The AEM UPDATE

Department of Aerospace Engineering and Mechanics
University of Minnesota

Chairman's Corner

This was our first year under the new semester system. Because of hard work by a lot of people, things went remarkably smooth and there were no problems of any real consequence. In the fall of 2001, we will be visited by the Accreditation Board for Engineering and Technology (ABET) as part of our six year accreditation cycle. ABET is chartered by the U. S. Department of Education to accredit all engineering programs in the United States. ABET has dramatically changed its procedures for accreditation since the last visit to the University of Minnesota in 1995. The accreditation process is now oriented toward continuous quality improvement. Briefly, based on our mission, we formulate educational objectives, educational outcomes and procedures for assessing whether we are achieving these objectives and outcomes. We use the results of our assessment procedures to guide us in making improvements in our program. All of this is done in consultation with our constituents. For more details please see the ABET web site at http://www.abet.org.

Our mission, objectives, desired outcomes and constituents are given in this edition of the AEM Update. These were developed with inputs from faculty, students, alumni, and employers. More information is given in our web site at http://www.aem.umn.edu/teaching/. Please give us your comments. If you have not visited our web site recently, please do as it is completely new and is a real improvement over the old site.

One of our assessment tools that you may be interested in is a survey of our alumni. Many of you participated in this survey last year and the results are given in this issue of the Update. For the most part, our program received high marks from our alumni; however, it appears that we need to do some work on our advising and intern programs. Alumni also indicated some dissatisfaction with the their education in the areas of propulsion and orbital mechanics. We have tried to remedy these problems by teaching propulsion in the Department rather than having our students take it from mechanical engineering and by requiring a course in spaceflight dynamics for graduation. We are also working on improving our labs and computational facilities (these are areas in which gifts from friends and alumni can make a huge difference). Alumni were also not happy with their liberal arts experience here at the University of Minnesota.

There have been several changes in the faculty this year. Tom Lundgren retired this year after 40 years as a faculty member. Tom will continue as a Professor Emeritus. We added two new faculty members in fluid mechanics who will join us this year. They are Dr. Ashley James, who comes from Georgia Tech, and Dr. Krishnan Mahesh from Stanford. With retirements and the addition of new faculty members, the AEM Department has the lowest average age of any Department in the Institute of Technology. This year we will be searching for a new faculty member in the aerospace systems area.

We continue to make improvements in Akerman Hall.

Continued on next page.

Inside

This year we are upgrading the electrical service in the building and are having chilled water for air conditioning and process cooling run into the building. It will be some time before the building has central air conditioning, but the first step has been made. In addition, we are building a new aerospace systems lab in the basement of Akerman and are substantially upgrading our seminar room. We have been able to accomplish these upgrades with help from the University, research grants, and gifts from friends and alumni. There is still a lot of work to do on Akerman Hall to bring it up to modern standards.

Research activity in the Department continues to be strong and this results in demands for quality space for labs. Unfortunately space is extremely limited. The University has started a new program in Biomedical Engineering which has priority for new space and we are forced to work with what space we have in Akerman and Shepherd Labs. The space in Akerman, in particular, often needs substantial upgrades in infrastructure. While we receive some help from the University, we have to pay for many of these upgrades out of departmental funds. Gifts supporting these improvements as well as improvements in our laboratory and computational equipment are essential.

One exciting project some of our students will be participating in next year is the NASA Reduced Gravity Student Flight Opportunities Program sponsored by NASA and the Texas Space Grant Consortium. This is a program where students propose and perform research projects on board the NASA KC-135 aircraft that is used to produce microgravity conditions for short periods of time. The flight path of this aircraft provides a roller coaster ride and it is nick-named "The Vomit Comet." Two student proposals were accepted from our Department and we hope to have pictures next year.

We want to keep in touch with our graduates, so please send us items for our Alumni News. This can be accomplished by contacting Donna Rosenthal at donna@aem.umn.edu or by fax at (612) 625-1558. I want to thank all of you for providing support for our Department. Your support is critical to us in making the improvements that are required to maintain excellence in our programs.

--Dr. William Garrard

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.

Constituents

Our constituents are the following:

1. Undergraduate Students in the BAEM Program.
2. Alumni of the BAEM Program.
3. Employers of the BAEM Graduates.
4. Faculty of the BAEM Program.

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 engineering background in aerospace engineering and mechanics, including fluid mechanics, thermodynamics, structural mechanics and controls.
2. To produce graduates who can apply their knowledge of aerospace engineering and mechanics to achieve success in the aerospace industry and related government agencies, and also in other engineering industries.
3. To produce graduates with skills in the essential tools used in aerospace and other industries. These include a background in experimental methods, problem solving techniques, computational methods and engineering design. Moreover, to produce graduates with the ability to both seek out assistance when needed and to learn new skills throughout their careers.
4. To produce graduates with the oral and written communication skills needed to successfully work in a modern multidisciplinary corporate environment.
5. 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.

Academics: Where are We Now?

AEM Undergraduate Program

The 1999-2000 academic year was the first year of teaching under the semester system. A couple of courses for the new program were taught in the previous year and other changes were made for this year to ease the transition for students. It seems that we have managed to make the transition relatively easy for most students. Very few students have had problems completing their degree taking the courses we have offered. So far no changes from the original plan have been needed for next years course schedule. As part of the ABET accreditation process which now requires continual review of the program (see Chairman's Corner on page 1) we will be identifying areas that need improvement with the help of our students and alumni. Once we have given the semester courses a few times there will no doubt be some changes made. But overall it seems that our original plan is working quite well.

There have been some changes in the space used for undergraduate laboratories in the past year. The teaching labs in the basement have been consolidated into room 25. This room now contains the mechanical testing machines, the water channel and the shaker used for vibrations experiments. There is a small blackboard area at one end of the room. This change, while freeing up space for other uses, also allows the educational equipment to be better maintained and organized in one place. In addition, we have added a card reader lock to the room, which allows students doing independent projects or experiments as part of the design class to have expanded access to this equipment. We are also in the process of adding a remote controlled video system and intercom between room 25 and the wind tunnels in room 330. This will allow handicapped students to participate in wind tunnel experiments and teaching assistants to keep track of simultaneous experiments.

Thomas Shield

Director, Undergraduate Studies

AEM Graduate Program

Last year, the Department enrolled 17 new students into the Aerospace Engineering and Mechanics graduate program. Three of these students were from the United States, six were from India, and two were from Norway. The other students came from Korea, Serbia, Mexico, Turkey, China, and Russia.

During the past year the Department awarded 16 Mas-

ters (13 in Aerospace Engineering and 3 in Mechanics) and 6 PhD degrees (four in Aerospace Engineering and 2 in Mechanics). Our graduates continue to secure lucrative and satisfying employment, some in industry and others teaching in higher education institutions. Several of our MS graduates last year continued on in the PhD program here in Minnesota and some went on for a PhD elsewhere.

A number of our graduate students participated in service activities with elementary schools along with conducting tours of our facilities and other activities with elementary school children during their visits to the Department.

Ellen Longmire

Director, Graduate Studies

Control Science and Dynamical Systems (CSDy)

Interdepartmental Ph.D. 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 seminar series focussed on research at the University of Minnesota this past Spring. A special seminar was given by Professor John Doyle from the California Institute of Technology on "Complexity and Robustness: Math and Physics Meets the Internet." Tom Kearns from MTS, a local Minnesota company, presented the first seminar of the Spring semester entitled "MTS Advanced Engineering Solutions." Professor Tryphon Georgiou from Electrical Engineering presented two seminars. The first entitled "Subspace Analysis of State Covariances" and the other on "Robustness of a Relaxation Oscillation." Professor Mos Kaveh, Electrical Engineering Department Head, presented a lecture on "Signal Processing for Mechanical Diagnostics Using Acoustic Emissions." This is ongoing research with five other faculty under a DARPA grant. Professors Brad Nelson and Will Durfee of Mechanical Engineering presented seminars on "Microactuators and Micromanipulation" and "System Indentification of Muscles." From the Honeywell Technology Center, Dr. Jorge Tierno lectured on the topic of "Satellite Formation Flying." Dr. Tierno recently taught a course in Aerospace Engineering and Mechanics.

