NEWSLETTER FOR ALUMNI, FRIENDS & STUDENTS

SPRING 1999

THE STREAMLINE

AEROSPACE ENGINEERING, MECHANICS & ENGINEERING SCIENCE

Chairman's Letter

Dear Readers:

Our department conducted a survey last November and December. In the following, we offer you a summary based on the responses received to date. If you have not responded, we would like to invite you to do so via the Internet at the address *http://www.aero.ufl.edu/survey98/*. Your input will help us update our database for further assessment. We will keep you informed as we continue our effort in the future. We also thank **Drs. M. Eisenberg**, **N. Fitz-Coy**, **U. Kurzweg** and **Delores Krausche** for making important contributions to this activity. Best regards,

Wei Shyy, Professor & Chair

ANALYSIS:

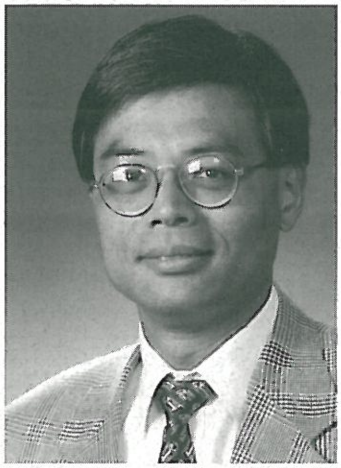
The AeMES's '98 Alumni Survey

The survey sought feedback concerning general aspects of the learning environment as well as the evolution of the curricula. There were 144 total responses to the survey: 108 from ASE (aerospace) alumni, 32 from ENS (engineering science) alumni. This summary presents the highlights of the results.

The *Learning Environment Agreement* was assessed for ten positive statements concerning curricula, teaching, advisement, faculty competence, staff helpfulness, nurturing environment, etc., on a scale in which 1 corresponded to strong agreement, 3 to neutral, and 5 to strong disagreement. Both groups expressed a positive view of their experience. ASE alumni rated the department, college, and university environments as 1.94, 2.03, 2.20, respectively. ENS alumni responded 2.17, 2.31, 2.38, respectively.

The *Curricula Scores* for traditional curricula elements (math, science, humanities, foundation topics in engineering) ranged from 2.98 to 2.82 on a scale of 1 to 5, 1 being too little, 3 being about right, and 5, too much. For major course work, the scores ranged from 2.75 to 2.69. Scores for topics such as teamwork, management, and skills in communications ranged from 2.41 to 2.10.

There were no statistical differences in responses from ASE and ENS alumni. In no category did respondents consider that requirements to be too great. Rather, the results indicate that respondents prefer to add more topics to the curricula. The remainder of the survey consisted of open questions. Response from both the ASE and ENS alumni followed the same trends concerning the curriculum.



Dr. Wei Shyy

* Respondents generally agreed with the direction of the Department's recent curricular revisions with a ratio of about 2:1 to those who thought that there was still a need for a stronger foundation or expanded program.

* The same ratio of respondents (2:1) considered it prudent to integrate additional topics into the curriculum rather than to create new courses.

* Many expressed suggestions to add topics in management and communication, presentation and team building skills, and to include more practical applications, design projects, CAD. There was also a strong sentiment of teaching a different computer language than Fortran.

* The needs for better communication and mentoring by faculty and more interactions with industry, via co-op programs or lectures, were also suggested. We agree with these qualitative comments, and have been making consistent efforts. For example, we regularly host visitors from industries and government agencies to visit and interact with faculty and students. We also have strong collaborative activities with many major companies including GE, Pratt & Whitney, Kimberly Clark, Johnson & Johnson, Ford,

Highlights

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Millsaps-Taylor Lecture in Feb. 2000
S. Nemat-Nasser,
University of California,
San Diego (see page 3).

UNIVERSITY OF FLORIDA

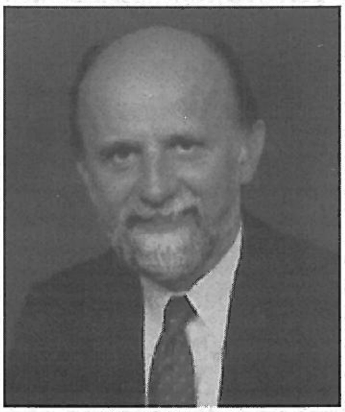
Boeing, Lockheed Martin, Emerson Electric, and Dresser-Rand. These companies encompass wide range of interests which overlap well with our Aerospace Engineering, Engineering Science, and Mechanics degree programs.

It is clear that teaching students skills to prepare them to join the fast developing technological community is a real challenge. Furthermore, we strongly believe that any graduates from our programs should possess good appreciation of science and humanity, in addition to being exposed to the current social and economic issues. With your help and support, we are committed to develop the most appropriate teaching, research, and service activities.

Knox Millsaps Memorial Lecture

On 28-29 Jan '99, **Dr. Ted Belytschko**, Walter P. Murphy Professor of Computational Mechanics and Chairman of the department of Mechanical Engineering, Northwestern University, visited the AeMES department for two days. In 1992, Dr. Belytschko, a leading authority on the Finite Element Method (FEM), was elected to the National Academy of Engineering for the development of nonlinear finite element methods and their applications to large-scale simulation. During his visit, Dr. Belytschko spent time talking to the AeMES faculty and graduate students, and then delivered the 3rd Knox Millsaps Memorial Lecture titled *The Element-Free Galerkin Method for Crack Growth* on Friday, 29 Jan '99, to a fully packed lecture room 303 Aerospace Building.

The Element-Free Galerkin method (EFG) is a mesh-free method based on a moving least-square approximation, which is constructed using only a set of scattered points and a description of the boundaries. The method is very well suited to problems with moving boundaries, such as crack growth, since no remeshing is required to follow a crack. In his presentation, Dr. Belytschko retraced the history of the development of this line of method, which received several different names from different researchers: the smooth-particle hydrodynamic method that began with astrophysicists such as Lucy (1977) and Monaghan (1982), the diffuse-element method by French researchers such as Nayroles, Touzot, and Villon in 1992, the EFG method by Dr. Belytschko in 1994, the h-p cloud method by J.T. Oden, the finite-point method by Zienkiewicz and Taylor (1996). Dr. Belytsckho, who favors the acronym "EFG" because of its alphabetical order, recounted that someone once jokingly referred to this type of methods as "pointless" methods.



