

NEWS

mechanical engineering

FALL 1998

Edited by
Diane Kukich,
Robert Veazey, &
Anthony S. Wexler

The Chair's Corner

by Dr. Andras Z. Szeri

It has been a very topsy-turvy summer. Dr. Stuart L. Cooper resigned as Dean of the College of Engineering, after a very successful five years of service, to become Academic Vice President at the Illinois Institute of Technology. Dr. Cooper assumed his new duties on September 1 of this year. I was appointed Interim Dean by the Provost, to serve while a permanent dean is selected. I am very pleased that Professor Suresh Advani has agreed to be Acting Chairperson of Mechanical Engineering during this interim period.

Dr. Advani has been at the University of Delaware for just over 10 years. He obtained his engineering degree from the Indian Institute of Technology, Bombay, and his master's and Ph.D. degrees from the University of Illinois at Urbana-Champaign. His field is rheology, the science of flow of materials, and he has attained international renown in composite materials manufacturing (resin transfer molding). He has published a significant number of papers and books, has been the recipient of important research funding from industry and government, and is well respected for his leadership in guiding undergraduate researchers. I wish Dr. Advani success in his new undertaking.

News Briefs

Curriculum 2000 went into effect this past fall. Students are now required to take 121 credits to graduate, in contrast to the earlier 131 credits. To increase the quality of incoming students, the first calculus course, Math 241, is no longer a graduation requirement. The main objectives of the new curriculum are flexibility and the ability to respond quickly to the ever-changing technical and business environment.

The revised Graduate Program has been approved by the Faculty Senate and is being implemented in the fall of 1998. The revision was dictated by the significant changes that had occurred in faculty composition during the past four years, the consequent broadening of the Department's research profile, and the continued increase in the quality of our graduate students.

Dr. Karl Steiner, Executive Director of the Center for Composite Materials, was appointed Adjunct Professor of Mechanical Engineering. Steiner has been instrumental in establishing the excellent cooperative relationship that now exists between CCM and ME.

Provost Schiavelli approved the secondary appointment of Dr. James Glancy, Associate Professor of Bioresources Engineering, as Associate Professor of Mechanical Engineering. Dr. Glancy has joint research with ME faculty, has supervised ME Senior Design students, and, starting in the fall of 1998, will take



responsibility for MEEG 347, our junior design course.

The Mechanical Engineering freshman class has 63 students, 14 of whom are in the Honors Program. The Department has 85 graduate students, 47 of whom are studying for the Ph.D. degree, and an additional 26 postdoctoral fellows, visiting scholars, research associates, etc. This represents 5.3 researchers per full-time faculty.

Professor Ajay K. Prasad was one of two recipients of the University of Delaware 1998 Excellence in Teaching Award.

The 2nd edition of Professor Michael Greenberg's text *Advanced Engineering Mathematics* was published by Prentice Hall. It is about 400 pages longer than the 1st edition, involving a major rewrite augmented by the addition of new material.

Professor Anthony Wexler was cited for "Excellence in Refereeing" by the Editor of the *Journal of Geophysical Research, Atmospheres*.

A team led by Professor Jack Vinson received a \$1.4-million grant to develop research focused on the structures and materials aspects of the Global Range Transport (GRT) envisioned in the New World Vistas Program of the United States Air Force (see article on last page).

Cambridge University Press published a 475-page graduate text, *Fluid Film Lubrication: Theory and Design*, by Professor Andras Szeri.

Professor Sunil Agrawal was one of eight U.S. panelists in an NSF USA-South Africa workshop on Design Education held in Johannesburg in August 1998.

Professor John D. Meakin was Co-Chair for Posters for the IEEE-Photovoltaic Specialists Conference.

Tsu-Wei Chou, Jerzy L. Nowinski Professor of Mechanical Engineering, visited more than 20 research institutes in China and Japan in conducting a "Technology Assessment of Composite Materials" for the Army Research Office.