Professor Nikolaos Papanikolopoulos of Computer Science presented results from his DARPA research contract in a talk entitled "Distributed Robots for Surveillance." This research has been the subject of a short CNN news clip and a video of his mobile robots has been seen on local and network news programs. Professor Max Donath of Mechanical Engineering and Director of the Institute of Transportation Studies (ITS) at the University of Minnesota presented the seminar "UMN Intelligent Vehicles Laboratory." This seminar focussed on the ITS SAFEPLOW experimental vehicle. This is ongoing research between ITS and Mn/DOT which was recently demonstrated to the U.S. Deputy Secretary of Transportation, Mort Downey, in Washington, D.C. Professor Bruce Lee of Mechanical Engineering gave a seminar entitled "New Concepts in Electrohydraulic Devices and Control." Professor Mehran Mesbahi, a

new faculty in Aerospace Engineering and Mechanics, presented a seminar on "Satellite Formation Control." Dr. Tom Posbergh described his work on "Control of Spinning Spacecraft" and Professor Prodromus Diaodtidis of Chemical Engineering finished the series with a seminar entitled "Nonlinear Process Control."

Two students, Dr. Jiecai Luo and Dr. Steven Haker, graduated with the PhD degree in CSDy during the 1999-2000 academic year. Dr. Luo's thesis was entitled "Optimal Control for Control Actions with Mixed Impulse Functions and Bounded Piecewise Continuous Functions." Dr. Luo's advisor was Professor E.B. Lee (EE). Dr. Haker's thesis was entitled "Geometric PDE's in Computer Vision." His advisor was Professor Allen Tannenbaum (EE). The CSDy Program has 6 students pursuing the PhD and all are Research Assistants working on various research projects related to the control and dynamics of systems.

For more information regarding Control Science and Dynamical Systems Program contact Kristal Belisle at (612)-625-3364 (e-mail: kristal@aem.umn.edu).

Visit the new AEM home pages at http://www.aem.umn.edu for information on

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

Undergraduate 1999 Alumni Survey
Aerospace Engineering & Mechanics

As part of the accreditation of our undergraduate program, we sent out an Alumni Survey. The results of this survey are on the following pages.

Undergraduate 1999 Alumni Survey
Aerospace Engineering & Mechanics

Number of Surveys = 52

Items:	Options:	Responses:	
1. When did you receive the BAEM degree	before 95	(1)	13 (25.0%)
from the University of Minnesota	95 spr/sum/fal	(2)	14 (26.9%)
Mean = 2.50 Median = 2.43	96 spr/sum/fal	(3)	15 (28.8%)
Standard Deviation = 1.20	97 spr/sum/fal	(4)	6 (11.5%)
Responses to item = 52 (100.0%)	98 spr/sum/fal	(5)	4 (7.7%)
2. I am currently employed:	eng aero field	(1)	18 (34.6%)
	eng non-aero	(2)	20 (38.5%)
Mean = 2.06 Median = 1.90	non-eng/tech	(3)	8 (15.4%)
Standard Deviation = 1.03	stud/fac ed	(4)	5 (9.6%)
Responses to item = 52 (100.0%)	none of above	(5)	1 (1.9%)
3. My education has prepared me to apply	Strongly agree	(1)	30 (57.7%)
knowledge of mathematics, science and….	Agree	(2)	20 (38.5%)
Mean = 1.46 Median = 1.37	Uncertain	(3)	2 (3.8%)
Standard Deviation = 0.57	Disagree	(4)	0 (0.0%)
Responses to item = 52 (100.0%)	Strg Disagree	(5)	0 (0.0%)
4. My ed has prepared me to design and con-	Strongly agree	(1)	11 (21.2%)
duct experiments, analyze/interpret data.	Agree	(2)	36 (69.2%)
Mean = 1.90 Median = 1.92	Uncertain	(3)	4 (7.7%)
Standard Deviation = 0.60	Disagree	(4)	1 (1.9%)
Responses to item = 52 (100.0%)	Strg Disagree	(5)	0 (0.0%)
5. My ed has prepared me to design a system,	Strongly agree	(1)	13 (25.0%)
component or process to meet desired needs.	Agree	(2)	29 (55.8%)
Mean = 1.96 Median = 1.95	Uncertain	(3)	9 (17.3%)
Standard Deviation = 0.71	Disagree	(4)	1 (1.9%)
Responses to item = 52 (100.0%)	Strg Disagree	(5)	0 (0.0%)
6. My ed has prepared me to use modern tools	Strongly agree	(1)	14 (26.9%)
necessary for engineering practice.	Agree	(2)	24 (46.2%)
Mean = 2.15 Median = 2.00	Uncertain	(3)	7 (13.5%)
Standard Deviation = 1.01	Disagree	(4)	6 (11.5%)
Responses to item = 52 (100.0%)	Strg Disagree	(5)	1 (1.9%)
7. My ed has prepared me to identify, formu-	Strongly agree	(1)	28 (53.8%)
late and solve engineering problems.	Agree	(2)	22 (42.3%)
Mean = 1.50 Median = 1.43	Uncertain	(3)	2 (3.8%)
Standard Deviation = 0.57	Disagree	(4)	0 (0.0%)
Responses to item = 52 (100.0%)	Strg Disagree	(5)	0 (0.0%)

Undergraduate 1999 Alumni Survey
Aerospace Engineering & Mechanics
Number of Surveys = 52
Page 2

Items:	Options:	Responses:	
8. My ed has given me a good understanding of	Strongly agree	(1)	9 (17.3%)
professional and ethical responsibilities.	Agree	(2)	18 (34.6%)
Mean = 2.50 Median = 2.44	Uncertain	(3)	16 (30.8%)
Standard Deviation = 1.01	Disagree	(4)	8 (15.4%)
Responses to item = 52 (100.0%)	Strg Disagree	(5)	1 (1.9%)
9. My ed has prepared me to communicate	Strongly agree	(1)	23 (44.2%)
effectively in both oral and written form.	Agree	(2)	23 (44.2%)
Mean = 1.77 Median = 1.63	Uncertain	(3)	2 (3.8%)
Standard Deviation = 0.91	Disagree	(4)	3 (5.8%)
Responses to item = 52 (100.0%)	Strg Disagree	(5)	1 (1.9%)
10. My ed has prepared me to understand the	Strongly agree	(1)	9 (17.3%)
the impact of technology on society.	Agree	(2)	23 (44.2%)
Mean = 2.29 Median = 2.24	Uncertain	(3)	16 (30.8%)
Standard Deviation = 0.84	Disagree	(4)	4 (7.7%)
Responses to item = 52 (100.0%)	Strg Disagree	(5)	0 (0.0%)
11. My ed has provided me with fundamentals	Strongly agree	(1)	28 (53.8%)
for continued learning throughout life.	Agree	(2)	22 (42.3%)
Mean = 1.52 Median = 1.43	Uncertain	(3)	1 (1.9%)
Standard Deviation = 0.64	Disagree	(4)	1 (1.9%)
Responses to item = 52 (100.0%)	Strg Disagree	(5)	0 (0.0%)
12. My liberal ed courses have given me an	Strongly agree	(1)	4 (7.7%)
appreciation of the societal context in…	Agree	(2)	16 (30.8%)
Mean = 2.83 Median = 2.83	Uncertain	(3)	18 (34.6%)
Standard Deviation = 0.96	Disagree	(4)	13 (25.0%)
Responses to item = 52 (100.0%)	Strg Disagree	(5)	1 (1.9%)
13.The basic science component of my eng ed	Strongly agree	(1)	21 (40.4%)
prepared me well for my major courses.	Agree	(2)	21 (40.4%)
Mean = 1.83 Median = 1.74	Uncertain	(3)	8 (15.4%)
Standard Deviation = 0.83	Disagree	(4)	2 (3.8%)
Responses to item = 52 (100.0%)	Strg Disagree	(5)	0 (0.0%)
14.The basic math component of my eng ed	Strongly agree	(1)	20 (38.5%)
prepared me well for my major courses.	Agree	(2)	20 (38.5%)
Mean = 2.06 Median = 1.80	Uncertain	(3)	4 (7.7%)
Standard Deviation = 1.17	Disagree	(4)	5 (9.6%)
Responses to item = 52 (100.0%)	Strg Disagree	(5)	3 (5.8%)

