Graduate Study in Computational and Applied Mathematics

WELCOME

The Computational and Applied Mathematics (CAM) graduate program at The University of Texas at Austin prepares students for the ever-growing applications of mathematical modeling. It will also lead you to a research area of growing significance within the mathematical sciences.

Today, mathematical modeling is used to simulate everything from aircraft wing design to black hole collisions to the evolution of the sun's magnetic field. Our program will prepare you to assimilate the most complex concepts of engineering, math and physics, placing you at the forefront of high technology's spiraling development.

CAM is interdisciplinary in content, scope and structure. You will complete advanced coursework in mathematics and computer science, and in a field of science or engineering or both. CAM draws faculty from the Colleges of Engineering and of Natural Sciences.

We hope that you will choose the CAM graduate program at UT-Austin to complete your graduate study. Please refer to the helpful numbers listed at the back of this brochure for additional information. Regardless of where you choose to pursue graduate study, we wish you success.

1 UT-Austin

UT-Austin is a major public research university with over 1,000 endowed faculty positions (more than any other public institution) and the second largest endowment in the nation. With 50,000 students, UT-Austin is an important presence in the city of Austin, Texas, the seat of state government and the home of numerous cultural institutions and recreational areas.

Academics.

A diverse faculty includes two Nobel Prize winners in chemistry and physics and two Pulitzer Prize winners in fiction and history. Additionally, many faculty have been elected to membership in prestigious scholarly organizations in recognition of contributions to their fields. These include

16 National Academy of Science members, 29 National Academy of Engineering members, 17 American Academy of Arts and Sciences members, and 21 members of the American Law Institute. The UT-Austin campus educational and research facilities. Our library is llbrary in the United campus librarles includ Engineering Library (the nation's eighth largest), one of the world's most important collections of Latin-American literature and the finest legal research facility in the Southwest. In addition, the Harry Ransom Humanities Research holds one of the world's leading depositories of modern English, French and Italian literature. Anthony Hobson's *Great Libraries* – a listing which singled out only five U.S. libraries – ranked UT Austin's library system among the world's 32 great libraries.

Research. A $223 million research budget in 1992-93 helped UT-Austin investigators explore everything from ancient Mayan hieroglyphics to robots performing tasks too hazardous for humans. Our research facilities are among the best in the United States. Eighty-seven organized research units are complemented by interdisciplinary and crossdisciplinary research programs.

Our facilities include the Balcones Research Center – a 475-acre tract home to 21 science, engineering and archeology laboratories – and extensive computer facilities. The latter furnish access to mainframe terminals, microcomputers and a Cray Y-MP8/486 supercomputer linked to a high-speed telecommunications network. All are available to academic departments and research centers, as well as to individual faculty, staff and students.

Culture. UT-Austin students can choose from a broad spectrum of activities held conveniently on-campus. The College of Fine Arts presents almost 1,000 arts events each year featuring faculty, students and visiting artists. Scheduled events include recitals, plays, musicals, operas, art exhibitions, and dance concerts. The Performing Arts Center, a complex of seven performance spaces, also brings many internationally and nationally known performers to UT-Austin. Discount rates are available to students for both UT and PAC productions.

Some of the world's greatest works of art are displayed as a part of touring exhibits at the Archer M. Huntington Art Gallery, adding to UT-Austin's permanent holdings which represent the entire range of art history.

2 College of Engineering

An outstanding, dedicated faculty combined with extensive research facilities make UT-Austin's College of Engineering one of the best in the United States.

Engineering has been pivotal to the development of a wide array of technological innovations which we take for granted today. It is clear that engineering will continue to make key contributions as our nation's technological needs evolve over the coming decades. The challenges of bringing new products, processes and materials to commercial reality while maintaining a leadership position in established technologies will require engineers with advanced graduate education.

The environment for engineering graduate study at UT-Austin is outstanding. Students develop a broad range of skills and knowledge which enables them to adapt and contribute to changing technologies and go beyond the bounds of conventional engineering practice. Graduate research experience at UT-Austin is enriched by input from fellow students and faculty, as well as our superior facilities.

Faculty. The UT-Austin faculty have distinguished themselves in the classroom, the laboratory and their respective industries. Examples of excellence include Dr. Herbert Woodson, dean of the College, who was named the 1990 Engineer of the Year by the National Society of Professional Engineersthe organization's highest honor.

Overall, the College has consistently ranked among the top five engineering colleges nationwide with at least ten faculty members of the NAE. A total of 12 College of Engineering professors had work sponsored through the National Science Foundation Young Investigator Award program in 1993. In addition, Dr. Rebecca Richards-Kortum of the electrical and computer engineering department was designated an NSF Faculty Fellow.

Research. Engineering graduate students are heavily involved in the $63 million in research conducted annually by the College. Graduate students can work with a wide variety of industrial-scale equipment including two Cray supercomputers; the 60 megajoule, nine megamp Balcones Homopolar Generator (HPG), which is the highest current-rated pulsed power supply in the world; and an industrial-size distillation and adsorption tower.

The College's interdisciplinary research programs in computer engineering, manufacturing systems engineering, materials science and engineering, and microelectronics are housed at Balcones Research Center in a $22 million facility.