Professor Leonard Schwartz was one of the organizers of the 9th International Coating Science and Technology Symposium held at the University of Delaware. Over 300 scientists from industry and academia attended this meeting.

Research Briefs

S. G. Advani (funded by the Army Research Office through the Tuskegee University Research Consortium)—*Intelligent Resin Transfer Molding for Integral Armor Applications*. This five-year collaborative program through the Center for Composite Materials focuses on developing intelligent manufacturing processes for multifunctional hybrid composite armor.

S. Agrawal (funded by the National Science Foundation through the USA/Germany Program)—*Laboratory Simulator for Space Robots*. The PI is working with the German Aerospace Agency, DLR, on further developments of a laboratory simulator for the capture and repair of satellites in space and training of astronauts. DLR has the distinction of sending out the first robot in space—ROTEX—with the Spacelab D-2 mission in 1993. Motivated by the PI's work, DLR has constructed a laboratory simulator using two robots. This simulator will be used to experimentally validate theoretical studies on space robots and to help plan future space missions.

I. W. Hall (funded by the Fraunhofer Resource Center-Delaware)—*Testing of Aluminum Foams at Various Strain Rates and Microstructure Examination*. Metal foams have been identified as being of potential interest for several applications including, for example, a filler material to increase the stiffness of automobile bodies, to provide improved energy absorption for low-velocity or shock impact, and to provide fire resistance. This program focuses on characterizing the high-strain-rate properties of a closed-cell metal foam by generating high-strain-rate compression data. Specimens are also being characterized by quantitative optical microscopy to determine characteristic cell size distribution, and the deformation modes are being studied by performing in-situ compression tests.

J. Q. Sun (funded by the State of Delaware and New Holland North America, Inc. through the Delaware Research Partnership)—*Development of Standard Adaptive Controls for Precision Agriculture Equipment*. The overall goal of this project is to improve the computer controllers for precision agriculture equipment, which involves the use of satellites to enable the application of precise amounts of pesticides and chemical fertilizers only where they are needed. The control algorithms and physical system models developed during this project will enable future equipment and control system design to provide robust and adaptive controls for other precision agriculture equipment using New Holland's task controller.

H. Wang (funded by the Air Force Office of Scientific Research through a subcontract from Princeton University)—*Optimization of a Comprehensive Detailed Chemical Kinetic Model for Simulating High-Speed Propulsion*. The aim of this research project is to develop a comprehensive, unified, and detailed chemical kinetic model of hydrocarbon-fuel combustion using solution mapping and constrained optimization. This model is designed to predict a wide range of fundamental combustion characteristics, including laminar flame propagation rate, shock-tube ignition delay, ignition and extinction of premixed and nonpremixed flames, and the rate of pollutant formation. The fully optimized and validated model can be used for the simulation and design of highly efficient, low-emission combustors.

A. S. Wexler (funded by the Public Health Service) with S. Binder-Macleod (Physical Therapy)—*Force Optimization*. Electrical stimulation of skeletal muscle can be used to assist individuals paralyzed due to central nervous system dysfunction to perform functional movements. Muscle fatigue, however, is a major limitation in the practical use of this approach. The studies will provide information needed to identify stimulation patterns that maximize force and minimize fatigue under a variety of physiological conditions. The model will allow clinicians and researchers to predict the optimal activation pattern for individual subjects under a variety of physiological conditions based on their responses to a single brief train of pulses.

ME Faculty Win Composites Awards

Two ME faculty members were honored at the American Society for Composites (ASC) Thirteenth Technical Conference in Baltimore on September 23, 1998. Dr. Tsu-Wei Chou, Jerzy L. Nowinski Professor, received the ASC Award for outstanding research, and Dr. Jack R. Vinson, H. Fletcher Brown Professor, received the Technomic Award for outstanding contributions in service, applied research, and education.

Established in 1988, the ASC Award has been won by a number of prominent researchers in the field of composites. The Technomic Award was established in 1995 and is given by the Society in conjunction with Technomic Publishing Company, a leading publisher of composites-related books, journals, and proceedings.