Undergraduate 1999 Alumni Survey
Aerospace Engineering & Mechanics
Number of Surveys = 52
Page 3

Items:	Options:	Responses:	
15. The lower division academic advising at the U of M was good. Mean = 2.60 Median = 2.44 Standard Deviation = 1.18 Responses to item = 52 (100.0%)	Strongly argee Agree Uncertain Disagree Strg Disagree	(1) (2) (3) (4) (5)	9 (17.3%) 18 (34.6%) 16 (30.8%) 3 (5.8%) 6 (11.5%)
16. The computational facilities available for my coursework and projects were good. Mean = 1.92 Median = 1.80 Standard Deviation = 0.94 Responses to item = 52 (100.0%)	Strongly argee Agree Uncertain Disagree Strg Disagree	(1) (2) (3) (4) (5)	19 (36.5%) 23 (44.2%) 6 (11.5%) 3 (5.8%) 1 (1.9%)
17. Instructors provided adequate feedback on my class performance. Mean = 2.06 Median = 1.97 Standard Deviation = 0.79 Responses to item = 52 (100.0%)	Strongly agree Agree Uncertain Disagree Strg Disagree	(1) (2) (3) (4) (5)	9 (17.3%) 36 (69.2%) 3 (5.8%) 3 (5.8%) 1 (1.9%)
18. Instructors were available to discuss course-related issues outside of class. Mean = 1.87 Median = 1.87 Standard Deviation = 0.68 Responses to item = 52 (100.0%)	Strongly agree Agree Uncertain Disagree Strg Disagree	(1) (2) (3) (4) (5)	15 (28.8%) 30 (57.7%) 6 (11.5%) 1 (1.9%) 0 (0.0%)
19. My courses included active learning experiences - discussions & team projects. Mean = 1.60 Median = 1.64 Standard Deviation = 0.53 Responses to item = 52 (100.0%)	Strongly agree Agree Uncertain Disagree Strg Disagree	(1) (2) (3) (4) (5)	22 (42.3%) 29 (55.8%) 1 (1.9%) 0 (0.0%) 0 (0.0%)
20. The upper division academic advising for the BAEM Program was good. Mean = 2.50 Median = 2.29 Standard Deviation = 1.03 Responses to item = 52 (100.0%)	Strongly agree Agree Uncertain Disagree Strg Disagree	(1) (2) (3) (4) (5)	7 (13.5%) 24 (46.2%) 11 (21.2%) 8 (15.4%) 2 (3.8%)
21. My ed provided me with a good understanding of engineering materials. Mean = 1.88 Median = 1.85 Standard Deviation = 0.78 Responses to item = 52 (100.0%)	Strongly agree Agree Uncertain Disagree Strg Disagree	(1) (2) (3) (4) (5)	17 (32.7%) 26 (50.0%) 7 (13.5%) 2 (3.8%) 0 (0.0%)

Undergraduate 1999 Alumni Survey
Aerospace Engineering & Mechanics
Number of Surveys = 52
Page 4

Items:	Options:	Responses:	
22. My ed provided me with a good understanding of aerodynamics. Mean = 1.60 Median = 1.58 Standard Deviation = 0.60 Responses to item = 52 (100.0%)	Strongly agree Agree Uncertain Disagree Strg Disagree	(1) (2) (3) (4) (5)	24 (46.2%) 25 (48.1%) 3 (5.8%) 0 (0.0%) 0 (0.0%)
23. My ed provided me with a good understanding of aerospace structures. Mean = 2.02 Median = 1.96 Standard Deviation = 0.84 Responses to item = 52 (100.0%)	Strongly agree Agree Uncertain Disagree Strg Disagree	(1) (2) (3) (4) (5)	14 (26.9%) 26 (50.0%) 10 (19.2%) 1 (1.9%) 1 (1.9%)
24. My ed provided me with a good understanding of aerospace propulsion systems. Mean = 2.29 Median = 2.06 Standard Deviation = 1.10 Responses to item = 52 (100.0%)	Strongly agree Agree Uncertain Disagree Strg Disagree	(1) (2) (3) (4) (5)	12 (23.1%) 25 (48.1%) 5 (9.6%) 8 (15.4%) 2 (3.8%)
25. My ed provided me with a good understanding of atmospheric flight mechanics. Mean = 1.83 Median = 1.86 Standard Deviation = 0.58 Responses to item = 52 (100.0%)	Strongly agree Agree Uncertain Disagree Strg Disagree	(1) (2) (3) (4) (5)	14 (26.9%) 33 (63.5%) 5 (9.6%) 0(0.0%) 0 (0.0%)
26. My ed provided me with a good understanding of orbital mechanics and space flight. Mean = 2.86 Median = 2.89 Standard Deviation = 1.14 Responses to item = 51 (98.1%)	Strongly agree Agree Uncertain Disagree Strg Disagree	(1) (2) (3) (4) (5)	7 (13.7%) 13 (25.5%) 14 (27.5%) 14 (27.5%) 3 (5.9%)
27. My ed provided me with a good understanding of flight dynamics and control. Mean = 2.25 Median = 2.13 Standard Deviation = 0.81 Responses to item = 52 (100.0%)	Strongly agree Agree Uncertain Disagree Strg Disagree	(1) (2) (3) (4) (5)	7 (13.5%) 30 (57.7%) 10 (19.2%) 5 (9.6%) 0 (0.0%)
28. The design experiences provided throughout the BAEM curriculum were good. Mean = 2.13 Median = 1.98 Standard Deviation = 1.00 Responses to item = 52 (100.0%)	Strongly agree Agree Uncertain Disagree Strg Disagree	(1) (2) (3) (4) (5)	15 (28.8%) 23 (44.2%) 6 (11.5%) 8 (15.4%) 0 (0.0%)

Undergraduate 1999 Alumni Survey
Aerospace Engineering & Mechanics
Number of Surveys = 52
Page 5

