NEWSLETTER FOR ALUMNI, FRIENDS & STUDENTS

SPRING 1998

THE STREAMLINE

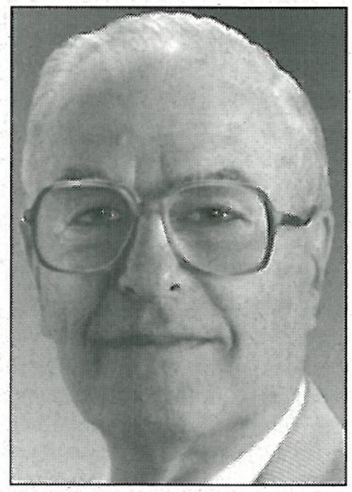
AEROSPACE ENGINEERING, MECHANICS & ENGINEERING SCIENCE

ASME Daniel C. Drucker Medal

It is our greatest pleasure to inform the readers that the American Society of Mechanical Engineers has established the **ASME Daniel C. Drucker Medal** to honor **Grad. Res. Prof. D.C. Drucker** for his contributions to applied mechanics in research, education, and leadership. The ASME Daniel C. Drucker Medal is bestowed in recognition of sustained, outstanding contributions to applied mechanics and mechanical engineering through research, teaching, and/or service to the community. There are only two other ASME medals sponsored by the Applied Mechanics Division, the Timoshenko Medal and the Koiter Medal.

Dr. Drucker has received numerous awards for being a pioneer in the development of the theory of plasticity, a prolific author, a contributor to the establishment and development of limit design, an inspired leader in education, president of engineering societies, and for establishing standards of excellence in research, in quality education, and in technical editorial activities that have made an indelible mark in the engineering profession. In the coming *13th U.S. National Congress in Applied Mechanics* at UF in Jun '98 (see article related to the USNCAM13 on page 6), he will receive the first ASME Daniel C. Drucker Medal at an award ceremony.

Before joining the AeMES department, Dr. Drucker was Dean of the College of Engineering at the University of Illinois, Urbana–Champaign from 1968-1984. He received his B.S. and Ph.D. from Columbia University, then went on to Cornell, Armour Research Foundation, U.S. Army Air Corps, Illinois Tech. He was on the faculty at Brown University for 21 years, before joining University of Illinois. Dr. Drucker is the author of one book, about 200 technical papers, and a number of articles on engineering and society. From 1956 to 1968 he was co–technical editor of the Journal of Applied Mechanics. He is a past–president and honorary member of ASME, SESA (now SEM), past–president of ASEE, the International Union of Theoretical and Applied Mechanics, the American Academy of Mechanics and other organizations, a member of the National Academy of Engineering, foreign member of the Polish Academy of Sciences, and fellow of the American Academy of Arts and Sciences.



Dr. D.C. Drucker

Among his awards for research, teaching, service, and contributions to the practice of engineering are the ASME Timoshenko Medal, the first William Prager Medal of the Society of Engineering Sciences, the ASCE von Karman Medal, the M.M. Frocht Award of SESA (now SEM), the Lamme Medal of ASEE, the Distinguished Educator Award of the Mechanics Division ASEE, the Egleston Medal of Columbia University Alumni, the Trasenster Medal of Liege, the John Fritz Medal of the Engineering Societies, and the ASME Medal. He has honorary doctorates from Lehigh, Technion, Brown, Northwestern, and the University of Illinois at Urbana–Champaign. A registered PE in Rhode Island and Illinois, Dr. Drucker is an honorary member of the Illinois Society of PEs. He was the 1986 Thurston Lecturer of ASME, a 1987, 1988, and 1989 ASME Distinguished Lecturer.

In 1988, Dr. Drucker received the National Medal of Science, and was appointed to a six–year term on the National Science Board. In 1993, he was inducted into the ASEE Hall of Fame. Finally, in 1998, the ASME Daniel C. Drucker Medal was established in his honor.

Highlights

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K. Millsaps Memorial Lecture in Fall '98 by Prof. T. Belytschko, Northwestern University (see page 4).

UNIVERSITY OF FLORIDA

AeMES Alumnus: Executive Director and Chief Scientist of Air Force Research Lab

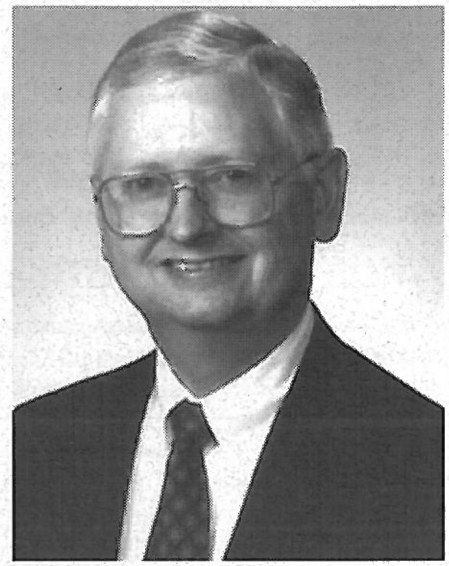
On Friday, 14 Nov '97, **Dr. Donald C. Daniel** —member of the Senior Executive Service, Executive Director and Chief Scientist of the newly formed Air Force Research Laboratory (AFRL)—visited UF, his alma mater, and the AeMES department, from which he received all of his three degrees (BS '64, MS '65, Ph.D. '73). Dr. Daniel is the senior civilian authority for all aspects of Air Force science and technology. He also serves as chairman of the Air Force Scientist and Engineer Career Program Policy Council.

A reception was organized in the AeMES department, prior to the seminar, in his honor. Also participating in this event, in addition to the AeMES faculty, were Vice Provost Gene Hemp, Engineering Dean Win Phillips, Associate Dean Warren Viessman, other department chairs, alumnus Mr. W. Roberts (see *Alumni Corner* on page 8). Dr. Daniel spent the day talking to various AeMES faculty and touring the research laboratories in the department. He was also given an overview on the AeMES teaching and research activities in a separate meeting with Dr. Shyy.