Dr. T. Belytschko

After a brief historical remark, Dr. Belytschko went on to describe the fundamentals of the EFG method along with some recent developments. He also described techniques for smoothing the functions in the vicinity of a crack tip and for enriching the approximation by singular functions. He then presented several applications of the EFG method to static and dynamic problems of crack growth, and compared the simulated results to experimental and analytical results. Figure 1 shows the geometry of a double cantilever beam, under tearing forces. The progression of the crack as computed by the EFG method is shown in Figure 2, where a cloud of points is seen to follow the crack tip. That is where the advantages of the EFG method compared to the FEM lie. On the other hand, according to Dr. Belytschko, it is unlikely that the EFG method will replace the FEM, since it is slower by three to eight times, compared to the FEM. Thus a combination of both methods (i.e., a marriage a' la mode between the EFG method and the FEM) offers the best alternative. Dr. Belytschko concluded his lecture by several video segments showing the animation of the computed crack growth. A flury of questions from the interested audience were addressed to him at the end of his lecture. Dr. Belytschko spent a pleasant Saturday in Gainesville, before returning to Chicago on Sunday.

Dr. Belytschko was born in the Ukraine, and followed his parents to Germany in 1944, before coming to Chicago in 1951, when he was eight years old. He still remembers the Allied bombing raids on the city of Worms, Germany, where his family was staying.

Dr. Belytschko received his Ph.D. from the Illinois Institute of Technology in 1968, and taught at the University of Illinois at Chicago until 1977. His research interests are in nonlinear finite-element methods and the simulation of prototype testing and other extreme environments, such as automobile crashworthiness, drop-test simulation and fracture of mechanical components. He has developed several approaches that are used frequently in nonlinear finite element software. His research contributions include implicit-explicit integration, partitioned and multi-time step integration, hour-glass control, localization limiters based on nonlocal theories and the identification of membrane locking. Recently, he has focused his effort on the development of meshfree methods. He recounted that his experience in developing the EFG method is as "exciting and exhilarating" as his earlier achievement in the late

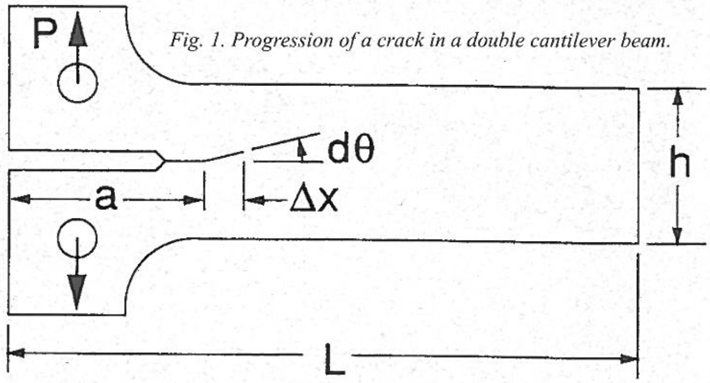


Fig. 1. Progression of a crack in a double cantilever beam.

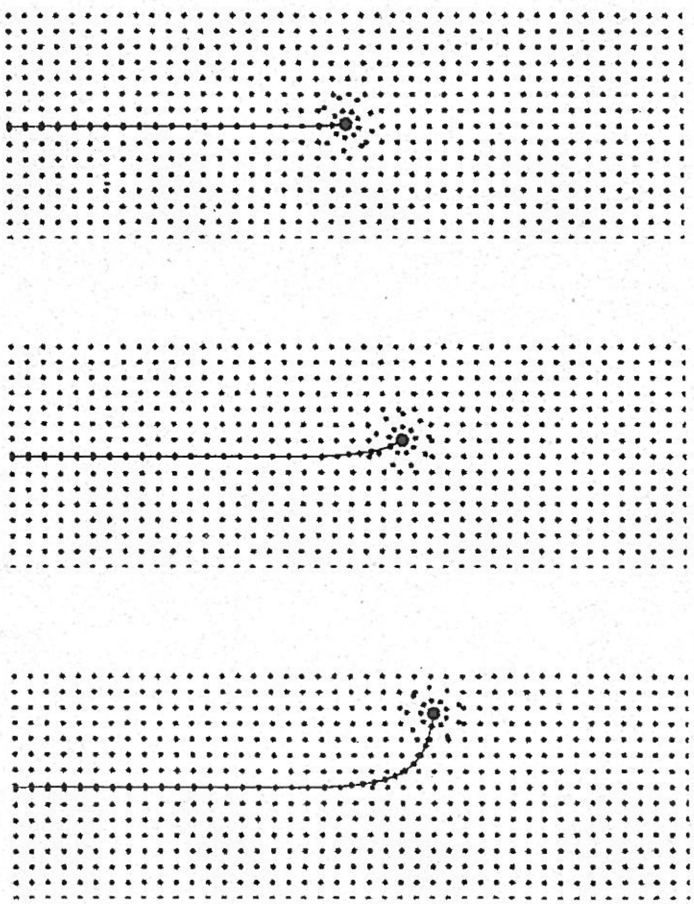


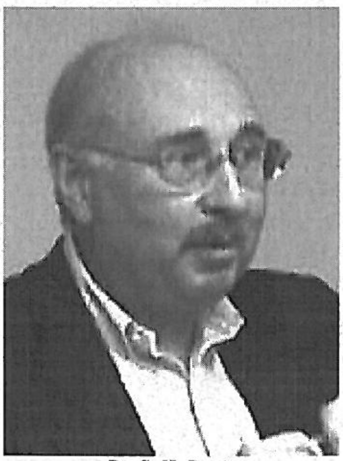
Fig. 2. Crack growth in a double cantilever beam modeled by a cloud of points.