Items:	Options:	Responses:	
29. The intern and/or work experiences enhanced my education. Mean = 2.48 Median = 2.32 Standard Deviation = 1.31 Responses to item = 44 (84.6%)	Strongly agree	(1)	13 (29.5%)
	Agree	(2)	11 (25.0%)
	Uncertain	(3)	11 (25.0%)
	Disagree	(4)	4 (9.1%)
	Strg Disagree	(5)	5 (11.4%)
30. The quality of laboratory facilities provided by the BAEM program was good. Mean = 2.29 Median = 2.16 Standard Deviation = 0.84 Responses to item = 52 (100.0%)	Strongly agree	(1)	7 (13.5%)
	Agree	(2)	29 (55.8%)
	Uncertain	(3)	10 (19.2%)
	Disagree	(4)	6 (11.5%)
	Strg Disagree	(5)	0 (0.0%)
31. The quality of computational facilities provided by the BAEM program was good. Mean = 2.35 Median = 2.06 Standard Deviation = 1.27 Responses to item = 52 (100.0%)	Strongly agree	(1)	16 (30.8%)
	Agree	(2)	18 (34.6%)
	Uncertain	(3)	6 (11.5%)
	Disagree	(4)	8 (15.4%)
	Strg Disagree	(5)	4 (7.7%)
32. The senior design courses improved my ability to work as part of a team. Mean = 2.04 Median = 1.80 Standard Deviation = 1.14 Responses to item = 52 (100.0%)	Strongly agree	(1)	20 (38.5%)
	Agree	(2)	20 (38.5%)
	Uncertain	(3)	5 (9.6%)
	Disagree	(4)	4 (7.7%)
	Strg Disagree	(5)	3 (5.8%)
33. The hands on lab exp provided me with good understanding of practical aspects of exp. Mean = 1.80 Median = 1.80 Standard Deviation = 0.74 Responses to item = 51 (98.1%)	Strongly agree	(1)	16 (31.4%)
	Agree	(2)	32 (62.7%)
	Uncertain	(3)	1 (2.0%)
	Disagree	(4)	1 (2.0%)
	Strg Disagree	(5)	1 (2.0%)

NEWS ABOUT OUR FACULTY

Professor Gary Balas was a member of the Technical Program Committee for the SPIE Conference on Smart Structures and Materials. He was also a member of the International Programme Committee for the 4th IFAC Symposium on Fault Detection and Identification; and the 6th Mini-Conference on Vehicle System Dynamics, Identification and Anomalie.

Professor Graham Candler gave an invited lecture at the 3rd MAPINT Symposiium on Multidisciplinary Applications and Interoperable Computing, Dayton, OH, August 1999. He was also a member of the Scientific Organizing Committee for VECPAR 2000, 4th International Meeting on Vector and Parallel Processing, Porto, Portugal, June 2000.

Professor Roger Fosdick gave invited talks at the Department of Mechanics and Materials Science at Michigan State University, November 1999, and at the Department of Theoretical and Applied Mechanics, Cornell University, March 2000.

Professor Richard James gave an Institute Lecture at the Isaac Newton Institute, Cambridge, and invited lectures at University of Bath, the National High Magnetic Field Laboratory, Harvard University (Applied Mechanics and Condensed Matter Physics), the University of Minnesota (CEMS and ME), the University of Nottingham, and Oxford University (Mathematics Institute and the Department of Materials). He organized, together with S. Mueller, G. Friesecke and E. Salje, a workshop on Passsage from Atomic to Continuum Scales at Castle Ringberg, Tegernsee, Germany, and he also organized, with G. Mcfadden, the 3rd SIAM Meeting on Mathematical Aspects of Materials Science. Professor James also gave invited presentations at the SPIE Conference on Smart Structures and Materials; the Isaac Netwon Institute Workshops on Phase Transformations and Homogenization, and on Nonlocal Effects in Materials; the annual meeting on Magnetism and Magnetic Materials (San Jose); and the Workshop on Dynamics (Oxford University).

Professor Perry Leo gave invited talks at the Gordon Conference on Thin Films; the SIAM meeting on Mathematics and Materials, Philadelphia, PA; the New York University Courant Institute, New York, NY; and the Newton Institute, Cambridge, England.

Professor Ellen Longmire gave invited lectures at the TEPCO International Symposium on Energy and the Environment in Yokohama, Japan; Kyushu Insitute of Technology, Japan; and Imperial College of Science and Technology in London. She also gave presentations at the 3rd International Workshop on Particle Image Velocimetry, Santa Barbara, CA, the APS Fluid Dynamics Conference in New Orleans, and the ERCOFTAC Conference on Particle-Laden Flows in Kappel, Switzerland.

Professor Ivan Marusic gave a presentation at the American Physical Society, 52nd Annual Meeting, New Orleans, LA 1999. He was an invited speaker at a Workshop on "Mining Scientific Data Bases" at Army High Performance Computing Research Center, Minneapolis. He was also a seminar speaker at Stanford University, Mechanical Engineering, November 1999; a seminar speaker at University of Illinos, Theoretical and Applied Mechanics, February 2000; and a seminar speaker at Princeton University, Mechanical Engineering, March 2000.

Professor William Warner, Professor Emeritus, has recently published a paper on "Optimal Design of Rods" in the International Journal of Solids and Structures (2000). Two further related papers have been accepted for publication. He may be reached by e-mail at warner@aem.umn.edu

Three New AEM Faculty Members

Professor Mehran Mesbahi joined the AEM faculty as an Assistant Professor in January of 2000. Professor Mesbahi's research interest is in system theory and control, particularly as applied in the design of distributed space systems. He has contributed to the theoretical and algorithmic foundations of the matrix inequality approach to the dynamic system analysis and synthesis, distributed decision making, and parallel optimization methods. Over the last few years, Professor

Continued on next page

Mesbahi's research has been concerned with the development of robust reconfigurable control and estimation algorithms for formation flying of multiple spacecraft. Another area of Professor Mesbahi's research is in the development of a set of analytic and algorithmic tools for designing high performance hybrid systems- systems that evolve according to an interaction between discrete (logic-based) and continuous dynamics.

Professor Ashley James will be joining the AEM faculty as an Assistant Professor in August of 2000. Professor James' primary research interests are in interfacial fluid flow and computational fluid dynamics. Her main area of concentration has been the vibration-induced breakup of a liquid drop. Other directions include the analysis of interfacial flows in industrial applications, the development of improved computational methods for interfacial flows, and basic research into the small-scale physics of interfacial breakup and coalescence.

Professor James Received her PhD from Georgia Tech in Mechanical Engineering in 2000, and her BS in Mechanical Engineering from the University of Florida in 1990. She worked for 3 years at Westinghouse Electric after receiving her BS.

Professor Krishnan Mahesh will be joining the AEM faculty in November of 2000. Professor Mahesh's primary interest is the computation, analysis, and modeling of fluid flows. Examples of his work include simulating the interaction between shock waves and turbulent flows, developing numerical algorithms for direct numerical, and large eddy simulation, and modeling the phenomenon of vortex breakdown. Professor Mahesh is currently developing a numerical method, and models to simulate turbulent reacting flows in realistic engineering geometries. Another area of current interest is plasma assisted materials processing, where the objective is to develop a robust, accurate numerical tool to study the plasma reactors used in semiconductor processing.

Professor Mahesh received his PhD and MS in Mechanical Engineering from Stanford in 1996 and 1990 respectively. He received his B. Tech. in Mechanical Engineering from IIT Bombay in 1989. He served as Research Associate at the Stanford Center for Turbulence Research before joining our faculty.

HONORS, AWARDS AND PRESENTATIONS

Professor Gary Balas received the Outstanding Young Investigator Award, ASME Dynamic System and Control Division in the Fall of 1999. The DSCD Outstanding Young Investigator Award is given biannually by the Dynamic Systems and Control Division of ASME to a DSCD member under 40 who as a mechanical engineering professional has demonstrated outstanding research contributions, either basic or applied, to the fields of interest to the DSCD.

Professor Perry Leo received the Outstanding Professor Award from the Institute of Technology Student Board at the University of Minnesota.