At 3pm on that Friday, the department's regular seminar session, Dr. Daniel fittingly gave a lecture titled *The Air Force Research Laboratory*, where he shared with the audience his perspective on the future research and development activities at the AFRL for the 21st Century USAF. At the opening of his talk, Dr. Daniel reminisced his student days at UF. Alluding to the article on the New Engineering Building (NEB) that appeared in the Fall '97 issue of *The Streamline,* and that is housing some of the AeMES research labs and offices, Dr. Daniel recounted that in 1968, the year he began his doctoral study in the AeMES department, the Aerospace Building, with its construction completed barely the year before in 1967, was the "NEB." The space for the Aero department before then used to be in a hangar, a much smaller space than the present Aerospace Building.

Dr. Daniel's talk on the AFRL activities was divided into the following topics: (i) organization, resources, and investment strategy, (ii) representative research and development effort, (iii) funding for universities.

The AFRL is a result of a reorganization of previous AF research laboratories, which were divided into twenty–two directorates. These twenty–two directorates have been consolidated into only nine directorates in the new structure of the AFRL, the umbrella organization of all AF research and development activities. The AFRL is headquartered at the Wright–Patterson Air Force Base in Ohio. The nine directorates are: Munition (Eglin AFB), Air Vehicles, Space Vehicles, Information, Directed Energy, Materials & Manufacturing, Sensors, Propulsion, and Human Effectiveness. The last directorate, the Human Effectiveness, is the largest of all nine directorates; research psychologists belong to this directorate. As a result of a poll of opinions among university researchers, the Air Force Office of Scientific Research (AFOSR) remains unchanged in the new structure of the AFRL, and functions, inside the AFRL, at the same organizational level as the other nine directorates, which are housed at nine major sites. The four major labs within the AFRL are Wright–Patterson, Rome, Phillips, and Armstrong.



Dr. D.C. Daniel

The mission of the AFRL is *to lead the discovery, development, and timely transition of affordable, integrated technologies that keep our Air Force the best in the world.*

The Commander of the AFRL is Major General R.R. Paul; below the Commander is the Executive Director, Dr. Daniel, who also holds the title of Chief Scientist. Overall, the AFRL has about 6,000 government employees, among which 25% are from the military, and 4,000 contract personnel. These 10,000 employees work in the nine directorates mentioned above.

In addition, there are about 20,000 persons from US universities, plus some international researchers, working on AFRL projects, covering about 5,000 topics. The AFRL is particularly proud to have supported the research of thirty Nobel Prize winners. One hundred and fifty AFRL employees are pursuing their Ph.D. degrees at the top twenty–five institutions.

The AFRL has a budget of 2.5 billions, approved by Congress, with more than one billion dollars earmarked for research. Of the total AFRL budget, 1.5 billion dollars are for Science and Technology (S&T) activities, and one billion dollars come from external sources. S&T activities are divided into: (i) basic research ((6.1) level, in military jargon), (ii) exploratory development ((6.2) level), (iii) advanced development ((6.3) level). The AFOSR oversees the basic research component, whereas the other AF labs focus on the two types of development activities.

A vision for 21st Century USAF is that of *Global Engagement*, based on space as key technology. Dr. Daniel quoted from the speech of Dr. Sheila Widnall, the speaker of the 1st Knox Millsaps Memorial Lecture (see the Fall 1996 issue of *The Streamline*): "The future defense of the nation depends on *space*..." The "Joint Vision 2010" is stated as follows: "find, fix, track, target, and hit anything that moves on the surface of the Earth." To this end, the AFRL is aiming at developing (i) Global situational awareness, (ii) Global communication and knowledge on demand, (iii) Global firepower within hours or less. Dr. Daniel gave an example of such vision: When a critical situation develops anywhere on Earth, say, e.g., in Bosnia, a secure and reliable communication system must simultaneously link a 25–year old pilot in Bosnia to the Secretary of the Air Force in the Pentagon, and to Dr. Daniel, who is visiting UF in Gainesville, Florida. These people must be in constant communication, no matter where they are, to effectively and swiftly deal with problems anywhere in the World.

Some examples of the current AFRL projects are the Airborne Laser (ABL), Clipper Graham, and Navstar Global Positioning System (see inset figures). As an early–defense system, the ABL is an accurate, aircraft–carried (Boeing 747), high energy laser that will shoot down theater ballistic missiles shortly after launch while the missiles are still over the launching country and in the vulnerable boost phase of flight. Actually, the ABL system is designed to multiple missiles launched from random, previously unidentified sites at long ranges while staying well within friendly airspace. Clipper Graham is an experimental single stage reusable rocket technology demonstrator.

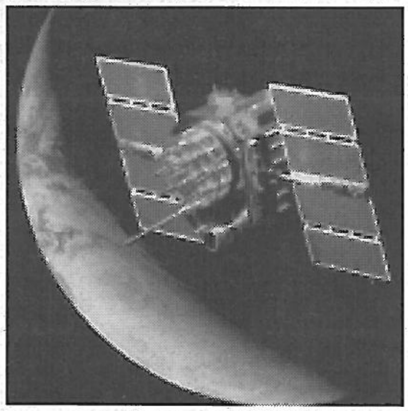
In FY99, the AFRL activities in Aerospace Engineering & Science will have the following changes in its targets and budget: (i) an increase in space propulsion and power, hypersonics, smart structures and systems, (ii) no reduction, (iii) the elimination of particulate mechanics and environmental quality programs. In Physics & Electronics, we see an increase in MEMS technology, in particular wide–gap semi conductor materials and devices. In RF technology, for surveillance from space, there will be development of low–cost, large area, light–weight arrays that have electronic protection. Other activities include

The Airborne Laser system shooting a missile in boost phase (upper right).

the development of high–density packaging, computational electromagnetics, digital receivers, etc. Smart structures, sensor incorporation, self–healing components were mentioned. The development of metal and non–metal engineered nano–materials is also an area of focus activity. Seventy to eighty percent of the basic–research budget is for supporting research at the top 25 universities; UF receives about $7 million a year from the Air Force.