'60s in developing the explicit FEM for automobile crashworthyness, while working at the IIT Research Institute.

With the retirement of the world-renowned Prof. O.C. Zienkiewicz, University of Wales, Swansea, UK, who is known as the "ambassador" of the FEM, Dr. Belytschko is the current co-Editor of the *International Journal for Numerical Methods in Engineering*, a reputable journal in computational mechanics. He is the past Editor of the *Nuclear Engineering and Design* and the *Engineering with Computers*. He has received the Pi Tau Sigma Gold Medal from the ASME, the Walter L. Huber Research Prize from the ASCE, the Thomas Jaeger Prize from the International Association for Structural Mechanics in Reactor Technology, the Computational Mechanics Prize of the Japanese Society of Mechanical Engineers, the ASCE Aerospace Structures and Materials Award, the Computation Mechanics Award of the International Association for Computational Mechanics and an honorary doctorate from the University of Liege. He is past Chairman of the Engineering Mechanics Division of the American Society of Civil Engineers, past Chairman of the Applied Mechanics Division of the American Society of Mechanical Engineers, and past President of the U.S. Association for Computational Mechanics.

24th G.I. Taylor Memorial Lecture: S. H. Davis

On 26 Feb '99, **Dr. Stephen H. Davis**, Walter P. Murphy Professor of Applied Mathematics and Mechanical Engineering at Northwestern University visited our department, and gave the 24th G.I. Taylor Memorial Lecture.



Dr. S. H. Davis

The title of Dr. Davis's presentation was "The Mechanics of Boiling". Dr. Davis is a world renowned fluid dynamicist working in the area of interfacial dynamics and stability. During the lecture, Dr. Davis gave an insightful analysis on the roles of fluid dynamics on the growth of the micro-scale bubbles associated with boiling heat transfer. Nucleate boiling depends heavily on the mechanics of the growth and collapse of a vapor bubble. In order to study the coupling between two thin films attached to the plates and the caps at their ends, a model was developed of a vapor bubble between two heated plates. The bubble dynamics is controlled by mass-transfer effects due to evaporation of the liquid and the condensation of the vapor. In one asymptotic limit, there is found to be a complicated nonlinear coupling with delay character between the profiles of the thin films and the overall bubble dynamics. By combining an elegant asymptotic analysis and numerical methods, non-monotomic growth of the bubble was predicted.

The seminar was attended by nearly 100 persons, and stimulated a heated discussion from the audience. During his visit, Dr. Davis also spent two days visiting various laboratories on campus.

Millsaps-Taylor Lecture

Starting next year, the Knox Millsaps Memorial Lecture and the G.I. Taylor Memorial Lecture are combined into a single lecture called the *Millsaps-Taylor Lecture*, which will occur once a year, before Spring Break. The goals of this lecture series are to invite exceptional scholars to (i) assess our research and teaching effectiveness, (ii) deliver stimulating lectures, (iii) enhance and promote personal interaction with faculty and students.

In Feb 2000, the Millsaps-Taylor lecturer will be **Dr. Siavouche Nemat-Nasser**, John Dove Isaacs Chair in Natural Philosophy and Professor of Applied Mechanics and Engineering Science at the University of California at San Diego. Dr. Nemat-Nasser is also the current Director of the Institute for Mechanics and Materials and the Editor-in-Chief of the international journal *Mechanics of Materials*. Dr. Nemat-Nasser's research covers a wide area, including the dynamic behavior of ductile materials; environmental effects and aging of polymeric composites; physically-based computational modeling of saturated soils; a new approach to structural reliability in fatigue failure; dynamic response, residual strength, and failure modes of rock, concrete, ceramic, ceramic/metal composites, and ceramics-metals-polymeric composite hybrids. His Millsaps-Taylor lecture will present new results on dislocation-based dynamic flowstress of metals over a temperature range extending from 77 K to 1300 K.

DEPT NEWS

Honors and awards

We congratulate **Profs. U. Kurzweg**, **B. Sankar**, and **Assist. Prof. P. Ifju** for winning *Teaching Improvement Program* (TIP) Awards. The TIP Award is a state wide program to recognize excellence in undergraduate and graduate teaching. Along with the recognition, the three faculty received a $5000 increase in their base salary. A reception was held in honor of all TIP winners at President Lombardi's Home. Out of the fifteen awards for the College of Engineering, three went to AeMES Faculty.

Prof. Pat Sforza, Director of the Graduate Engineering and Research Center (GERC), was a lecturer in the NATO Special Short Course on "Fluid Dynamics Research on Supersonic Aircraft" held at the von Karman Institute for Fluid Dynamics in Rhode-St-Genese Belgium on May 25th through 29th, 1998. The course was sponsored by the Applied Vehicle Technology Panel of NATO's Research and Technology Organization (RTO) through the RTO Consultant and Exchange Program and the von Karman Institute for Fluid Dynamics. Dr. Sforza was one of 11 invited lecturers from 6 countries; he presented two of the twenty lectures: "Vortex-Plume Interaction Research" and "Shock-Vortex Interaction Research".

Teaching activities

Undergraduate Curriculum Changes

During the past year, our curriculum has undergone significant changes. We have created several new courses, and added some new requirements for our B.S. programs. Above all, we have created a new *Combined BS/MS Program*, which will allow qualified students to obtain a Master's degree within five years of their study.

For the BSAE program, while Chemistry II is no longer a required course, Computer Aided Graphics and Design, an ME course, has become a required course. The CAD course was added because of suggestions made by a large number of alumni who felt that an earlier training in CAD could make our graduates competitive in the job market. Elimination of Chemistry II is unfortunate; we did not have much choice but to work with a total of 128 credit hours for the program. Students can, however, use Chemistry II as a science elective. The Aerodynamics course has gone through some changes. We have added a new course called Aero-Thermal Processes.