Professor William Garrard was elected to the Board of Directors of the National Space Grant Alliance.

Professor Richard James was the Rothschild Visiting Professor at Cambridge University Fall of 1999. He also received a Focus Grant from the National Science Foundation to do research on biomedical MEMS (micro-electro-mechanical systems). This involves exploring the use of ferromagnetic shape memory (and related) materials, powered remotely by magnetic fields applied external to the body, to run microscale actuators for non-invasive surgery and drug delivery.

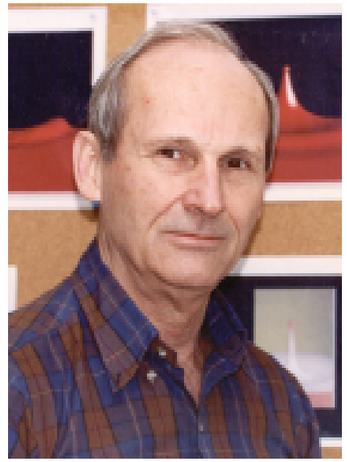
Dr. Raffaella Rizzoni, Dipartimento di Ingegneria at the Universita' di Ferrara, a frequent postdoctoral visitor to the Department who works with Professor James on active thin films and microactuators, received the "Best Poster of the Conference" at the EuroMech Congress in 2000 for her poster on pressurized thin films.

Professor Daniel Joseph received the FLUID DYNAMICS PRIZE OF THE AMERICAN PHYSICAL SOCIETY 1999.

Professor Ivan Marusic received a National Science Foundation Career Award. His project is entitled, "A Physical Modeling Approach to Wall Turbulence and Enhancing the Educational Experience Through the Beauty of Fluid Motion." The project will provide an educational plan for undergraduates and graduates with relevant and inspiring courses, together with a strong research experience; and second, promote the physical sciences by bringing the field of fluid mechanics closer to pre-university students. The first phase will involve teaching techniques for lectures that includes a laboratory component. The second phase includes high-school teacher workshops on using interactive flow visualization exhibits. Project collaboration will be done with both Minneapolis and St. Paul schools and other K-12 University of Minnesota units.

Professor Marusic also received a McKnight Land-Grant Professorship. It runs from July 1, 2000 to June 30, 2002. Professor Marusic's research is in fluid dynamics, with a focus on turbulent flow near solid surfaces. His main goal is to understand the underlying physical mechanisms that self-sustain wall turbulence. Understanding turbulence is important in many technological fields ranging from aerodynamics of aircraft to microelectronic mechanical systems.

Professor Thomas S. Lundgren Retires



Thomas S. Lundgren was born in Omaha, Nebraska in 1931 and was raised in Indianapolis, Indiana where his father managed an advertising agency. He was educated at the University of Minnesota earning a BS in 1954 and a MS in 1956 from the Aeronautical Engineering Department (now Aerospace Engineering and Mechanics) and a PhD in Fluid Mechanics in 1960. After graduating, he joined the Aeronautical Engineering Department as an Assistant Professor. The ranks of Associate Professor and Full Professor followed in 1963 and 1965. Professor Lundgren was highly regarded and a popular teacher of advanced courses in fluid dynamics, many of which he introduced into the curriculum. These courses were popular with students of fluid mechanics from all departments. Many of his students have advanced to high prominence and his influence is felt by a generation of leading fluid mechanists from Minnesota.

Professor Lundgren benefited from Sabbatical leaves at the California Institute of Technology, the National Center for Atmospheric research and at NASA Ames Research Center, where he has maintained close ties.

His research has been in theoretical fluid mechanics. He has written numerous papers in vortex dynamics, turbulence and in free surface hydrodynamics. He is best known for two seminal works; Distribution Functions in the Statistical Theory of Turbulence, Physical Fluids (1967) and Strained Spinal Vortex model for Turbulent Fine Structure, Physical Fluids (1982). He is widely regarded as one of the few world leaders in the theory of turbulence. He was elected a fellow of the American Physical Society for his contributions in 1998. Professor Lundgren is retiring after 50 years at the University of Minnesota, 40 of them as faculty member.

Minnesota Space Grant Consortium

Experimental Study Group: In spring semester 2000, the Minnesota Space Grant had a trial run of an Experimental Study Group for students enrolled in one of our AEM service courses, Deformable Body Mechanics (AEM 3031). The Study Group introduced different learning strategies for the students involved and, utilized some of our own AEM graduate and undergraduate students as group leaders.

Advanced STEPS camp for girls: A program funded by the Society of Manufacturing Engineers Education Foundation (SMEEF) and the Bush Foundation is designed to give women and minorities a better chance of becoming engineering heroes. The program entitled STEPS (Science Technology & Engineering Preview Summer) is a summer camp program which is the nation's first coordinated and integrated approach to attracting girls and minorities into careers in manufacturing and technology. Its concept is to reach girls early enough to influence their choices of math, science and technical courses in middle and high school and, to prepare them to succeed in college level engineering programs. This year, the University of Minnesota sponsored the first senior high level camp called Advanced STEPS that featured a rocket payload and launch. Faculty from the Department of Mechanical Engineering and Aerospace Engineering, designed and implemented the curriculum for the camp. Graduate and undergraduate students from each of the two departments assisted with pre-launch, and post-launch activities each week, including the assistance of Ky Michaelson, alias "The Rocketman," a professional pyrotechnician in the Twin Cities area. The University of St. Thomas, and Alexandria Technical College hosted the junior high STEPS camps that will feed into the Advanced STEPS camps at the Univeristy of Minnesota next year.

The 1999-2000 Annual MnSGC Undergraduate Student Research Symposium was held at Augsburg College and Bemidji State University on April 14 and 19 respectively this year. There were featured speakers, student research-paper and research-poster presentations to highlight the successful and informative symposium at each of the schools.

Exchange Visitor Program

Beatrice Belletti, a graduate student at the University of Parma in Parma, Italy, visited the laboratory of Professor Shield for two months this spring. She studied microscopic moire interferometry methods that Professor Shield uses to measure surface strains on single metallic crystals. Ms. Belletti hopes to apply similar methods to study the micromechanics of concrete as part of her post-graduate research.

Jo Einar Emblemsvåg is a Fulbright Scholar from Norway. He came to the Department in August 1999 as an exchange student. He applied to and was admitted to the graduate program in Aerospace Engineering and Mechanics, where he is now studying.

Professor Toshio Funada returned to the Department for two short periods in late 1999 and early 2000. The Ministry of Education, Science and Culture in Japan provides travel grants and maintenance for Dr. Funada's research travels. Again, he collaborated with his faculty sponsor here, Professor Dan Joseph, continuing their research on topics related to solid-liquid flows and cavitation.

Arnauld Loyer is an exchange student visitor from Paris, France. He is working together with Professor Ellen Longmire and Professor Ivan Marusic on their project concerning the acquisition of stereo PIV measurements in turbulent boundary layers. The work Mr. Loyer does here will help to fulfill degree requirements at his school, Ecole Centrale de Nantes in France.

New Departmental Postdocs and Other Academicians

Dr. Matthew McCarthy was a visiting Professor in the Department during Fall Semester 1999. He taught two of our service courses, AEM 2012, Dynamics and the combined course AEM 2021, Statics and Dynamics. He came to us from the National University of Ireland at Galway where he is a Professor of Mathematical Physics. His research work has included the study of wave propagation in composite media, as well as with the scattering of elastic waves by obstacles of finite size.

Dr. Gianni Royer has been a visiting scholar to the Department several times since 1994. In Spring Semester 2000, Dr. Royer taught our Dynamics course AEM 2012 both in day and night school. He is an Assistant Professor in the Department of Civil Engineering at the University of Parma, Italy.