Dr. Daniel concluded his overview of the AFRL with a quotation that he particularly liked: "The first essential of air power is pre–eminence in research" by General H.H. Arnold in 1944, who was a friend of the famed CalTech professor T. von Karman.

Prior to beginning his career with the Air Force, Dr. Daniel was a research engineer with the Boeing Co. (1965-68), Huntsville, AL, where he conducted mission analyses and digital flight simulations for the Apollo/Saturn V manned lunar landing program under contract to NASA. He joined the Air Force Armament Laboratory at Eglin Air Force Base, Fla., in 1972 where he enjoyed a wide variety of assignments with progressive responsibility concluding as chief of the Advanced Guidance Division in 1988. During this time he was also a member of the adjunct faculty of the University of Florida's Graduate Engineering Center, teaching courses in aerodynamics. He later served as chief scientist of the Arnold Engineering Development Center, the largest and most diverse aerospace ground testing complex in the world. From late 1994 until early 1997, Dr. Daniel served as deputy director of science and technology, Headquarters Air Force Materiel Command. For a four–month period in 1995, he was also acting deputy assistant secretary of the Air Force for research and engineering. His principal fields of interest are aerodynamics, astrodynamics and flight mechanics. He has authored or co–authored more than 40 publications in these areas. Dr. Daniel is a Fellow of the AIAA and of the Royal Aeronautical Society.



Navstar Global Positioning System

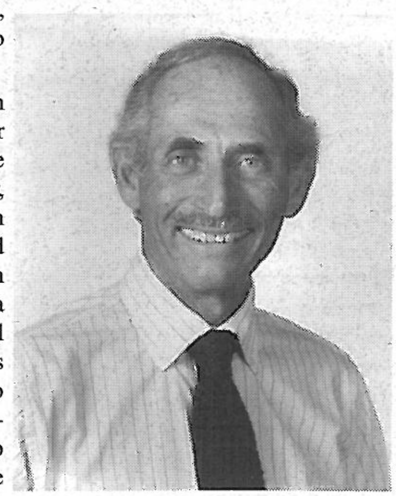
Clipper Graham

For more information on the AFRL, you can browse the AFRL web page at *http://www.afrl.af.mil/.*

Highlights of Dept Seminars

23rd G.I. Taylor Memorial Lecture

On Fri, 27 Mar '98, **Prof. Thomas R. Kane**, Applied Mechanics Division, Stanford University, delivered the 23rd G.I. Taylor Memorial Lecture titled *Computerized Symbol Manipulation in Mechanics*. The author of nearly 200 publications and five books, Dr. Kane has had a distinguished career for more than 40 years of providing fundamental results in Mechanics and Dynamics. In 1995, ASME bestowed on Dr. Kane its highest award, the ASME Honorary Membership, recognizing his lifetime service to engineering.



Dr. T.R. Kane

Dr. Kane's early college education was interrupted after only one year by World War II. During the war he served as a combat photographer, covering the campaigns in Bougainville, New Guinea, and the Phillippines. He worked with the U.S. Navy in the South China Sea, and covered General MacArthur's arrival in Japan. His last overseas assignment was to photograph the Japanese surrendering on board the battleship Missouri. In 1946, following the end of his service and taking advantage of the opportunity offered by the G.I. Bill, he enrolled at Columbia University. By 1953, he had completed four degrees, two BS degrees, one in Mathematics and one in Civil Engineering, an MS degree in Civil Engineering, and a Ph.D. degree in Applied Mechanics. Dr. Kane's Ph.D. advisor at Columbia, Prof. R.D. Mindlin, was also Dr. D.C. Drucker's Ph.D. advisor. (See the cover story on Dr. Drucker, and the article on Mr. Roberts in the *Alumni Corner* on page 8.)

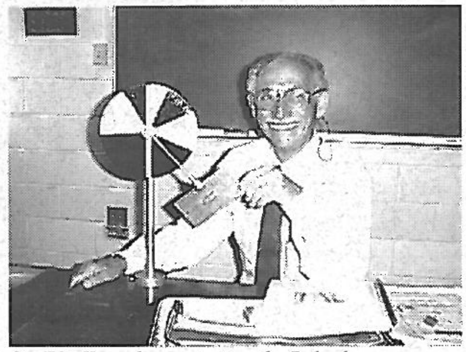
He then taught at the University of Pennsylvania, where he was promoted to Associate Professor, until 1961, when he joined Stanford University as Professor of Applied Mechanics, a position at which he remained until his recent retirement. Throughout his career, he held visiting professorships at the Manchester College of Science and Technology, U.K., and at the Federal University of Rio de Janeiro, Brazil. He also held shorter appointments at the Shanghai Jia–Tong University, China, and at the Soviet Academy of Sciences in Moscow.

Within the areas of Applied Mechanics, his career has shown remarkable breadth. His earliest research was on the propagation of elastic waves in solids. Within two years after receiving his Ph.D. degree, Dr. Kane turned his interest to the dynamics of rotational motion, especially of spacecraft. He made fundamental contributions to spacecraft attitude dynamics. Many of the now classical control strategies originated in his work, or saw their final fruition there. Throughout the past thirty years, he has maintained a large output of papers in spacecraft dynamics.

In his lecture, Dr. Kane mentioned that since the early development of Dynamics with Newton's seminal contributions, except for successful applications to celestial mechanics, Dynamics did not provide much help to the development of complex machinery during the Industrial Revolution. The reason is that prior to the advent of digital computers, the range of solvable dynamics problems was rather restricted, primarily due to mathematical difficulties to solve the resulting nonlinear equations of motion. To illustrate the point, he demonstrated experimentally the interesting dynamical behavior of a simple device with only two degrees of freedom, known as the Babyshoe, which can be modeled by two nonlinear, coupled ordinary differential equations. An analytical solution to these ODEs cannot be obtained easily. Dr. Kane created the Babyshoe device to explain the dynamics of a dangling baby shoe (a common ornament used on rearview mirrors). Depending on the amplitude of swinging of the connecting string in a vertical plane, the baby shoe may or may not rotate about the connecting string. The two degrees of freedom here are the swinging angle of the string and the angle of rotation of the baby shoe about that string.