For the BSES program, the only major change is the addition of the above mentioned CAD course as a requirement. We were able to maintain the total credit hours at 128 by trimming hours in other design courses. Four new undergraduate Biomechanics courses have been created and/or regularized: Fundamentals of Biomechanics, Bone Mechanics, Bio-Fluid Mechanics and Bio-Heat Transfer and Bioengineering Physiology.

All past instrumentation and laboratory courses have been combined into a two-course sequence: Experimental Methods I & II.

The combined BS/MS degree program would allow qualified students to earn a BS degree in AE/ES and a corresponding MS degree with savings up to 6 credit hours. Qualified students would be allowed to begin MS degree course work in their senior year and to double-count up to 6 graduate course credit hours for both the BS and MS degree requirements. It is expected that students would be able to complete the MS degree requirements within two or three semesters after completing the BS degree requirements. Seniors admitted to the combined BS/MS program will be classified as 7EG, and hence will be eligible for teaching and/or research assistantship including tuition waiver. Admission to the program, however, does not guarantee that an assistantship would be awarded. Engineering Science majors with a minor in Biomechanics can opt for a M.S. degree in Biomedical Engineering, which is a college-wide interdisciplinary graduate program.

Please contact **Prof. B. Sankar** (sankar@ufl.edu), our undergraduate coordinator, for your comments on the curriculum.

AeMES Undergraduate Conference

On the morning of 10 April '99 the AeMES Department held the Second Undergraduate Research Conference. The event provides a forum for undergraduate students to present their research. This year there were a total of ten presentations with prizes for the best presentation and two honorable mention awards. The event was organized by Jenny Mindock and Mike Ebert. Most of the papers were of very high quality which made judging the competition difficult. First place honors went to **My Hanh Nguyen** for her presentation on "Effects of Pitch on Failure Strength of Krackow ACL Reconstruction Suture Technique". **Catalin Teodoru** received an honorable mention award for his presentation titled "Assessment of Flowability of Dry Polymeric Powders Using Triaxial Testing". **Craig Yates** received the other honorable mention award for his presentation on "Flexible Airfoils for Micro Aerial Vehicles".

Dr. L. Vu-Quoc

Research activities Prof. L. Vu-Quoc's research

Assoc. Prof. L. Vu-Quoc received the Diplome d'Ingenieur in Structural Engineering with Highest Honors from the Institut National des Science Appliquees, Lyon, France, in 1979. He worked for two years (1979-81) developing finite-element codes for use in the French nuclear engineering program at the Technical Center for Mechanical Industries at Senlis, France. In 1981, he received an M.S. degree in Structural Mechanics from the Illinois Institute of Technology, Chicago. Later, at the University of California at Berkeley, he was conferred in 1985 an M.S. degree in Electrical Engineering and Computer Science, and in 1986 a Ph.D. degree in Structural Engineering and Structural Mechanics. After two years of postdoctoral work at Stanford and Berkeley, he joined the University of Florida in 1988.

With the funding from an NSF Research Initiation Award and an NSF Presidential Young Investigation Award, together with funding from other agencies (state and industry), Dr. Vu-Quoc has established and directed the Computational Laboratory for Electromagnetics and Solid Mechanics (CLESM) since 1990. Some of the research projects within CLESM are described below.

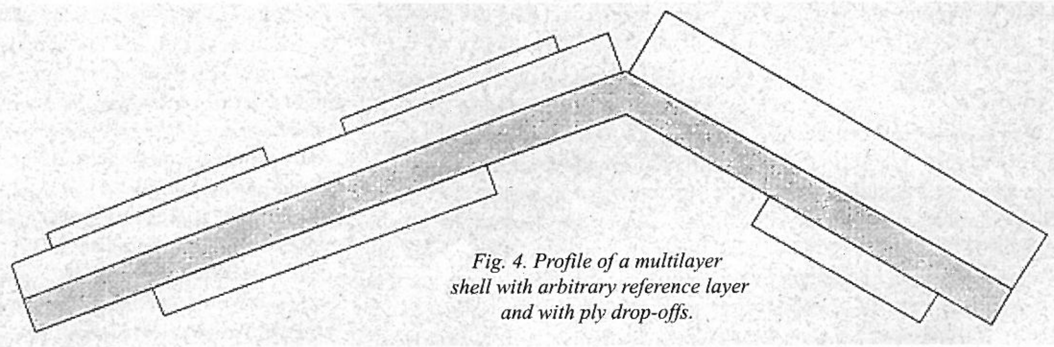


Fig. 4. Profile of a multilayer shell with arbitrary reference layer and with ply drop-offs.

Geometrically-exact multilayer structural theory. Multilayered structures have widespread applications in engineering. Laminated composite structures, initially developed for use in the aerospace industry, have played an increasingly important role in robotics and machine systems that require high operating speed. The low weight and high stiffness offered by laminated composite structures help reduce the power consumption, increase the ratio of payload/self-weight, and would contribute to improve the accuracy in the motion characteristics and the reduction in the level of acoustic emission of these systems. It is shown from computer simulations with experimental corroboration that the low weight/stiffness ratio of laminated composites is essential for obtaining high performance in slider-crank and four-bar linkage systems. More recently, considerable attention has been given to a class of smart structures with embedded piezoelectric layers as sensors and actuators for monitoring the strain level and for vibration control. Large overall motion of multilayered structures can be found in robot arms or space structures with embedded ensors/actuators. Yet another example of multilayered structures can be found in the damping of structural vibration by the use of constrained viscoelastic layers.

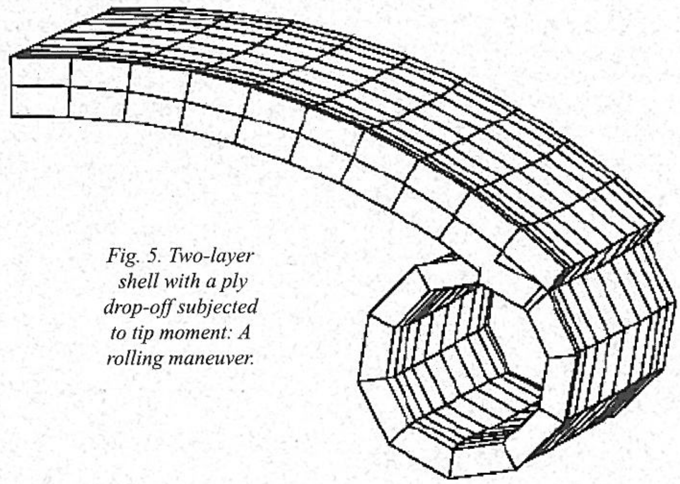


Fig. 5. Two-layer shell with a ply drop-off subjected to tip moment: A rolling maneuver.