Dr. Jorge Tierno who is currently a Principal Senior Research Scientist at Honeywell Technology Center in Minneapolis, taught AEM 4311, Automatic Control Systems for the Department in Fall Semester 1999. Dr. Tierno received his PhD degree in Electrical Engineering from the California Institute of Technology in Pasadena. His research at Honeywell Technology Center has recently included serving as Principal Investigator for the AFOSR program Techsat21, under which algorithms for management and control of closely spaced satellite clusters were developed.

Maria (Pino) Martin-Aquirre, completed her PhD in the spring of 1999 and was hired as a postdoctoral associate to work with Professor Graham Candler on his research project on the direct numerical simulation and large-eddy simulation of turbulent reacting flows.

Robert Tickle, completed his PhD, Spring 2000, and was hired as a postdoctoral associate to work with Professor Richard James on his research project on ferromagnetic shape memory materials at large and small scales.

Chris Mitchell completed his MS degree in Aerospace Engineering, Spring 2000 and was hired as a Research Fellow to work with Professor Gordon Beavers in conducting shock tube experiments to study the aerodynamic breakup of thickened simulants under conditions corresponding to high-altitude intercepts of missiles. His work also includes the development and carrying out of experiments to study the outgassing and gas reabsorption characteristics of thickened simulants.

Student Awards

1999-2000 IT Honors Undergraduate Scholars supported by the Minnesota Space Grant Consortium
Sterling Williams and Philip Swenson

2000-01 AEM Graduate School Fellowship
Hong Yang

2001-01 AEM Graduate Doctoral Dissertation Fellowship Konstantinos Hennighausen

2001-01 AEM Graduate Doctoral Dissertation Fellowship
Daniel Khalitov

2000-01 CSDY Graduate National Science Fellowship
Matthew Montminy

2000-01 University of Minnesota Minnesota Space Grant Consortium Scholarships
Kirsten Quanbeck and Julie Zogg

Matt Carper, AEM graduate student, won a Fulbright Fellowship for study in Norway.

Travis Schauer, AEM undergraduate student, won an Astronaut Fellowship.

Degrees Awarded 1999-2000

Bachelor of Aerospace Engineering and Mechanics

BAEM

Johan Christian Bakken
Scott Douglas Bartelt
Cristopher Russell Blattner
Sara Jean Brandenburg
Mark Joseph Effertz
Abbey Elizabeth Eichman
Keith Eugene Hedin
Bradley John Herzberg
Johan Mark Hoff
Tom Asle Hompland
Brad James Kelly
Stephen Woon Hey Kwong
Chad Earl Martin
Jeffrey Jason Miller
Carlos Mostek
Michael John Olson
Shea Donald Peterson-Burch
Jamison Keith Roman
Kasey Susan Roskopf
Scott Michael Schuh
Erick Olof Swanson
Ryan Swanson
Chad M. Wernlund
Reagan Kirkbride Woolf

Master of Science

MS (Mechanics)

Armando Pereira	12/99
Jun Cui	2/00
Mike Egorov	5/00

MS (Aero)

Chris Mitchell	6/00
Jacob Hageman	9/99
Nina Tortosa-Boonaker	12/99
Jack Ryan	2/00
Manoj Nagulapally	11/99
Kosti Hennighausen	1/00
Gunnar Einarsson	1/00
Stamatios Pothos	6/99
Timothy Norman	12/99
Subhabrata Ganguli	5/00
John Callan	7/00
Firat Testik	7/00
Travis Smieja	8/00

Doctor of Philosophy

PhD (Aero)

Jeff Barker	11/99
Keith Stein	12/99
Pino Martin	7/99
Heath Johnson	6/00

PhD (Mech)

Eric Carlson	9/99
Rob Tickle	5/00

Special Sethna Lecture*

Professor Ronald L. Adrian gave the special Sethna Lecture on April 27th on Large-scale Structures Created by Small-scale Motions in Wall Turbulence: The Energy Cascade Reversed.

Professor Adrian is a member of Department of Theoretical and Applied Mechanics at the University of Illinois, Urbana-Champaign where he holds the Hoeft Chair in Engineering and is the Director of the Laboratory for Turbulence and Complex Flow. His research interests are the space-time structure of turbulent fluid motion and the development of techniques, both experimental and mathematical, to explore this structure. Methods to which he has made fundamental contributions are the laser Doppler velocimeter technique, the method of particle image velocimetery and the stochastic estimation method. Currently, he serves as Associate Editor of Journal of Fluid Mechanics. He is a Fellow of the American Physical Society and a member of the United States National Academy of Engineering.

*The Sethna lecture is supported by funding from the AEM Excellence Fund.

ALUMNI HIGHLIGHTS

Dr. Stuart Antman (PhD, Mechanics 1965) received the 1999 Theodore von Karman Prize of the Society of Industrial and Applied Mathematics for his work on Nonlinear Elasticity of Rods, Plates and Shells. (He shared the prize with John Ball of Oxford University, who has collaborated with Professor Richard James.) The prize is given every five years for a notable application to mechanics of the Engineering Sciences. Dr. Antman is a Professor of Mathematics at the University of Maryland.

Dr. James Licari (BS 1965, MS 1967, Mechanics and Materials, PhD 1970, Mechanics and Materials) has retired from IBM in Rochester and joined the University's new Digital Technology Center as Assistant Director for Industrial Liaison. More information on the IT Digital Technology Center can be found at: http://www.it.umn.edu/walter/.

Col. Jeffrey Koss (BS, ME 3/80; MS 8/81) is with the Air Force in Melbourne, FL. He is the Director of Engineering for the STARS Joint Test Forces.

Col. Tom Konicke (BAEM 6/80; MS 8/81) and family left Albuquerque, NM for an F-15 flying job in Anchorage, AK. Col. Konicke is currently in requalification training for F-15s and should be finished in late November.

Jon S. Berndt (BAEM 1986), is a senior software engineer and team lead at Coastal Flow Measurement, Inc., in Houston, TX. Currently, he is participating in the development of electronic gas measurements data management software (to be used by such companies as Alliance Pipeline and Coastal Corporation). Prior to 1999, he had been supporting space shuttle and space station training simulators for various NASA contractors. He is keeping his feet wet in the simulation arena by participating in the open source, multi-platform, flight simulator software development project called FlightGear (www.flightgear.org) which has a strong Minnesota connection. Jon has a home page on the web at www.hal-pc.org/~jsb and can be contacted via email at jsb@hal-pc.org.

Karl Rink, a 1983 BAEM graduate, went on to receive his MS in Mechanical Engineering at Purdue, graduating in 1986. After a couple years of work, he returned to school to earn his PhD in Mechanical Engineering at the University of Utah in 1993. He is currently a Manager of Compressed Gas Research at Autoliv Automotive Safety Products in Ogden, Utah. Autoliv is the world's largest manufacturer of automotive safety restraint systems (airbags, airbag inflators, seat belts, initiators and more).

ALUMNI NEWS

Robert Jewett, a 1931 AEM Alumus passed away in May of 2000.

Robert Gilruth, a 1935 BS and 1936 MS Aeronautical Engineering, AEM alumnus passed away August of 2000.

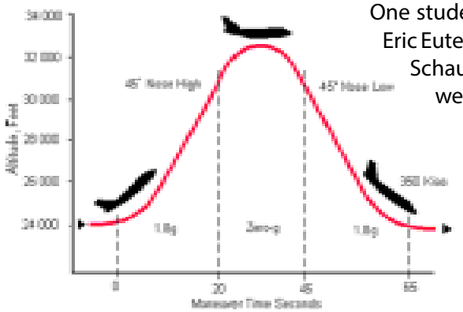
New Alumni Resource Addition

We have added a section on our AEM Web page for alumni at http://www.aem.umn.edu/alumni/. As part of this process, we are also creating an Alumni Network section, where you can place information about where you are, etc. and update as needed. This will be formally rolled out this next year.