With numerical solution methods using computers, there were yet another hurdle: The amount of labor required to formulate (rather than to solve) the equations of motion, and to bring these equations to a form suitable for efficient computer simulations. Dr. Kane developed a methodology that minimizes this labor, and that leads to equations of particularly simple form. Multibody dynamics, which can be very tedious in traditional Lagrangian formulation, now becomes much simpler. Kane's method, based on the so–called partial velocities and partial angular velocities, is also suitable for symbolic computation, the topic of his G.I. Taylor Lecture. With his associates, he is the co–author of AUTOLEV, a program for carrying out symbolic and numerical studies in dynamics. Dr. Kane remarked that more often in practice, one encountered systems with a relatively few bodies, which he dubbed "paucibody" systems (with "pauci" being Latin for "poor" or "few"), instead of "multibody" systems.

A new area of his research, not totally detached from the previous ones, was announced with the publication of a 1967 paper entitled "The Reorientation of a Human Body in Free Fall." The focus here, of course, was on the maneuvering of Apollo astronauts in orbit, but was extended also to the problem of how a falling cat reorients itself. The space–oriented research was extended to include humans with thrusters, but Dr. Kane studied also human forces in the tennis game, automotive dynamics, robot manipulators, control of flexible bodies, and dynamical studies of computer hard disks. His research on human–body dynamics in free fall in space has been applied to the fall, generally fatal, of human beings to the ground. Dr. Kane has been a frequent witness in this area, both in civil and in criminal trials, where he has been able to give expert testimony on whether a victim had fallen accidently, or had been pushed. In criminal trials and in more than twenty civil cases that have gone to trial, the decisions have always been in concert with his testimony.


Dr. T.R. Kane demonstrating the Babyshoe experiment during his G.I. Taylor lecture.

Dr. Kane became Professor Emeritus in 1994, and continues to work at Stanford University. Currently, in addition to his research, he is revising two of his earlier books, first published more than 35 years ago. These revised books will bring many new fruitful ideas in his research into undergraduate Engineering education.

3rd Knox Millsaps Memorial Lecture in Fall '98

The third Knox Millsaps Memorial lecture will be given by **Prof. T. Belytschko** of Northwestern University in Fall 1998. Dr. Belytschko research areas are in the development of the Finite Element Methods and in Computer–Aided Engineering. Specifically, he has made fundamental contributions to nonlinear mechanics problems, such as shear localization, shell buckling, and processes with severe deformations. Other topics of his research include development of new elements and time integrators, adaptive processes, parallel algorithms, and probabilistic methods.

More recently, Dr. Belytschko has focused his attention on a meshless, or particle–type computational method called the element–free Galerkin method. Although at an early stages, EFG shows great promise in solving problems that traditional FE methods have difficulty with, such as crack propagation.

Well known for his works, Dr. Belytschko received numerous awards, including a membership in the National Academy of Engineering.

Dept News

Adjunct Assoc. Prof. G. Miller, who has a part–time appointment in Biomechanics in the AeMES department since 1995, was invited to the international meeting *IV Journadas de Cirugia de la Artrosis – Gonartrosis II*, Barcelona, Hospital del Mar, Spain, 6-7 Feb '98, to deliver the paper titled "Total knee components: Designing for long–term performance," and to participate at the round–table meeting among the conference participants. Dr. Miller was on the faculty in the Medical School at UF for twenty years until 1997, when he resigned to devote full–time to Exactech, Inc., his orthopaedic implant manufacturing company.

Prof. B.V. Sankar has been appointed to the Editorial Advisory Board of Materials Science Foundations, a monograph series published by Trans Tech Publications, Zurich, Switzerland. Five monographs are scheduled to be published annually, and the collection is expected to become a basic reference source covering all fundamental concepts and phenomena of materials science and technology.

Teaching activities

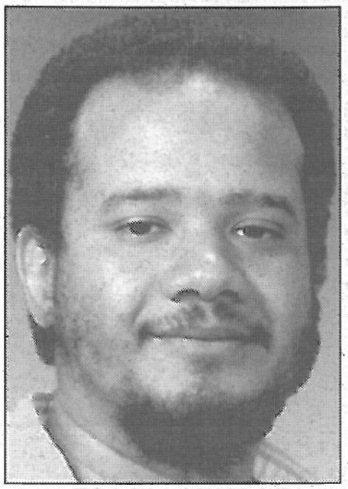
New Course: Integrated Product and Process Design

Since Fall 1997, a new design course—the *Integrated Product and Process Design* (IPPD) course—has been introduced into the undergraduate curriculum in the AeMES department. The goal of the IPPD course is to bring *real, industrial–sponsored* engineering design projects into the classroom. Students in their senior year, working on these projects within multidisciplinary teams, will have their opportunity for employment upon graduation improved.

Through this program, students learn (i) how fundamental engineering science is relevant to effective product and process design, (ii) that design involves not just product function, but also producibility, cost, schedule, reliability, customer preference, and life cycle issues, (iii) how to complete projects on time and within budget, (iv) that engineering is a multidisciplinary effort. Working in small multidisciplinary teams, students develop import practical experience in team work, communication, leadership, management, and people skills. The IPPD course, which stretches over the Fall and the Spring semesters with a total of six credit hours, replaces a technical elective and the capstone senior design course.

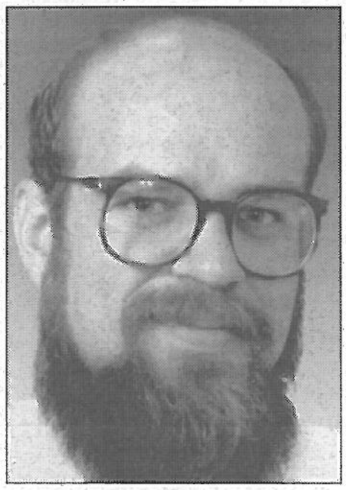
In the academic year 1997-98, there are 29 projects, sponsored by 23 companies, and coached by 23 faculty members. In total, 180 students from all engineering disciplines participate in the projects. The following projects are being coached by AeMES faculty: (1) Boeing: *Solenoid valve health monitoring system*, coached by **Assoc. Prof. N. Fitz-Coy**, (2) Eglin AFB: *Split quad wing*, coached by **Assoc. Prof. D. Mikolaitis**, (3) Lockheed–Martin: *Laser–mode switch redesign*, coached by **Assoc. Prof. L. Vu-Quoc**.