The *cardinal features* of our geometrically-exact *multilayer* formulation are as follows: (i) The *dynamics* of a (possibly unrestrained) flexible structure is *referred to* a *fixed inertial frame*, (ii) The models can describe *large deformation* and *large overall motion*, (iii) *Shear deformation* in beams and shells are accommodated for, (iv) The *continuity* in the *displacement* across the *layer interface* is preserved, (v) The number of layer is unrestricted, while the *reference layer* can be selected to be any of the layers. The displacements of all layers are expressed in terms of those of the refer-

Fig. 3. Stroboscopic view of the deformed shape of a free-flying flexible beam.

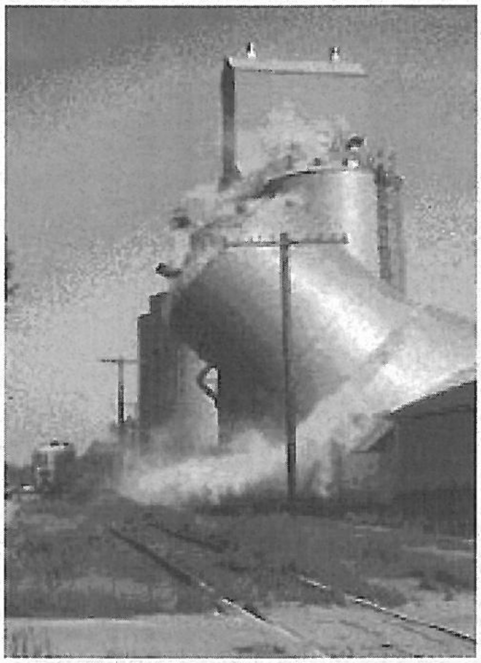


Fig. 6. Collapse of a grain silo near a railroad track.

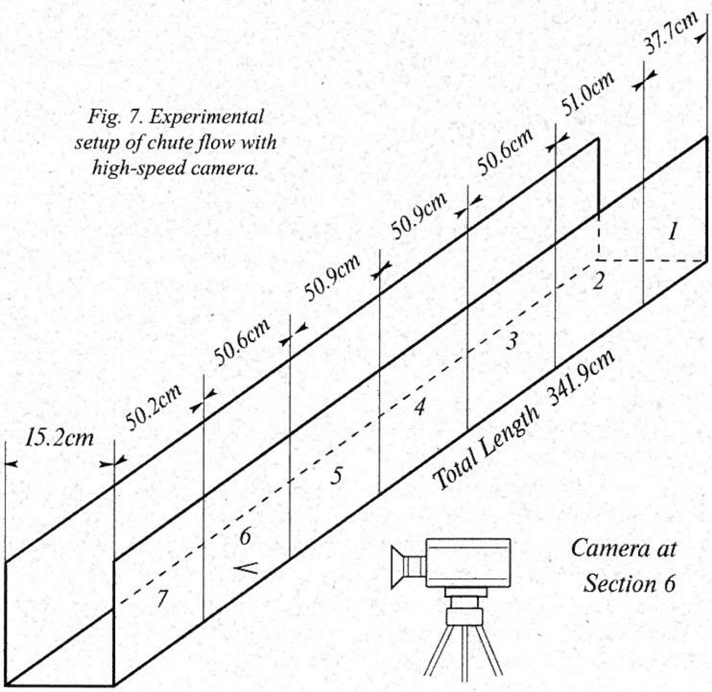
ence layer, which is not necessarily the middle layer. Figure 3 shows a sequence of snapshots of the free flying of a flexible beam, where both large deformation and large overall motion can be seen. No magnification of the deformation was used in the figure. Figure 4 shows the profile of a multilayer shell structure with arbitrary reference layer (gray shaded) and with ply drop-offs. Figure 5 displays the deformed shape of an initially flat two-layer plate with a ply drop-off, subjected to a tip moment.

For single-layer structures, Dr. Vu-Quoc contributed, together with the late Prof. J.C. Simo of Stanford University, to pionneer the development of geometrically-exact structural theory since the beginning. For multilayer structures, the topic that Dr. Vu-Quoc initiated at UF, he has co-authored a number of papers with Prof. I.K. Ebcioglu, and his graduate students H. Deng, S. Li, X.G. Tan.

Geometrically-exact formulation has found applications in many areas of engineering: Flexible/rigid multibody dynamics, satellite dynamics, multilayer (composite) structures. In a review paper titled "Computational Strategies for Flexible Multibody Systems", to appear in the *Applied Mechanics Review*, T.M. Wasfy and A.K. Noor (Center for Advanced Computational Technology, University of Virginia) classify the Simo/Vu-Quoc geometrically-exact methodology—which they call the "fixed inertial frame approach"—as the most recent of the three principal methods of formulation.

Surprisingly, geometrically-exact beams have also been used to study the deformation and the supercoiling of DNA molecules in biology. Our first three papers in this field, all appeared in 1986, have a combined number of citations of 246 times (as of Mar 1999). Several mechanics software companies have also implemented our formulations in their simulation software. At present, Dr. Vu-Quoc and his students K.S. Mok and X.G. Tan are studying the incorporation of complex, nonlinear materials (e.g., shape-memory alloy) into geometrically-exact multilayer shells.

Fig. 7. Experimental setup of chute flow with high-speed camera.