AEM STUDENTS TO PARTICIPATE IN MICROGRAVITY EXPERIMENTS

For several years NASA and the Texas Space Grant have sponsored an opportunity for students to participate in reduced gravity flight experiments (see web site at http://www.tsgc.utexas.edu/floatn/) . In the spring of 2001, two teams from the University of Minnesota will participate in this opportunity. The students are designing experiments to be performed on the NASA KC-135 aircraft, which is used for astronaut training, as well as experiments, which require short periods of reduced gravity. The students will travel to Texas to undergo training and perform their inflight experiments while the aircraft is performing maneuvers which produce microgravity for about 30 seconds. The flight path of the aircraft is like a roller coaster and student will experience relatively large "g" forces as well as reduced gravity, so the ride should be very exciting.

Students of Houston Community College Northwest prep for their inflight experiment done April 2000 (NASA).



One student team is comprised of Eric Euteneuer, Cecilia Ortiz, Travis Schauer, and Christopher Teeuwen whose project is entitled Study of Pinch-Off and Reconnection of Liquid-Liquid Flows in Micro- and Macro-Gravity. Professor Ellen Longmire is mentoring this team. The other team is comprised of Jeffrey Rollings, Dakri Nelson, Nick Velander, Tim Jackson, and William Hambleton. Their project is Nitinol Vibration Damping in Microgravity. (Nitinol is an alloy which is has damping properties which may be useful in space applications). Professors William Garrard and Thomas Shield mentor this team. Check out the departmental web site for updates on these projects.

Senior Capstone Design Class

PROJECT "VOLCAN": AIRCRAFT DESIGN

MISSION STATEMENT: Design a four-place airplane for the low cost business market. The airplane will cruise at 230 knots TAS at 8,000 ft with 800 NM range plus IFR reserves. The airplane will meet FAR Part 23 requirements.

The Aircraft Team designed a four-place airplane and was organized into five disciplines led by two project managers. The System Layout/Weights discipline used Pro/ENGINEER software to physically integrate all the airplane components: several different cabin layouts were considered until the optimal arrangement was found. They used a weight-and-balance spreadsheet to locate components such that the final airplane weight-and-balance was within the Aerodynamic allowable weight-and-balance limits 3625 lbs maximum takeoff weight.

The Aerodynamics discipline determined the allowable weight-and-balance limits by examining longitudinal static stability and control characteristics. Airplane configuration was also chosen to meet performance criteria. The airplane ended up with a 34 ft wing span and 29 ft length. The Structures discipline researched new composite materials and new construction methods to fabricate the aircraft. Pro/ENGINEER was used to design a retractable tricycle landing gear.

The Cockpit Systems discipline was responsible for selecting and arranging the airplanes avionics, controls and other systems which require pilot interface.

Each student was required to actively participate in their chosen discipline and meet as a team on a weekly basis to present and discuss design issues. The Project Managers organized and conducted these meetings. The aircraft team successfully presented their design at a formal Conceptual Design Review at the end of Fall Semester.

The Aircraft Design Team was reorganized during Spring Semester into the following groups: Windtunnel Group, Structures Group, Cabin Mockup Group, Radio Controlled (RC) model group, and Data Acquisition group for the RC model.

The Wind tunnel test group consisted of four students, who built an 8 % scale wind tunnel model of the Vulcan and tested it in the AEM 38 x 54

Aircraft Design Team AY 99-00 (left to right): Hamed Kebriaei, Stephen Kwon, Wade Willams, Tim Jackson (far back), Chris Italiano, Sara Brandenburg, Erick Swanson, Lorenzo Locante, Lisa Parkin, Jo-Einar Emblemsvåg , Dan Hitchcock, Abbey Eichman, Johan Bakken, Tom Hompland, Scott Munson, Colin Kerelchuk.

inch re-circulating wind tunnel. Pro/ENGINEER was used to NC machine the airplanes wings, horizontal stabilizer, and a left/right side male mold of the fuselage (vacuum formed with hot plastic). They successfully determined that the airplane was longitudinally stable and controllable. Flow visualization around the aircraft was also done in order to compare the flow pattern to the experimental data. The Structures group consisted of two students, who built a half scale wing using Hexcel composite material in order to evaluate the wing under different loading conditions. The cabin mock-up group consisted of four students who built a full scale mockup of the airplanes interior including the cockpit and the instrumentation panel to evaluate human ergonomics, the chosen seating configuration, and to minimize cabin cross-section. The instrument panel was modeled using X-Plane simulation software.

Five students built a ¼th scale RC model with the goal of flying it by the end of Spring semester. The students used Pro/ENGINEER and NC machining to fabricate parts for a conventional RC model construction (balsa wood with monocote covering)

The Volcan design team paused after a successful day at the Jensen Airfield field with Toni Riga (third from left).

A Data Acquisition System (DAS) group of two students used a data logger data acquisition system along with sensors to measure dynamic pressure, angle of attack, normal acceleration, and elevator throttle and position. The other responsibility of the DAS group was to make sure that the data acquisition unit did not interfere with the pilots control input. All aircraft testing and flying was done at Jensen airfield in Rosemount, Minnesota. Toni Riga from the Tri-Valley Flyers RC club volunteered to be their pilot because the students had limited experience flying radio controlled models.

Building the 1/4th Scale model: Dan Snyder, Scott Munson, Johan Bakken, Wade Williams.

The RC team took several trips to Jensen airfield. The first trip to Jensen airfield was to break in the engine. The second trip to Jensen field was to perform high-speed taxiing. On the first flight Toni carefully brought the RC model to five feet off the ground for a distance of approximately 50 feet. The RC model touched down and quickly cut to its right, shooting off the runway and into some corn stalks. The damage was minimal and the propeller was broken.

After adding twist to the wing, and fixing the minor damage, the RC model was ready for its next flight. The plan was to fly a racetrack pattern around the runway. The takeoff was successful. The RC speed was an estimated 25 mph and then climbed to an estimated altitude of 40 feet. The RC model then lined up with the runway and glided in to a perfect three-point landing. The RC model was a success.

Senior Capstone Design Class
PROJECT "PILE-DRV":
PROBE INVESTIGATING LIFE ON EUROPA – DEEP RAMMING VEHICLE

MISSION STATEMENT: Travel to Jupiter's moon Europa, penetrate the surface, and conduct experiments to determine whether life exists either in or below the ice crust.

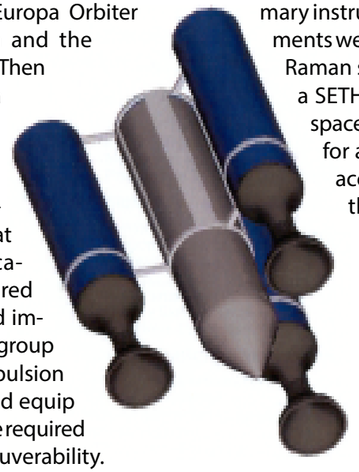
As in the previous academic year, the spacecraft senior design team did a project to parallel one of the many Jet Propulsion Laboratories (JPL) initiatives. The images of Europa that NASA's Galileo spacecraft recently sent back to Earth have triggered extensive debate on the possibility of a subsurface ocean underneath the European ice. A remarkable lack of craters suggests that the surface is relatively young. Geographical formations that resemble drifting icebergs, frozen "puddles" and ice ridges suggest that at least at some point in time liquid water came to the surface of the planet. The possible existence of liquid water naturally raises the question of whether any evidence of life can be found there. JPL is working on the Europa Orbiter scheduled for launch in 2003. The mission of the Europa Orbiter is to determine whether a subsurface ocean exists and if so, determine its characteristics.