Chou and Vinson have both been active in composites research and education at the University for almost three decades. Vinson, founder of the Center for Composite Materials and the Center's first Director, taught the first course in composite structures at UD in the fall of 1969. The following semester, Chou initiated a course on composites with an emphasis on the material aspects of the topic.



Dr. Tsu-Wei Chou

"It was a proud moment for me to be present at the banquet and the awards ceremony where faculty from our department were being recognized for their efforts with a standing ovation, said Prof. Suresh Advani, Interim Chair of ME.



Dr. Jack R. Vinson

Class Notes

William H. Just 63BME of Atlanta is founder and corporate president of Total Association Management Service Inc., providing management services to national and international professional associations.

William G. Mavity 72BME of Los Altos, Calif., is president and chief executive officer of InnerDyne Inc. in Sunnyvale, Calif.

Carl Moore 74BME of Wilmington, Del., sings in the Regina Coeli choir.

John R. Lombardo 82BME of Marietta, Ga., is an engineering and construction manager for Tricon Global Restaurants Inc.

Eugene T. Camponeschi, Jr. 90 PhDME of Severna Park, Md., has been elected chairperson of Committee D30 on

Composite Materials of the American Society of Testing and Materials.

Ronald Jasper 91BME of Folsom, Pa., is an engineer for Bell Atlantic in Williamstown, N.J.

James F. Alesi 96EG of Blackwood, N.J., is pursuing a master's degree in education at the University of Delaware, with the goal of becoming a high school physics instructor.

Gerard Bijwaard 63MME and **Patricia Burke Bijwaard** 64MHP are retired and living in Roanoke, Va.

MARRIAGES

Richard Irwin 86BME is a systems engineer with TeKnowledge in Cherry Hill, N.J. and **Catherine Platt Irwin** 82BA is employed by the DuPont Company and is pursuing a degree in mental health counseling. The couple lives in Newark, Del.

Edward J. Stewart 94BME is pursuing a Ph.D. in applied ocean science at the University of Delaware, and **Loisa Hartenstein** 95BA is a research assistant and a safety manager at Analytical Biological Service Inc. in Wilmington, Del. The couple resides in Bear, Del.

Michael T. Galbus 91BME is a process engineer for Allied Signal Inc. **Crystal Splitteroff Galbus** 92BA is a Web page designer with American Express Corp. The couple lives in Chandler, Ariz.

DEATHS

Urban F. Pizzala 44BME of Greenville, Del., Nov. 19, 1997.

Augustus J. Shank 48BME of Merced, Calif., June 30, 1997.

Richard W. French 29BME of Dallas, Dec. 16, 1997.

James M. Flounders 34BME of Melbourne, Fla., Dec. 25, 1997.

John T. Grabowski, Sr. 50BME of Newark, Del., March 12, 1998.

David L. Bennett 67BME 68MME of Wilmington, Del., March 2, 1998.

Thomas E. Hume 76BME of Wilmington, Del., Feb. 13, 1998.

Mechanical Engineering Department 1998 Honors Day Awards

SENIOR YEAR AWARDS

Faculty Award to the Distinguished Senior in Mechanical Engineering • \$295.00

For the extraordinary senior Mechanical Engineering student who has demonstrated creativity, academic accomplishment, and achievement as determined by the faculty of the department.

Joseph J. Salvia II

Delaware Section of the American Society of Mechanical Engineers Senior Design Project

For achievements in the senior design project based upon the final design presentation as judged by members of the Delaware Section of the ASME with the concurrence of the faculty.

AWARDS:

First Place • \$100.00

Team 5, Metal Foam Injection System

Sponsor: Fraunhofer Research

Center-Delaware, represented by

Dr. Chin-Jye (Mike) Yu

Members: **Dina Berlingieri, Harminder Parmar, Shawn Riley, and Stephanie Simpson**

Simpson

Advisor: Dr. Azar Parvizi-Majidi

Mission: To design, assemble, and test a

system that will inject molten metal foam.