Solenoid valve health monitoring system. NASA is planning system upgrades to its Space Shuttle fleet in an effort to increase flight rates, cut operation costs, and reduce ground service time. Currently, the operational condition of the solenoidal valves used in the Shuttle's main propulsion system is determined during pre–launch preparation by connecting clamp–on ammeters to the valves and by analyzing the resulting electrical signature traces. Time and cost restraints allow for only 3 of the 46 valves to be checked. The objective is to use Hall Effect sensors for autonomous, non–intrusive health monitoring of the valves. The monitoring system should not interrupt the fluid flow, and not draw power from the valve power supply. The sensors should be able to identify off–nominal conditions such as seal and seat degradation, contamination, and subcomponent structural failure. The signal analysis is carried out using neural network.



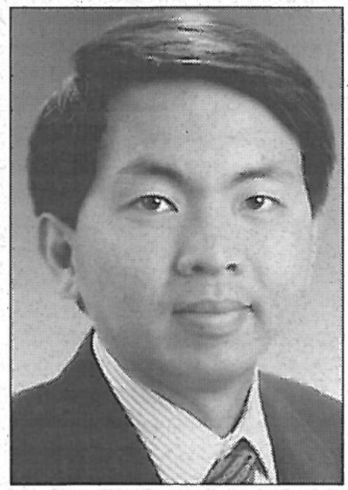
Coach: *Dr. N. Fitz-Coy*

Split quad wing. Stealth aircraft must carry their munitions internally to maintain their small radar cross–sections. They are also highly visible on radar whenever their bomb bays are opened. For this reason, the USAF has developed a new class of small, smart bombs. The goal is to design a range extending attachment for small smart bombs. The farther from the target that an air–dropped munition can be deployed, the safer it is for the aircraft and the crew. Thus an objective is to design an inexpensive (under $5,000) aerodynamic attachment package to extend the range of a small, smart bomb from 9 nautical miles (NM) to 30 NM, and to expand the footprint radius from 5 NM to 9-12 NM. With such a large footprint, it is anticipated that up to eight individual targets can be selected while opening the bomb bay doors only once. For low wing weight and for stowability, a fabric wing is being designed for high subsonic flight regime. The wing must be under a very large tension to alleviate potential panel flutter problems.



Coach: *Dr. D. Mikolaitis*

Laser–mode switch redesign. The project objective is to redesign a switch assembly, with exterior access, in the laser targeting pod, which is a product of the Lockheed–Martin LANTIRN (Low Altitude Navigation and Targeting Infrared for Night) project. The pod is mounted on F-14, F-15, and F-16 military aircraft. It emits a laser on to selected targets to guide smart bombs to these targets. The switch is used to toggle between two laser wavelengths, 1.06 and 1.54 microns. The 1.06 micron wavelength, used for live bombing missions, has better accuracy than the 1.54 micron wavelength because of higher energy level. Unfortunately, the 1.06 micron wavelength can cause severe eye damage to friendly ground troops, and for this reason the 1.54 micron wavelength (not harmful to eyes) is used for training exercises. The goals of the project are to reduce cost, the total number of parts, and to increase robustness. For the images of the prototype, visit the web page of Dr. Vu-Quoc, which can be accessed through the department web page.



Coach: *Dr. L. Vu-Quoc*

(continued on page 7)

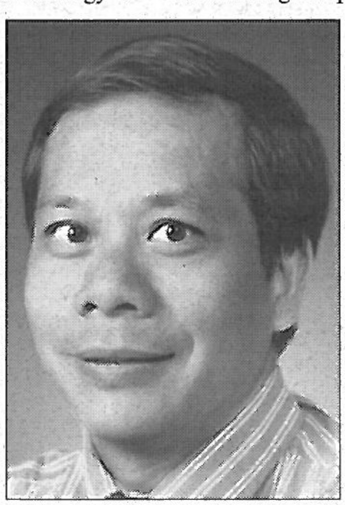
Research activities

Dr. Tran-Son-Tay's Biomechanics Research

Assoc. Prof. Roger Tran-Son-Tay has been with the AeMES Department since August 1993. He is the director of the *Laboratory of Cellular Mechanics and Biorheology*. His laboratory emphasizes the development of novel instruments, techniques, and mathematical modeling to better understand the behavior, role, and functions of cells in health and diseases. Dr. Tran-Son-Tay teaches courses on dynamics, engineering analysis, bio–fluid mechanics/heat transfer, and biomechanics. He is also the faculty advisor for the UF Biomedical Engineering Society.

Dr. Tran-Son-Tay received his BS in Mechanical & Aerospace Engineering (1978) from l'Ecole Supérieure des Transports et Propulsion, Orléans, France; his MS in Biomedical Engineering (1979) from l'Université de Technologie de Compiègne, Compiègne, France; and his D.Sc. in Mechanical Engineering (1983) from Washington University, St. Louis, MO. After graduation, Dr. Tran-Son-Tay spent a year as Research Associate in the department of Biophysics at the University of Southern California, CA, and two years as Senior Research Associate in the department of Chemical Engineering at Rice University, TX. He then joined the department of Mechanical Engineering at Duke University, Durham, NC, as Research Assistant Professor in 1987, and was appointed Research Associate Professor in 1993.