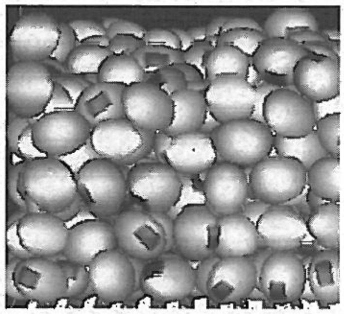


Fig. 8. Simulated flow of soybeans.

Contact mechanics and granular flow. The flow of granular materials is crucial in many areas of engineering for moving materials from one place to another. Yet, the mystery in behavior of granular flows is still not well understood. Even though granular materials possess some of the properties of the three phases—gas, liquid, solid—of matters, they do not completely behave as one of these three phases. For this reason, many physicists attribute granular materials to the fourth phase.

Examples of granular materials that must be transported for processing or for storage are, e.g., minerals in mining engineering, metal powder in mechanical engineering, drug powder in pharmaceutical industry, grains in food and agricultural industry, coal in the utilities industry, etc. Because of the lack of precise knowledge on the behavior of granular flows, disasters with the loss of human lives, not to mention the material cost to industry, have frequently occured. Figure 6 shows the collapse of a grain silo near a railroad track, with one person dead. Other types of granular flows that have greatly affected human lives are snow avalanches and soil liquefaction in earthquakes. There are cases in which whole villages, and even cities, were buried under snow after devastating avalanches. On Wed, 10 Feb 99, two villages in the beautiful ski resort in Chamonix, France, were destroyed by an enormous snow avalanche charging down a nearby mountain at the speed of 60 mi/hr, killing 12 people and injuring many. Later in Feb '99, snow avalanches killed more than 33 people in Austria. Within the first two months of 1999 alone, more than 70 people died in snow avalanches in Europe. Soil liquefaction in the recent earthquake in Kobe, Japan, was the cause of the collapse of many buildings and highway structures.

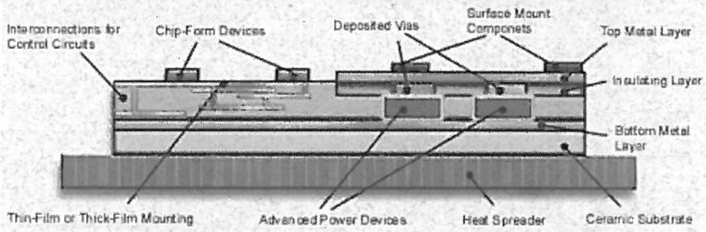


Fig. 9. Structure of a power electronic module.

The flow behavior of granular materials must be understood to properly design transport, handling, and storage equipment. Despite wide interest and more than a hundred years of experimental and theoretical investigations, many aspects of the behavior of flowing granular materials are still not well understood.

Obtaining the information about the flow *inside* the flow domain—velocity, stresses, frequency of collision, magnitude of collision forces—is, however, much more *difficult* and *expensive*. If *computer simulations* can reliably *reproduce* the *bulk and surface measurements* obtained in conventional experiments, then the *information inside* the flow domain obtained from simulations will also be reliable and useful for predicting various *important* quantities, such as the *forces applied on the side wall of a grain silo* and the *rate of breakage or attrition* among the colliding particles. For example, when transporting food particles (e.g., soybeans, rice, etc.) from the production sites, we do not want to have the food particles broken up into powder when reaching the consumers. The same applies to other minerals, precious stones, etc.

To understand the causes of costly disasters such as that in the collapse of a grain silo in Figure 6, *accurate contact force-displacement (FD) models are essential* because the *forces that are exerted on the silo walls must be accurately predicted* in the design of the silo. In a paper that will appear in the *Proceedings of the Royal Society, London*, Dr. Vu-Quoc and his former doctoral student, Dr. X. Zhang (now with Lucent Technology, New Jersey), propose the first accurate and original contact FD model that accounts for plastic deformation. To appear also is a series of papers resulting from the work of Dr. Vu-Quoc and his former students, Dr. X. Zhang, and Mr. L. Lesburg (now at Parametric Technology Corp., Boston). Dr. Vu-Quoc also collaborated with Dr. O.R. Walton, Mechanical Engineering at UF. An on-going research effort with Dr. Rajasekaran, Computer Science at UF, has been under way. Figure 7 shows a cartoon of a chute together with the location of a high-speed camera. Nearly ellipsoidal particles such as soybeans were used, because of their abundance in nature, to validate our code. Figure 8 shows a frame of a simulated flow.

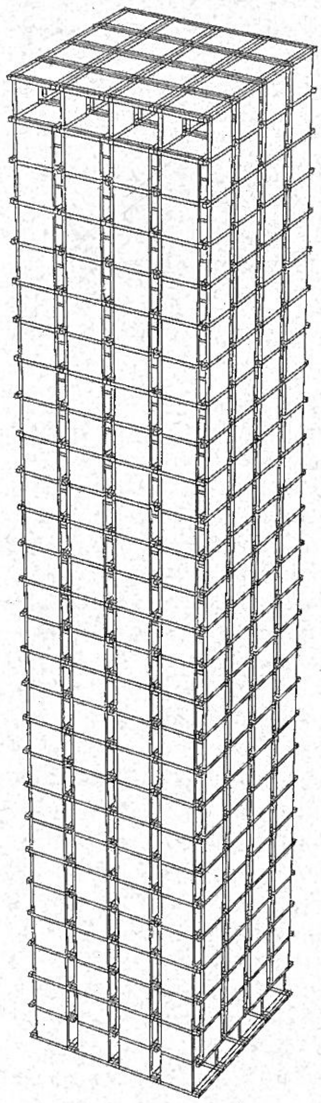


Fig. 10. Finite element model of an advanced multilayer capacitor (2.5cm x 2.5cm x 0.05cm) with 60,000 unknowns.

Power electronic simulations. How to convert the electrical power obtained from the outlet in your home from the form of an alternative current with a voltage amplitude of 220 Volts and a frequency of 60Hz to a direct current at 5 Volts for use in your computers is a goal of the Power Electronics discipline, which aims at converting efficiently and compactly one form of electrical power into another. On this subject, Dr. Vu-Quoc has been working closely with EE Prof. K.T.D. Ngo, an expert in this field.