Second Place • \$75.00

Team 2, Rocket Sled

Sponsor: Army Ballistics Lab, Aberdeen,

MD, represented by Mr. Jack Armstrong.

Members: **Tom Bartoski, Brian Bitter,**

Brian Dearolf, Rob Gifford, and

Tom Koehler

Advisor: Dr. Leonard Schwartz

Mission: To design, assemble, and test a

rocket sled that tests the impact of a pro-

jectile on a target at supersonic speeds.

Third Place • \$50.00

Team 6, Bridge Protection System

Sponsor: Delaware River & Bay

Authority and Hardcore DuPont,

represented by Mr. George Tunis

Members: **Nik Bhate, Brandon Clark,**

Neil Smith, and Scott Suhmann

Advisor: Dr. Jack Vinson

Mission: To design, fabricate and test a

working scale model of an energy dissipating

bridge protection system that gives

meaningful information towards replacing

the current fender system on the Delaware

Memorial Bridge.

MEEG 101 Undergraduate Teaching Assistant Award

In recognition of selected Senior ME stu-

dents, who developed their leadership,

communication, and teaching skills by

providing support to new ME students in

the Introduction to Mechanical

Engineering class.

Brian Givens and Jeffrey Lawrence

JUNIOR YEAR AWARDS

W. Francis Lindell Mechanical Engineering Achievement Award • \$800.00 each

For junior Mechanical Engineering stu-

dents in recognition of scholarship

and creativity in engineering as recom-

mended by the students and faculty of

the department.

Justin Schaffer and Ricardo Blackett

Thiokol Corporation Scholarship • \$1,000

For a junior Mechanical Engineering

student in recognition of outstanding aca-

ademic achievement.

David Geesaman

OTHER DEPARTMENT AWARDS

Delaware Section of the American Society of Mechanical Engineers Outstanding Student • \$100

To the outstanding student in the

Delaware Section of the ASME.

Shawn Riley

American Society of Mechanical Engineers Student Section

A certificate to an outstanding member

of the ASME Student Section for good

academic standing and valuable contri-

butions to the chapter.

David Rabeno

Robert T. Bosworth Scholarship • \$1,000

To student majoring in Mechanical

Engineering with both outstanding acad-

emic achievement and financial need.

Sharon Collyer

Redden Scholarship • \$1,400 each

To student majoring in Mechanical

Engineering with both outstanding acad-

emic achievement and financial need.

Brandon Fichera and Gregory Frantz

Star Enterprise Scholarship • \$2,000

To student majoring in Mechanical

Engineering with outstanding academic

achievement.

Scott Quirico

Fraunhofer Resource Center-Delaware, 1998 Achievement Award

In recognition of outstanding contributions

to the Center's research and development

objectives.

Winners: Senior Design Team 5, Metal

Foam Injection System.

Dina Berlingieri, Harminder Parmar,

Shawn Riley, and Stephanie Simpson

Student Engineers Display Innovative Design Projects

Adapted from UD *UpDate*, Vol. 17, No. 33, May 28, 1998

Innovative inventions have been the hallmark of the mechanical engineering senior design class since 1976, and this year's projects ranged from a lunar rover for an educational space program to a bike bridge.

Taught this year by Dick Wilkins and Michael Keefe, the class functions as a pseudo-company, New Castle Design Associates. Students are divided into teams and are linked with clients to design and manufacture products that meet specific needs.

At the end of the year, the teams display their inventions, make presentations, and are judged by members of the Delaware Section of the American Society of Mechanical Engineers.

This year's winning team designed an injection gun, a system for injecting molten metal foam while maintaining a desired temperature. The client was the Fraunhofer Research Center-Delaware, and the team's advisor was Azar Parvizi-Majidi.

According to Wilkins, the device can be compared to a glue gun. But, while a glue gun uses plastic at low temperatures, the injection gun is designed for light metals at high temperatures that must be carefully regulated. The injection gun is a prototype for a system for structural applications, such as injecting light metal into the inside of a car door, for example.

