heidt
Kevin Hicok
Daniel Hitchcock
Timothy Jackson
Daniel Jensen
Hamed Kebriaei
Gregory Kline
James Kovarovic
Ryutaro Koyama
Alfred Leano
Ryan Leece
Lorenzo Locante
Brian Mader
Scott Munson
Dakri Nelson
Cecilia Duenas Ortiz
Lisa Parkin
Thomas Polachek
Christopher Regan
Jeffrey Rollings
Stephen Rosenbaum
Matthew Rust
Travis Schauer
Alexander Snyder
Daniel Snyder
Timothy Swanson
Chris Teeuwen
Ryan Tiaden
Michael Travanty
Brian Ulman
Beenu Varghese
Nicholas Velander
Christopher Waino
Wade Williams
Cristina Wurst

Master of Science

MS (Mechanics)
Gary Kunkel
Andres Marcos
Ganesh Ramesh Rathinam

MS (Aero)
Sesha K.Dassanayake
Subhabrata Ganguli
Mariann Jansen
William Sheridan

Doctor of Philosophy

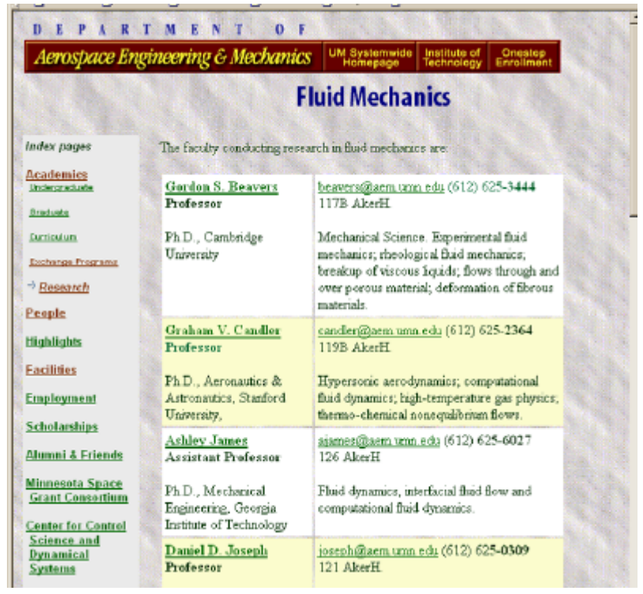
PhD (Aero)
Krishnendu Sinha

PhD (Mech)
Eric Peterson

AEM on the Web, http://www.aem.umn.edu/

Visit the new AEM web pages for privous issues of the AEM Update and information on

- Academics
- Faculty
- Research
- Facilities
- Highlights
- Programs
- Alumni Network



A page from http://www.aem.umn.edu/research/fluids_index.shtml

Other Faculty & Staff

Emeritus Faculty

Professor Emeritus
J. L. Ericksen
Philip G. Hodge, Jr.
C.C. Hsiao
Thomas Lundgren
Robert Plunkett
William H. Warner

Associate Professor Emeritus
Eugene Stolarik

Temporary Faculty

Assistant Professor
Jorge Tierno
Satish Ramadhyani

Research Staff

Postdoctoral Associates
Runyuan Bai
Heath Johnson
George Papageorgiou
Krishnendu Sinha
Robert Tickle

Research Associates
Jozsef Bokor
Marie-Claude Druguet
Qi Pan
M.G.A. Tijssens
Michael Wright

Research Fellow
Chris Mitchell

Technical Staff

Jim Frame, Scientist
Dave Hultman, Managing Research Engineer
Ray Muno, Scientist
John Tucker, Scientist
Steve Nunnally, Principal Lab Machinist

Administrative Staff

Kristal Belisle, Principal Secretary
Dan Hegland, Principal Accountant
Randi Quanbeck, Associate Program Director, MN Space Grant Consortium
Ruth Robinson, Senior Office Supervisor
Donna Rosenthal, Senior Administrative Director
Lisa Schouviller, Accounts Specialist
David Vogel, Jr. Application Programmer

Head
William L. Garrard

Associate Head
Perry H. Leo

Director of Undergraduate Studies
Thomas W. Shield

Director of Graduate Studies
Gordon Beavers

Aerospace Engineering
and Mechanics,
Institute of Technology,
University of Minnesota
107 Akerman Hall,
110 Union St SE
Minneapolis, MN 55455

Tel: 612-625-8000
Fax: 612-626-1558
dept@aem.umn.edu

Address Service Requested

Nonprofit Org.
US Postage
PAID
Minneapolis, MN
Permit No. 155

2000-2001 The AEM Update

This publication is available in alternative formats upon request. Please call or write to Donna Rosenthal in the Department of Aerospace Engineering and Mechanics, University of Minnesota, 107 Akerman Hall, 110 Union Street S.E., Minneapolis, MN 55455, (612) 625-3348, donna@aem.umn.edu.

The University of Minnesota is an equal opportunity educator and employer.