A Power Electronic Module (PEM) includes the following components: Power devices (diodes and seminconductor transistor devices such as MOSFETs, IGBT, etc.), magnetic components (transformers, inductors), and capacitors. The current trend is to integrate all these components into ever shrinking power electronic modules. Thermal dissipation is an essential concern for the operation of these models. Most design incorporates a substrate of high conductivity, called heat spreader, to quickly dissipate the heat generated from the transistors. Figure 9 depicts the internal structure of a PEM, showing the location of the power devices and the heat spreader.

To design PEMs, it is important to simulate the response of the electronic components and of the heat sinks or heat spreaders. The electronic circuitry is governed by nonlinear ordinary differential equations (ODEs), whereas the thermal problem is governed by a partial differential equation (PDE). Traditionally, circuit designers use circuit analysis software such as SPICE, SABER, etc. to analyze their circuits, without accounting for the thermal problem. To facilitate the design process, it is important in practice to simulate the coupled electro-thermal problem in the same circuit software environment. Dr. Vu-Quoc, together with his former graduate student J.T. Hsu, has developed a method to convert the discretized thermal PDE into equivalent circuit networks for simulating the complete coupled electro-thermal problem within the same circuit analysis code. They also applied model-reduction techniques to electro-thermal simulations. Their publications in the *IEEE Transactions on Circuits and Systems* immediately received some attention; as a result, Dr. Vu-Quoc received funding to develop model-reduction techniques for the simulation of micro-electro-mechanical systems (MEMS). Prof. Ngo and Dr. J.T. Hsu later generalized this method to treat the coupled electro-magneto-thermal problems.

Fig. 11. Lightning, triggered by a rocket launched at Camp Blanding near UF, charging down a wire conductor connecting the rocket to the launcher.

Capacitors act as electrical buffers that divert spurious electrical signals, and store surges of charge that could damage the circuits or disrupt their operation. These electronic guardians of all electrical circuits are present in PEMs. Miniaturization is an urgent priority of the capacitor industry, because the advantages of shrinking PEMs cannot be realized if capacitors did not shrink with them. Dr. Vu-Quoc, together with his former students, Dr. V. Srinivas and Mr. J. Langford, has developed a finite element formulation and model for analyzing Advanced Multilayer Capacitors with novel geometry (Figure 10) patented by Prof. Ngo. He also developed accurate models for ferroelectric materials, which as used as dielectric materials in capacitors.

Dr. Vu-Quoc is also working with EE Profs. M. Uman, V. Rakov, and graduate student Mr. C. Mata to apply some of the ideas developed in the above research to formulate models for analysing lightning protection systems (Figure 11).

Other than the above topics, Dr. Vu-Quoc has also published on the dynamics of high-speed magnetically levitated trains (maglev). The funding for his research came from NSF, DARPA / CFD Research Corp., Digital Equipment Corporation, Stanford Linear Accelerator Center, Florida Space Grant Consortium, Florida Technological and Research Development Authority.

AIAA students visiting the Kennedy Space Center.

Student Society Activities

The **Biomedical Engineering Society UF Chapter** organized and held its **First Annual Biomedical Engineering Design Competition** on Saturday, 20 Feb '99. The theme was on *Assistive Technology*. Each team was asked to design a device that would aid a person with a disability. Eight teams, four from Duke University and four from UF, participated. **Duane Chin** and **Iona Dy-Liacco** from AeMES won first prize for their "Child Safety Seat for Wheelchairs" in conjunction with Faith Factora and Angeline Lo of UF's Occupational Therapy Department. **Dipa Patel**, **William Robinson**, **Pete Chiabotti**, **Mark Felt**, and **Chad Forbes** also from AeMES received honorable mentions. The finished devices were donated to the people that they were designed for.

AIAA 50th Annual Southeastern Regional Student Conference

The AIAA 50th Annual Southeastern Regional Student Conference was held 14 - 17 April '99 at the University of Alabama in Tuscaloosa, Alabama. Attendees at this year's conference were AIAA Faculty Advisor **Dr. Chen-Chi Hsu** and six AeMES students including AIAA Branch President **Craig Yates**, Vice President **Matt Veldhuis**, Treasurer **Tara Segall**, Secretary **Jenny Mindock**, active member **Domenico Ruggiero**, and graduate student **Steven Cox**. Craig Yates presented a paper titled "Flexible Airfoils for MAV's". Steven Cox presented a paper, "Global Optimization of a High Speed Civil Transport Configuration", which won 3rd place in the Graduate Level Technical Paper Competition. Conference participants attended student paper presentations, a talk given by rocket pioneer Konrad Dannenberg, a tour of the Mercedes-Benz M-Class manufacturing facility, a panel discussion with representatives from industry, and the awards banquet. The branch officers and Dr. Hsu also attended a breakfast meeting where each school's officers discussed their chapter's activities.

AIAA Activities

This year was another active year for the student chapter of AIAA. On 1 April '99, The student chapter took a "behind the scenes" VIP tour of the Kennedy Space Center. The students would like to thank Dr. Jane Hodges, of University Programs and Mr. Wayne Ranow, a Space Station Logistics Engineer, for guiding them on the tour. Thirteen students attended the tour that included a visit to the Space Station Processing Facility for a view of the current Space Station components. They also visited launch pad 39-B, the Vehicle Assembly Building with the Space Shuttle Columbia, Orbiter Processing Facility #3 for an up close look at Space Shuttle Atlantis, and a brief tour of the Saturn V center. The students were given the opportunity to learn about the daily activities of the Space Center and a number of student programs offered by NASA available to students in the local area. For more information, email: AIAA_UF@listbot.com.

As with the past two years, AIAA students will compete in the Micro Aerial Vehicle MAV competition held at Archer Field. The team will enter a series of MAVs based on a flexible wing design. Using this unique design concept the students have built and flown MAVs with a maximum dimension of only nine inches.