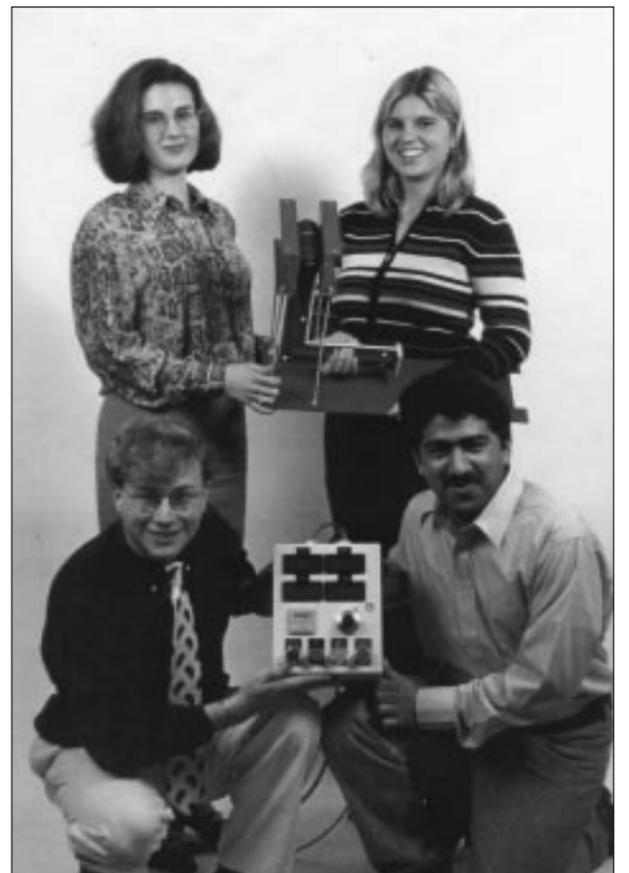
In addition to winning first place, the group was awarded the Fraunhofer Resource Center-Delaware Achievement Award, which consists of a plaque and a cash award.

The second-place team designed a rocket sled that tests the impact of a projectile on a target at supersonic speeds. The customer was the U.S. Army Ballistics Laboratory at Aberdeen, Md.

The third-place award was for a bridge protection system, using a working scale model that can provide meaningful information about the fender system of the Delaware Memorial Bridge. The cus-

tomers for this project were the Delaware River and Bay Authority and Hardcore DuPont.

The winning team in the mechanical engineering senior design competition are shown with their metal foam injection gun, developed for Fraunhofer Resource Center. From left, (standing) are Dina Berlingieri and Stephanie Simpson and (kneeling) Shawn Riley and Harminder Parmar. Photo by Gwynn Lyell



From the Great Bambino to the Big Mac: ME Alumni Live to See Sixty-Plus Years of History After Graduation

By Diane S. Kukich, 73BA, 84MA

It's 1927. Babe Ruth hits a world-record 60 home runs for the New York Yankees, the Ford Model T enters its final year of production, Calvin Coolidge is President, and Irvin S. Taylor is a freshman mechanical engineering student at the University of Delaware.

Taylor, who earned his BSME in 1930, is one of 26 living alumni from the decade between 1930 and 1939. He is the sole survivor of the class of 1930, while the remaining class years in the decade have from two to four living alumni each. A resident of Hockessin, Del., Taylor joins nine other alumni from the thirties as a citizen of the First State. Florida and Maryland are the next most popular states, with three MEs each; New Jersey, Pennsylvania, Georgia, and Texas each have two, while California and South Carolina each claim one. The oldest of these alumni, now approaching 90 years of age, were born shortly after the first Model Ts hit the road, while the younger ones were born as World War I was coming to an end.

Taylor may be living proof that mechanical engineering is "the liberal arts of engineering," as the current ME Web site proclaims. Despite earning his degree in this discipline, he never worked in the field. "I tanned leather, did some textile work, and finally ended up in the insurance business," he says. "There weren't too many jobs back then in anything, so I didn't get to use much of my education."