Dr. Tran-Son-Tay's research focuses on the application of fluid mechanics and rheology to biology and medicine. (Rheology is the science dealing with the deformation and flow of matters). An understanding of the rheological behavior of blood cells, for example, is essential for understanding the ability of the blood cells to deform and flow in the capillaries, and/or to migrate in the tissue. A complete characterization of the rheological properties of the cells is critical in order to evaluate the effects of physical forces on the structure and function of the cells. These properties play a major role in the response of the cells to diseases and infections. There are currently four main areas of special interest:



Dr. Tran-Son-Tay

1. Rheology and Adhesion of White Blood Cells. Understanding the rheology and adhesion of leukocytes has been a focus of research in recent years, and has direct relevance to the human immune response and cancer metastasis. Rheological studies of leukocytes (white blood cells) are essential not only for the comprehension of microcirculatory flow dynamics, but also for the understanding of their functions and behavior in health and disease. The rheological properties of the leukocyte, together with its structural characteristics, determine the deformability of the cell, especially during large deformations, such as those involved in their release from the bone marrow or extravasation into the interstitium. This deformability is also critical in the leukocyte's response to disease/infection in humans because it determines the ability of the cell to flow and deform in capillaries and/or migrate in tissue.

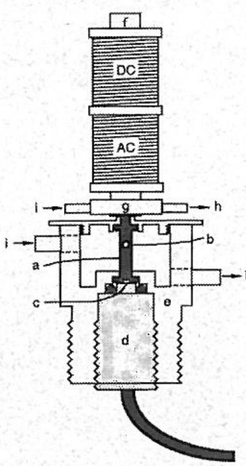
To leave the bloodstream, circulating leukocytes must first attach to the vessel wall and then migrate through the endothelial monolayer. Mechanisms of cell adhesion and migration occur in a dynamic environment. Dr. Tran-Son-Tay and his research group are investigating the effects

A student working in Dr. Tran-Son-Tay's lab.

of hydrodynamic forces on the adhesion of white blood cells to endothelial cells and chemically treated surfaces. In collaboration with Drs. H.-C. Kan, W. Shyy and H.S. Udaykumar, they are making substantial contributions to our understanding of the biomechanical aspects of these highly complex phenomena.

2. Biorheological Properties of Sickle Cell Hemoglobin. The fundamental characteristic of sickle cell disease is that it is a disease of abnormal blood rheology. In particular, the change in blood rheology in sickle cell disease patients is thought to be mainly caused by the abnormal rheology of the sickle red cells, although the rheological properties of other blood cells, such as the neutrophil, could also change in sickle cell disease. Sickle red cells have several abnormal properties. They adhere more easily to endothelial cells than do normal erythrocytes; they become rigid when deoxygenated because of the intracellular polymerization of the sickle hemoglobin; and some of them, even when fully oxygenated, have abnormal shapes due to irreversible membrane abnormality (the irreversibly sickled cells, ISCs) and are much less deformable than the normal biconcave shaped red cells.

In collaboration with Drs. A. Schechter and Connie Noguchi, National Institutes of Health, and Dr. R. Lottenberg, Dept. of Hematology & Oncology at UF, they are investigating the polymerization process of sickle hemoglobin and its effects on the blood mechanical properties.



Dr. Tran-Son-Tay's microrheometer: (a) Sample chamber, (b) stainless-steel ball, (c) ultrasound crystal.

Applications involve the design of new therapeutic treatments and tools for assessing the severity of the sickle cell disease.

3. Assessment of Cell Damage During Treatment Against Cancer. A new treatment that was developed to fight cancer uses stem cells. The procedure is conceptually simple. Blood cells are first extracted from the bone marrow of the patient. Then, treated magnetic beads (specific to the cancer cells) are mixed with the collected blood sample, and an electromagnetic field is applied to remove the cancer cells. The healthy stem cells in the sample are then washed, frozen, and stored for later usage. In the mean time, the patient undergoes chemotherapy. The goal of this step is to kill as many cancer cells as possible. After this treatment, the stored healthy stem cells are thawed and reinjected into the patient. The hope is that these stem cells will develop into the specific white cells needed, and in quantity large enough, to kill the remaining few cancer cells.

During this preparation procedure (collecting, separating, freezing, storing, and thawing), stem cells are damaged. This is evidenced by the abnormal long time that it takes for the patient to recover his/her normal white blood cells count. In collaboration with Drs. Wingard and Magheed, Dept. Pediatric Hematology & Oncology at UF, they are developing a technique for assessing cell damage, and for identifying the procedure(s) where most cell damage occur.

4. Rheological Measurements of Biological Fluids. Many biological fluids have important rheological properties that can be directly associated with diseases. However, many of them cannot be obtained in large volume (synovial, mucus, etc.). The thrust of this project is to develop microrheometers and sophisticated models for analyzing the complex rheological behavior of biological fluids. Some of the work are done in collaboration with Drs. N. Cristescu and R. Mei from the AeMES dept., and with Dr. J. Lindon and Mrs. Amy Achter from Kimberly Clark Corp. Microrheometers are also very useful for measuring the properties of rare or expensive fluids, as well as micron size particle suspensions. For example, some of the instruments developed in the laboratory have been used to characterize the formation and breakage of flocs.

The Laboratory of Cellular Mechanics and Biorheology is also involved in a variety of other projects that include understanding cell damage in bioreactors, and designing a novel ventricular assist device (VAD). The primary purpose of a ventricular assist device is to decrease the workload of the damaged myocardium while facilitating adequate cardiac output and systemic pressure to perfuse vital tissues organs. Ventricular assist devices can support left, right, or both ventricles. These devices can assist patients who, for instance, are unable to wean from cardio-pulmonary bypass or have end–stage heart disease. They can also save patients who cannot undergo heart transplantation because of their age, or of donor heart availability. The estimated size of the U.S. population that could benefit from heart replacement exceeds the available supply of donor hearts by at least an order of magnitude. The goal of this project is to develop a VAD that is totally implantable, compact, efficient, durable, biocompatible and non destructive to blood cells.

Dr. Tran-Son-Tay explains the heart machine to students.

Dr. Tran-Son-Tay's research has been funded by the National Science Foundation, the National Institute of Health, and Kimberly Clark Corporation.