Spacecraft Design Team AY 99-00 (left to right, kneeling): Junwon Kang, Brian Mader, Keith Hedin; (standing) Chad Wernlund, James Kovarovic, Stephen Rosenbaum, Matt Rust, Kelly Randall, Scott Bartelt, Ryan Tiaden, Cris Blattner, Ryutaro Koyama, Johan Hoff, Stephen Balistreri, Jeff Miller.

In conference with JPL the students of the 1999/2000 spacecraft design team decided to design a probe, named PILE-DRV, that could "piggy-back" the Europa Orbiter. This probe is designed to separate from the Europa Orbiter upon reaching the Europa orbit, and penetrate 10–20 meters into the ice of the planet. A drill designed to obtain a core sample of the ice is provided to look for evidence of life. The probe is equipped with communications to transmit data back to the Europa Orbiter.

The objective of Fall semester was to develop a conceptual design for the spacecraft. The spacecraft design team was organized into 6 disciplines. The Orbiter/Vehicle Integration discipline was responsible for placing the probe on the Europa Orbiter in such a way that any inter

ference with the operation of the Europa Orbiter would be avoided. This involved developing a way to separate from the orbiter without changing its trajectory significantly. Furthermore, this discipline was responsible for integrating the PILE-DRV's components. Pro/ENGINEER was an important tool in this process. Braces were designed to attach the propulsion module to the penetrator in such a way that the penetrator could break free from the propulsion module prior to impact with Europa. The Orbital Mechanics/Impact Trajectory discipline looked into the trajectory chosen for the Europa Orbiter to reach Europa and the final Europa orbit. Then they developed a trajectory that would bring the probe from this orbit to impact the planet at a promising location with the desired impact angle and impact velocity. The group developed a propulsion system that would equip the probe with the required power and maneuverability.



The Impact Ballistics and Structure disciplines designed a probe that would penetrate into the surface. Their design had to be lightweight, but with properties to protect the experiments inside from being damaged by the impact with the ice. The Environmental Protection/Power and Heating/Communications discipline were responsible for all the systems on-board the spacecraft. The probe was designed to carry experiments that needed to stay at a comfortable temperature in order to be functional. In addition, the probe needed to be protected from harmful radiation from Jupiter and its moons. Since the probe would be as much as 20 meters below the planet's surface, the design of the communications system proved to be a challenge. Much effort was put into developing a robust design. The Experiments discipline selected what instruments to bring in order to learn as much as possible about the Europa environment to ensure a successful mission. The primary instruments for experiments were a microscope, a Raman spectrometer and a SETH cigar. Additional space would be allotted for a seismometer, an accelerometer and a thermometer. The discipline decided that a drill would be the best way to collect a sample of the ice. Two project Managers were selected to keep the team on task and moving forward according to the timeline.

The team was reorganized into project groups for Spring semester to conduct selected tests of the conceptual design. The projects were the following: to build a full-scale model with some functional parts, to perform impact tests, to create a video of the mission and to develop a simulation of the trajectory.

Vehicle Integration/Weights Team: Scott Bartelt, Cris Blattner.

Each project group learned to optimize the conceptual design from the Fall semester. The finished design is approximately 1 meter long, the probe diameter about 17cm and the diameter of the vehicle with thrusters attached about 53cm. The total mass of the vehicle is approximately 100kg.

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.

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.

Recent Research Projects of AEM Professors

Air Force Office of Scientific Research

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

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

Analysis, Design, and Computation of Active Materials
Richard James & Mitchell Luskin

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

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

Robust Nonlinear Control Theory as the Applications to Aerospace Vehicles (with CalTech)
Gary Balas

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

Advanced Methods for Interceptor Flow Simulations
Graham Candler

Aerodynamic Breakup, Cavitation, & Rupture Fluids
Daniel Joseph

Aerodynamic Breakup of Liquids (with Battelle Memorial Institute)
Daniel Joseph & Gordon Beavers

Break-up of Viscoelastic Liquids in High-Speed Air Flow
Daniel Joseph

Design, Modeling and Computation of Active Thin Films
Richard James & 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 Nonequilibrium Rocket Motor Plums
Graham Candler

Simulation of TMD Flowfields
Graham Candler

Two-Phase Flows of Rheologically Complex Fluids
Daniel Joseph

Department of Energy

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 & Ellen Longmire

DiaSorin, Inc.

Flowcell Investigation
Daniel Joseph

The Hoechst-Celanese Company

Study of Spinning Rod Interfacial Tensionometer used to Measure Polymer Bands
Daniel Joseph

National Aeronautics and Space Administration (NASA)

Development of the Space-Time CE/SE Method for Large Eddy Simulations of 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 (NASA Headquarters)
William Garrard

Nonlinear Feedback Control of Aircraft Propulsion Systems (Lewis)
William Garrard & Gary Balas

Numerical Simulation of Atmosphere Entry Flows
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)

Regional Mechanics of Injured Lungs (with Mayo Foundation)
Theodore Wilson

Respiratory Action of the Intercostal Muscles
Theodore Wilson

Respiratory System Mechanics (with Baylor College of Medicine)
Theodore Wilson

National Science Foundation

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 & Sue Mantrell

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

Nonlinear Control of Systems with Relative Equilibria
Thomas Posbergh

Nonlocal Models in the Mechanics of Materials
Roger Fosdick

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

Studies of Reservoir Stimulations, Drilling, Transportation, Emulsion Stability and Foaming Bubble Reactor
Daniel Joseph & Gordon Beavers

Transitions and Defects in Ordered Materials
Richard James & Mitchell Luskin

Office of Naval Research

Investigation of Ferromagnetic Shape Memory in Heusler Alloy
Richard James

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

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

Exxon Mobil

Lubricated Transport Chad Oil
Dan Joseph

Schlumberger Dowell

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

1999-00 FACULTY & STAFF

Regular Faculty

Professors
Gordon S. Beavers
Graham V. Candler
Roger L. Fosdick
William L. Garrard
Richard D. James,
Distinguished McKnight
University Professor
Daniel D. Joseph,
Russell J. Penrose Professor,
Regents' Professor
Thomas S. Lundgren
Theodore A. Wilson

Associate Professors
Gary J. Balas
Perry H. Leo
Ellen K. Longmire
Lev Truskinovsky
Thomas W. Shield
Yiyuan Zhao

Asistant Professor
Ivan Marusic
Mehran Mesbahi

Akerman Professor of Design
Andrew Vano

Adjunct Associate Professor
Dale F. Enns

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

Associate Professor Emeritus
Eugene Stolarik

Temporary Faculty

Assistant Professor
Leonard Imas
Yohannes Ketema
Mathew McCarthy
Gianni Royer
Jorge Tierno

Research Staff

Postdoctoral Associates
Runyuan Bai
Hyung Gwon Choi
Kevin Hane
Yi Jian Huang
Heath Johnson
Pino Martin
Robert Tickle

Research Associates
Antonio Fortes
Leonard Imas
Qi Pan
Neelesh Patankar
Thomas Posbergh
Ram Rao
Xiaoyen Wang
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
Ellen Longmire

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.

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

This brochure is printed on recycled paper containing 10% post-consumer waste.

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

Nonprofit Org.
U.S. Postage
PAID
Minneapolis, MN
Permit No. 155

Address Service Requested