Unlike the graduates of the later years of the decade, Taylor attended classes in post-War wooden buildings—it wasn't until the year he finished his studies at UD that Evans Hall was completed and dedicated. Otherwise, the 1930s might seem to be years that little of import hap-



pened on the UD campus: a catalogue of significant dates in the University's history on the Internet lists nothing between 1921 and 1945.

It's no accident that all 26 alumni from the 1930s are white males. Coeducation did not become the rule at Delaware until 1945, while black students were not admitted until 1948. Although coeducation was "permitted with conditions in senior and junior classes" as of 1938, Taylor's interactions with women were limited to the library, a common meeting place between the Women's College and the University of Delaware.

The crowds of students walking the mall to classes were much smaller six decades

ago—the entire student body didn't exceed 1,000 until after World War II. The view on the mall was quite a bit different, too. Photos from that era show that the stately elms gracing the campus in recent years were mere saplings back then. The campus was also a much quieter place 60 years ago. "I don't know much about what's happening on campus now except what I read in the paper," Taylor says, "but we had a lot less partying back then."

Although annual in-state tuition didn't climb into the \$1,000+ range until the 1970s, paying even the nominal fees of the 1930s was not a trivial matter. Colonel Wilmer K. Benson (37BME) of Gaithersburg, Md., recalls holding down three or four jobs, all at the same time, in order to stay in school.

"I served as treasurer of my fraternity, which paid my fraternity dues; as a waiter in the dining room, which got me my meals; and as a lab assistant in both mechanical engineering and physics, which helped pay my tuition," he says of his Depression-era education. He was also in ROTC, which paid about \$25 a month. Immediately upon graduation, Benson accepted a direct commission into the Army Corps of Engineers, where he served for 30 years.

Benson also spent 15 years as an income tax consultant, an activity he gave up only recently. Several of the other alumni from the late 1930s have remained active professionally into the 1990s. As of late 1997, George Stradley (37BME) of Spring, Texas, was active as a consulting engineer, O. L. Richardson (39BME) of Roswell, Ga., as a self-employed construction engineer, and Julius Reiver (38BME) of Wilmington, Del., as a member of the Commemorative Coin Committee to Advise Congress.

These alumni grew up long before the technological age. They were children back when kids played sandlot baseball rather than organized sports. But Reiver, a Fellow of the American Numismatic Society (ANS), lived long enough to have his picture appear on the ANS Web site; and Earl McCord (39BME), captain of the 1938 UD soccer team, survived to see formal participation in his sport grow to include almost half of the kids in America's suburbs.

And along with the 24 other living ME alumni from the 1930s, they were around when Babe Ruth set a home-run record in 1927 that had lasted 34 years and when Mark McGwire broke another that had lasted 37.

Faculty Awards

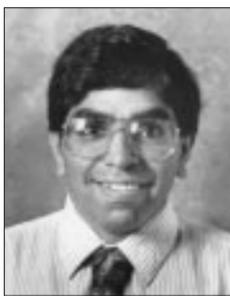
Dr. Ajay Prasad, Associate Professor, was one of seven faculty to receive the University of Delaware's Excellence in Teaching and Excellence in Advising awards during Honors Day ceremonies on May 8, 1998.

In recognition of outstanding teaching, and recommended by written evaluations from students, each honored faculty member received a \$2,500 award from funds made available by the Christian R. and Mary F. Lindback Foundation and the University of Delaware Alumni Association.

Research Focus on Biomechanical Engineering

by Diane S. Kukich, 73BA, 84MA

Linkages. Fluid flow. Structural mechanics. These topics are typical areas of study and research in the field of mechanical engineering, but the average person seldom thinks of them with reference to the human body. However, biomechanics researchers in ME are applying all of these principles to the field of medicine. "The human body is basically a mechanical system characterized by fluid flows and structural and dynamical components," says Prof. Suresh Advani, Acting Chair of ME and a member of the research group working in the area of biomechanics.