Congratulations

This year, **Xiaokai Niu** and **Ruiqiang Zhang** won the Fifth International Student Award for excellence in academic performance and research. Last year, the award went to **Xiangguang Tan** and **Xiang Zhang**.

Mike Owens received the first *Henter-Joyce Scholarship* award for visually impaired engineering students. The $1000 scholarship was presented to Mike by Mr. Ted Henter, President of Henter-Joyce, Inc. which specializes in software that enables blind computer users to browse the web, read e-mail, and manage data bases and spreadsheets.

Dept News

Other activities

Prof. R. Haftka co-authored a new book: Gurdal. Z., Haftka, R.T. and Hajela, P., *Design and Optimization of Laminated Composite Materials*, John Wiley, 1999.

Assoc. Prof. C. Segal presented a paper titled "Visualization of Liquid Jets Shock Wave Interactions", co-authored with T. Livingston, M. Schindler, M.G. Owens, and V. Vinogradov, at the 8th Symposium on Flow Visualization, Sorrento, Italy, September 1998.

Assist. Prof. A. Rapoff received on 1 Oct '98 a grant titled "Clinical and Biomechanical Analysis of Competing Instrumentation Systems in Spine Surgery" from the Florida Foundation for Research in Spinal Disorders, a private research foundation.

Alumni corner

Alumni news

Dr. Donald C. Daniel, an AeMES alumnus, is now in charge of all aspects of Science, Technology, and Engineering for the Air Force, as the Deputy Assistant Secretary of the Air Force. He was the Executive Director of the Air Force Research Laboratory, Wright-Patterson Air Force Base, Ohio. We refer the readers to Spring 1998 issue of *The Streamline* for a cover story on Dr. Daniel.

John L. Avery joined the company Scaled Composites (http://www.scaled.com/) in Mojave, California. In Apr '98, he defended his master thesis entitled "Compressive Failure of Delaminated Sandwich Composites".

Mark L. Baumgartner, BSAE '91, son of Dr. Thomas G. and Elaine S. Baumgartner of Gainesville, FL, received his Ph.D. in Mechanical and Aerospace Engineering from Princeton University, Princeton, NJ, on 5 May '97. Mark's doctoral research centered on the construction of a Mach 8 wind tunnel at Princeton's Gas Dynamics Laboratory and the experimental investigation of the structure of compressible turbulent boundary layers. He is presently a strategy consultant with Helmer & Associates in Los Altos, CA. His wife, Jennifer, who attended UF for two years, received her Ph.D. in Chemical Engineering from the University of Delaware on 24 Apr '97.

Rocco Ferri, MS '94, has joined the Sigma Labs in Pinellas Park, FL. Sigma Labs is involved in chemical and mechanical testing and analysis of materials including composites.

Max Friedauer, MS '96, has been working as a mechanical/aerospace design engineer with GE Aircraft Engines at the Combustion Center of Excellence, since Oct '96.

John Garcelon, Ph.D. '95, has been working at Vanderplaats R & D, Colorado Springs, since Jul '97. Research and software development in numerical optimization is the primary focus. The company is active in adding to their code non-gradient method's (e.g., Genetic Algorithms and response surface methods). They are working on an Air Force SBIR II to develop methods that make optimization technology easier to use and better integrated into CAE (e.g., Pro/Engineer, MSC/PATRAN, ANSYS, Genesis, etc.). John finds his work enjoyable and challenging.

Sharjeel Jaitapker, MS '95, has been with Forma Scientific, Inc., Marietta, OH, since Oct '95. His work consists of performing finite element analyses of heat transfer in incubators, refrigerators for biological research.

Jian Liu, PhD '96, is now working at Western Atlas, Houston, TX, after a summer of internship with Shell Development Company in Houston.

Andrew P. Malcolmson, MS '95, is currently a Research & Development Engineer at Insitec Measurement Systems in San Ramon, CA, which fabricate particle size measurement instruments for industrial and research applications.

Ramesh Marrey, Ph.D. '95, has been with Advance USA, Old Lyme, CT, since Mar '96. He is developing computer models using CAD software (Pro-E) and performing finite element analyses to support the research and development of composite sandwich panels for cars.

Hong Ouyang, Ph.D. '96, is currently with the Atchison Casting, Co., where she is integrating analysis software with CAD systems. She is now working on solidification modeling for Quaker Alloy, Inc. and Empire Steel Casting, Inc.

Madhukar Rao, Ph.D. '96, has been at Analytic & Computational Research, Inc., in Cincinnati, Ohio. His company supplies CFD services and software to the Combustion Center of Excellence, GE Aircraft Engines, Cincinnati, Ohio. Currently, Madhukar is developing an unstructured mesh, incompressible flow solver that will be used by GE as the kernel for their Advanced Combustor Code. According to Madhukar, Cincinnati is a pleasant place to live and work. Employment opportunities there are good for engineers, since this area has a good number of industries.

After working at GE Corporate RD, Schenectady NY for 4 years in the area of Life Prediction for Aircraft engines and other GE products, **Mr. Suresh K. Sharma** (MS 94) will be joining Global Technology Center of GE Energy Services. In his new business process leader role he will be responsible for integrating, developing and supporting the technologies and business processes relating to Life Management and Service Business of GE Energy Services. He will be based at GE Energy Services headquarters in Atlanta.

Richard Smith, Ph.D. '94, has taken up a position, since 17 Mar '97, in the Hydromechanics Branch of the Computational Science Division at the Naval Coastal System Center (NCSC) in Panama City Florida. There, Rick continues to work on Computational Fluids Dynamics in moving boundary problems, and in a number of naval architecture and marine hydromechanics programs within the U.S. Navy. At NCSC, he also joined two other AeMES alumni, Kennard Watson (MS '82) and John Webster (MS '90), who are currently working in the Hydromechanics group.

Editor's note: *All news items and articles that did not appear in the present issue of the newsletter will appear in future issues. We thank you for your support and understanding.*

UNIVERSITY OF FLORIDA

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