Service to profession

A Scholarly Olympiad Comes to UF

A pop quiz: Complete the sequence: IIT, Michigan, Brown, UC–Berkeley, Minnesota, Harvard, Colorado, UCLA, Cornell, UT–Austin, Arizona, Washington, ______ *Hint:* Scholars from 36 nations will be assembled at the **13th U.S. National Congress of Applied Mechanics** (USNCAM13). If you answered UF, host of the event this year, you were right. USNCAM13 will be coming to UF during the period of 21-26 Jun '98, in the break between Summer A and Summer B. The AeMES department was responsible to bring the event to UF, and to organize this event, with Prof. M.A. Eisenberg as the Congress General Chairman.

Like the Olympics, the Congress is a quadrennial event. Like the Olympics, the privilege of hosting the event is hotly contested. The Olympics has its U.S. and International Olympic Committees. The USNCAM is sponsored by the U.S. National Committee on Theoretical and Applied Mechanics (USNC/TAM), a committee reporting to the National Academies of Engineering and Science via the National Research Council. USNC/TAM represents U.S. interests at the International Union of Theoretical and Applied Mechanics (IUTAM). The USNC/TAM has a handful of at–large and ex–officio members, elected to assure appropriate and broad representation of all segments of academic, industrial, and governmental agencies with interests in mechanics.

But the majority of USNC/TAM members are official delegates of the societies for which mechanics is central to their respective missions. Participating societies are: Acoustical Society of America, American Academy of Mechanics, AIAA, AIChE, American Mathematical Society, American Physical Society, ASCE, ASME, American Society for Testing and Materials, Society of Engineering Science, Society for Experimental Mechanics, Society for Industrial & Applied Mathematics, Society for Naval Architects and Marine Engineers, and the Society of Rheology.

Given the diversity of the constituency of the USNCAM meetings, the agenda necessarily covers a broad spectrum of interest. Thus, this Summer's meeting will include about 700 papers delivered in the course of about 275 hours of technical sessions. Every day begins with a plenary lecture delivered by a well–established scholar. Profs. J.T. Oden and A. Rosakis will lecture on computational and experimental solid mechanics, respectively. Profs. P. Marcus and A. Prosperetti will lecture on fluid mechanics, and Prof. Y.C. Tai on Micro–electro–mechanical systems.

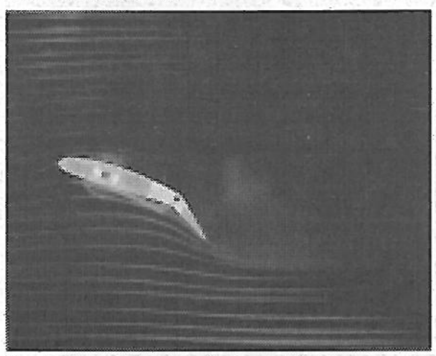
There will be about 90 sessions on solid mechanics, structural mechanics, and dynamical systems, and about 60 sessions on fluid mechanics. Of special interest is a three–day symposium in memory of AeMES Grad. Res. Prof. C.S. Yih (see obituary in the Fall '97 issue of *The Streamline*). There are two–day long symposia on Mechanics Applied to Living Systems, Instability, Micromechanics and Damage Characterization of Advanced Materials, Multiphase & High Reynolds Number Flows, Advances in Plasticity, Vortex Dynamics and Turbulence, Structural Dynamics, and Complex Fluids & Low Reynolds Number Flows. There are day–long symposia on Plasticity in Manufacturing Processes & Product Performance, Shear Banding & Failure in Granular Materials, Structural and Aero–Acoustics, and Geomechanics. There are special sessions on interdisciplinary fields such as Smart Structures, Optimization, Pattern Analysis, Functionally Graded Materials, Piezoelectrics, Nanomechanics, and Shape Memory Alloys and Ferroelectric Domain Switching. Sessions on various aspects of Composite Materials, Fracture Mechanics, and Wave Mechanics pervade the program.

As part of the USNCAM meeting there will be a nationally televised panel discussion on *Engineering and Science in a Public Policy Context: Why Does the Public Care about What We Do*, in which Dean Win Phillips will be a featured participant. The USNCAM Banquet on 24 Jun will mark an historic event. ASME will award the first Daniel C. Drucker Medal to our most distinguished AeMES colleague whose name the medal bears. The following day there will be a special lunch where friends, students, and colleagues will gather to honor Dr. Drucker.

For more information on the event, contact persons, volunteering help, please visit the USNCAM13 web page, which can be accessed through the the AeMES department web page. Above all, please join us at this exciting event.

Students activities

ΣΓΤ Activities



Smoke tunnel demo at Engineer's Fair.

Spring '98 marked definitive changes for the UF Chapter of ΣΓΤ. The Chapter has updated its officer instructions, revised its by–laws, and formed four permanent committees to oversee the student–faculty picnic, Engineer's Fair, undergraduate conference, and the annual banquet. Together with AIAA and BMES, the UF Chapter of ΣΓΤ now has a dedicated room, equipped with a PC, in the Aerospace building for its functions. In Spring '98, ΣΓΤ chaired the organizing committee for the annual undergraduate conference. The Chapter also redesigned a smoke tunnel used for educational demonstrations, using a theatrical fogger and a collection chamber. Visit the web site *www.aero.ufl.edu/org/sgt* for more information.

The ΣΓΤ team at this year's Engineer's Fair.

***IPPD** (continued from page 4)*

The success of the IPPD course, now in its third year, is largely the result of the effort of **Prof. H. Fridrich**, Industrial and Systems Engineering department. The number of funded projects, participation of students and faculty in all engineering disciplines, have increased rapidly; first year: 5 projects, 30 students, 6 disciplines, 6 faculty coaches; second year: 18 projects, 108 students, 8 disciplines, 12 faculty coaches; third year: See above. To keep the class within manageable size so to manage efficiently the projects and thus maximize the success of the program, it has been decided to limit the number of students and projects for next year to 150 students and 25 projects. Student selectivity will further increase as a result of this limitation.

Prof. Fridrich came to UF in 1994 after 43 years with IBM Corporation, where he began his career in 1950 in Germany. He held a number of key management positions, including Vice President and General Manager for IBM's largest development and manufacturing site for semiconductors and electronic packages. In 1987, he was elected IBM Vice President responsible for worldwide manufacturing and quality until his retirement in 1993. He is a member of the German Society of Engineers and a Fellow of the Royal Academy of Engineering in the U.K.