Suresh G. Advani

The research covers many areas including musculoskeletal modeling, prosthetic design, kidney modeling, respiratory analysis, neural control, and sports medicine. According to Advani, research in these areas is generally done in collaboration with other researchers from the biomedical industry, local hospitals such as the A. I. du Pont Institute, nearby medical schools such as Thomas Jefferson Medical School and the University of Pennsylvania, and/or other departments on campus such as



Sunil K. Agrawal



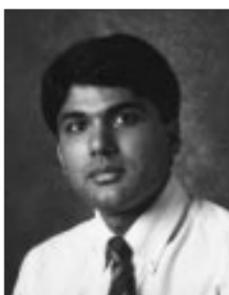
Thomas S. Buchanan

Physical Therapy, Exercise and Sports Science, and Computer Science.

In addition, many faculty members have appointments in the interdisciplinary Biomechanics and Movement Science Program and are members of the Orthopedic and Biomechanical Engineering Center (OBEC).

The following provides an overview of the biomechanics research in ME:

Musculoskeletal Modeling—Using biomechanical computer graphics models and medical imaging techniques, we are examining musculoskeletal disorders such as Juvenile Rheumatoid Arthritis of the wrist and osteoarthritis of the knee. In addition, robotic models of the spine are being developed to aid in surgical procedures. Finally, models of muscle dynamics are being used to study muscle fatigue and functional electrical stimulation.



Ajay K. Prasad

Prosthetic Design—We are using composite materials to design artificial hip joints. Composite materials allow the stiffness of the artificial joint to match

that of the human bone, which eliminates some of the problems that often lead to loosening and failure.

Artificial Kidney—Models of the renal concentrating mechanism are critical for understanding the kidney. We are developing physiologically based models that characterize transport through the kidney.

Respiratory Analysis—Using fluid mechanics and medical imaging methods, researchers are able to model the air flow in the nasopharynx and lungs for specific patients. Of particular interest in this work is its application to the study of sleep disorders such as apnea and the transport of air pollutants in the lungs.

Neural Control—The way the nervous system controls muscles in the limbs is of particular importance to the understanding of spasticity due to cerebral palsy or stroke. In addition, by coupling electromyographic recordings with the aforementioned musculoskeletal models, we are developing virtual reality models of the human arm, which can be used to study neural control mechanisms.



Jian-Qiao Sun

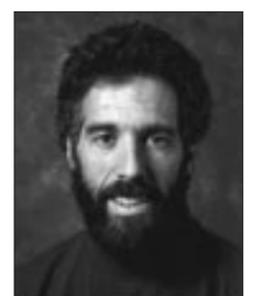
Sports Medicine—We are studying knee joint stability in patients with knee ligament disorders. Many patients in these groups use their muscles differently from unimpaired subjects. We are using

biomechanical methods to predict the outcomes of patients with ligament injuries.



Lian-Ping Wang

To facilitate research in this general area, the Orthopedic and Biomechanical Engineering Center (OBEC) is an interdisciplinary center administered through the Department of Mechanical Engineering. OBEC's mission is to provide engineering science and clinical technology to reduce the impact of disease on the everyday life of individuals. It was created to provide an appropriate forum and infrastructure to promote the interaction of researchers from the University and the medical community. As such, it serves as a research umbrella under which researchers from a variety of fields can collaborate.



Anthony S. Wexler

Faculty actively conducting research in biomechanics include S. G. Advani, S. K. Agrawal, T. S. Buchanan, A. K. Prasad, M. H. Santare, J.-Q. Sun, L.-P. Wang, and A. S. Wexler. Information about each professor's work can be found on the Mechanical Engineering web site (www.me.udel.edu).