To enroll in the IPPD course, a student should satisfy the following requirements: (i) have completed the prerequisites for his/her major, (ii) be a senior graduating in Spring or Summer term, (iii) does not have more than 30 credit hours left for graduation, (iv) fill out an application form (see Ms. Shirley Robinson or the above three AeMES coaches), with an attached resume.

***Alumni Corner** (continued from page 8)*

across the campus on my own. Fortunately, there are many reminders of the past years still there in the midst of the bustling campus. There are also haunting familiarities on the faces of the students as they hurry between classes. They look similar to the faces that peer out at me from my old yearbook from almost 50 years ago. Perhaps the quest for knowledge creates that sameness of expression, or maybe it is just because we are all true Gators.

Editor's note: *The reader is referred to a recent, informative PBS program on the G.I. Bill, which was conceived and passed to avoid unemployment for returning WWII G.I.'s, and thus to ward off the looming threat of communism at that time. The Bill was largely responsible for the building of middle–class America by providing the higher education that many could not afford prior to WWII. Success stories were abound, as many seized that rare opportunity. See also the article on Prof. Kane in this issue.*

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.

Alumni corner

The Way It Was: 50 Years Ago

by William F. Roberts

It was 50 years ago (6 Jun 1947 to be exact) that I was admitted to the University of Florida, as one of the many World War II veterans that flooded the campus. I had flown 50 combat missions as a B-26 Marauder pilot and still had a love for airplanes, which drew me to the fledgling Aeronautical Engineering Department. This enrollment led to my B.S. degree in Aeronautical Engineering in 1950, with a subsequent Masters from UCLA in 1963.

Mr. W.F. Roberts

The AeMES Golden Anniversary Celebration in Sep 1996, which I attended along with several other classmates from the Class of 1950, allowed us to explore the present campus and to reminisce about the changes that had occurred; not only the physical changes, but the equally considerable changes in the campus way of life.

The most apparent change, of course, is the sheer size of the campus and the student body. In 1947, there were less than 10,000 students. At the time, the campus boundaries basically extended North and South from University Avenue to Stadium Road and East and West between 13th St. and North–South Road. There were a few outlying facilities, but essentially all of the campus was within those boundaries.

Another big change was the composition of the student body itself. Women were still a rare sight on campus. Overall, there was a distinct lack of diversity in the student body, compared to today. The most noticeable division at that time was between the returning WWII veterans and those right out of high school. Generally, the veterans were much more serious about classes in an attempt to 'make up for lost time' (see Editor's note).

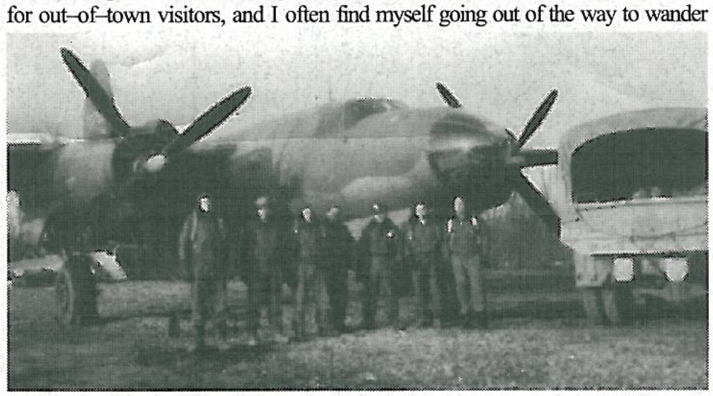
The large influx of veterans meant that essentially all facilities on campus were overloaded. Temporary buildings were either moved in or constructed to fill this need. An aircraft hangar was assembled, about where the O'Connell Center is now located, to serve the needs of the new Aeronautical Engineering Department. The hangar contained classrooms, offices, a small wind tunnel, link trainers, laboratory space, and even several airplanes. In other words, it was home to the aeronautical engineering students. It may seem hard to believe now, but none of the classrooms were air–conditioned!

The job market for Aeronautical Engineers was not too good in 1950, making us wonder why we had chosen this particular career. WWII was over, Korea had not yet started, the aeronautical industry was retrenching, and NASA did not yet exist. Little did we know that we were to be active participants in the incredible growth of the aeronautical field and the birth of the space age. It turned out to be a truly exciting time to be an engineer, and particularly in the aerospace profession.

My particular career path went in many directions, all of them interesting and rewarding. After graduation in 1950, I was lured to Southern California, after a brief stop at Chance Vought Aircraft (best known for its F4U Corsair Navy fighter plane in WWII) in Dallas, Texas. I spent seven years at the Northrop Corporation included a variety of aircraft design assignments, primarily as a structures engineer. The new space field, and the term aerospace, began in 1957 when the Russians put the first satellite in orbit. This development attracted me to the Aerospace Corporation in 1959, where for over eight years I was involved in many exciting projects. Aerospace Corporation provided technical management for all Air Force space programs, with most of the early space programs devoted to the military. For example, I worked on the first communication satellite, an early 'spy satellite,' and the Manned Orbiting Laboratory (which was eventually combined with the NASA Space Shuttle program). In 1967, I moved to Philadelphia to take a position as Manager of Vehicle Engineering for General Electric Co. Within three years, I left, however, the big aerospace market to become an entrepreneur. To make a long story short, this development involved another exciting period of establishing and leading a new company (in the marine/environmental field) for almost twenty years before selling the company and retiring in 1987.

Engineering offers many career directions to explore, as can be seen from my own example above. The other classmates who were here for the AeMES celebration took different and similarly exciting paths.

I am very pleased to be now living just twenty miles from the University of Florida campus, and to have frequent opportunities to return. It is a mandatory visit for out–of–town visitors, and I often find myself going out of the way to wander



Mr. Roberts (second from left), on his 23rd birthday, with his crew and B26 Bomber (France, 1945) before flying into Germany.

(continued on page 7)

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