Department Wins Air Force Grant for Global Range Transport Program

A new research program has been awarded to the Mechanical Engineering Department by the Air Force Office of Scientific Research (AFOSR). Entitled "Advanced Composite Material Research for the New World Vistas," the \$1.4-million, three-year initial grant will support research focused on structures and materials aspects of the Global Range Transport (GRT) envisioned in the New World Vistas Program of the U.S.A.F. The GRT is planned to be available in the year 2020, will have a gross weight of some 900,000 lbs., and will deliver people and materiel anywhere in the world from its continental United States base. The fleet of GRTs must be capable of providing 49–52 million ton-miles per day for uses by the Air Mobility Command.

The new research program will be directed primarily toward research of the fuselage structure to carry the cargo described above. The fuselage

investigation will be focused on a non-cylindrical shell shape, complex in that it will consist of shell and plate elements to maximize the ratio of internal volume to structural weight. To effect this, sandwich construction as well as other advanced composite material constructions will be investigated. Sandwich configurations that are midplane asymmetric and/or of varying thickness will be studied to reduce bending stresses in the complex

fuselage shell. Woven, braided, three-dimensional, and hybrid composites will be studied along with more conventional laminates to provide the lightest, most durable structure. Since 65 percent of the cost of composite structures is in processing, various resin transfer molding (RTM) and resin infiltration processes (RIP) will be studied analytically and experimentally to develop the best processing methods to employ.

In the research, typical GRT loading and environments will be studied and used. Thermoelastic, aerodynamic, vibration, and cargo loads will be investigated for short-term analysis, as well as for the viscoelastic, creep, and damage accumulation effects of long-term loads.



The research in this initial grant will be conducted by a nine-person team, with Dr. Jack R. Vinson, H. Fletcher Brown Professor of Mechanical

Engineering, as the Principal Investigator. Other researchers at the University of Delaware are Dr. Tsu-Wei Chou, Jerzy L. Nowinski Professor of Mechanical Engineering; Professor Suresh Advani; and Associate Professor Jian-Q Sun. Working with them are two researchers at the University of Cincinnati, and one researcher each at the Georgia Institute of Technology, the Ohio State University, and the University of Missouri.

University Launches First-Ever Comprehensive Fund-Raising Effort

On October 2, the University of Delaware launched the first-ever fund-raising effort in its history. The Campaign for the University of Delaware, a five-year, \$225-million initiative, hinges on the notion that our future depends on our present. What we do now to ensure the continued viability of top-flight teaching, research, and public-service programs will have a profound impact in the years to come.

The College of Engineering is a key component of the campaign, with a goal of \$41.4 million. A focus of the Campaign will be on raising private gifts to support endowment for faculty chairs and professorships, graduate fellowships, and undergraduate scholarships. Thirty-five percent of the goal is dedicated to this endowment effort. The remaining 65 percent is divided among raising dollars for a new 60,000 square-foot addition to DuPont Hall, for equipment and teaching aids, and for annual operating support of the College.

The Campaign will be led by a National Steering Committee to be co-chaired by Charles M. Cawley, Chairman and Chief Executive Officer of MBNA America; Robert W. Gore (Engineering Class of '59), President and Chief Executive Officer of W. L. Gore & Associates, Inc.; Jack A. Krol,

Chief Executive Officer of E. I. DuPont de Nemours and Co., and P. Coleman Townsend (Agriculture and Natural Resources Class of '69), President and Chief Executive Officer of Townsends, Inc.

The College of Engineering is in the process of forming a steering committee to guide the College's efforts in the Campaign.

A key component of the Campaign for the College of Engineering will be the continuing quest for annual gifts to support the operations of the College. Annual gifts made to the Department of Mechanical Engineering will be included in the Campaign total and will go a long way towards helping the College meet its fund-raising goal. When contacted by the Annual Giving Office either by mail or over the telephone, please consider a generous gift to Mechanical Engineering. You can designate how you would like to see your gift used.

If you have any questions about the Capital Campaign or the Annual Giving effort, contact Stewart H. Stabley, Director of Development for the College of Engineering, by mail at 200A Academy Building, Newark, DE 19716, by telephone at (302) 831-3043, or by e-mail at Stewart.Stabley@mvs.udel.edu.

UNIVERSITY OF
DELAWARE



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