Employment. As the need for technically educated professionals increases, an advanced degree in engineering provides additional career choices and more challenging assignments. The College's Career Assistance Center helps students with their job searches by offering individual career counseling. Both past and present students can receive information about resume writing, career options and job search techniques. Large companies seeking engineering graduates to fill positions worldwide schedule on-campus interviews through the Center.

3 College of Natural Sciences

The College of Natural Sciences is a dynamic academic college constantly striving to attain high levels of excellence in teaching and research. Instruction and research in the College covers an array of subjects and interests ranging from human nutrition and artificial intelligence to the structure of matter and molecular genetics.

The College, which celebrated its 20th anniversary during the 1989-90 academic year, was part of the College of Arts and Sciences until 1970. However, some components of the College – mathematics, physics and chemistry – existed since UT-Austin's inception.

The College has grown into 11 academic departments, one teaching division, 29 organized research centers, and three central user facilities. Students and faculty take advantage of this rich intellectual environment to investigate the full spectrum of modern natural sciences.

Departments. Academic departments and research centers are clustered into five general categories: Life Sciences, including the Division of Biological Sciences and the Departments of Botany, Microbiology and Zoology; Physical Sciences, including the Departments of Astronomy, Chemistry and Biochemistry, and Physics; Mathematical Sciences, including the Departments of Computer Sciences and Mathematics; Earth Sciences, including the Departments of Geological Sciences and Marine Science; and Human Ecology, encompassing Nutrition and Child Development.

Faculty The College's faculty is a distinguished group whose excellence is amply demonstrated by their success in obtaining research support from local, state and federal agencies. Consistently, faculty members in the College garner fully one-third of research funds granted to UT-Austin.

Within the College, a leading role in the CAM graduate program is taken by the Mathematics Department which has more than one-quarter of the CAM faculty in its ranks. Its entire faculty is composed of 70 full-time members who are recognized nationally for their strength in teaching and research, including two MacArthur Award winners and past recipients of the Cole, Salem and Wiener Prizes. The department has strong programs in Algebra, Analysis, Topology, and Mathematical Physics. It also has one of the best department computer networks on campus, featuring an extensive array of mathematical software.

4 CAM

The CAM graduate program, interdisciplinary by design, requires students to develop competencies in three concentration areas: applicable mathematics, numerical analysis and scientific computation, and mathematical modeling geared toward applications in a science or engineering discipline. Within these broad areas, students may take courses and conduct research in numerical analysis and scientific computing, applicable mathematics, computational mechanics and physics, parallel computing and computer architecture, mathematical modeling, and in supporting engineering and science areas involving mathematical modeling of physical phenomena and engineering systems.

Research for CAM theses and dissertations must demonstrate an interdisciplinary theme and draw on knowledge from the CAM disciplines. Each student must develop a program ol study that lncludes a substantla component from the three concentration areas.

Master of Science The M.S. requires completion of 33 semester hours of coursework including a research report, or 36 hours of coursework without a report. At least 24 hours must be taken for a letter grade from the three concentration areas, with at least six hours from each area.

Doctor of Philosophy In addition to developing a program of study, to become a Ph.D. candidate students must pass a qualifying exam in each concentration area. Students must prepare a written dissertation proposal; an oral presentation of the proposal and an oral examination on the underlying subject matter are also required.

5 Concentration areas

Course offerings are categorized according to the three concentration areas below. The first two concentration areas comprise courses joint listed with supporting graduate programs from the Colleges of Engineering and of Natural Sciences.

5.1 Area A: Applicable Mathematics

- CAM 381D, Complex Analysis
- CAM 681E, Real and Abstract Analysis
- CAM 381M, Methods of Mathematical Physics
- CAM 381N, Methods of Mathematical Physics
- CAM 684C, Theory of Probability
- CAM 684D, Mathematical Statistics
- CAM 386M,Functional Analysis in Theoretical Mechanics
- CAM 386N, Qualitative Methods in Nonlinear Mechanics

- CAM 391, Introductory Dynamical Systems
- CAM 391C, Topics in Analysis
  - Fourier Analysis
  - Wavelets
  - Advanced Dynamical Systems
- CAM 393C, Topics in Applied Mathematics
  - Methods of Applied Mathematics
  - Approximation Theory
  - Introduction to Partial Differential Equations
  - Abstract Cauchy Problems and Nonlinear Partial Differential Equations
  - Nonlinear Wave Equations
  - Euler and Navier-Stokes Equations
  - Pseudodifferential and Fourier Integral Operators
  - Statistical Mechanics
  - Ergodic Theory
  - Quantum Mechanics
  - Bifurcation Theory
- CAM 394C, Topics in Probability and Statistics
  - Nonparametric Statistics
  - Advanced Probability

5.2 Area B: Numerical Analysis and Scientific Computation

- CAM 380N, AlgorithmsforParallel and Distributed Computation
- CAM 381C, Computational Physics
- CAM 382L, Numerical Methods in Petroleum Engineering
- CAM 383, Special Topics in Petroleum Engineering
  - Numerical Solution of Time-Dependent Problems
  - Topics in Computational Methods
- CAM383C, NumericalAnalysis. LinearAlgebra

- CAM383D, NumericalAnalysis: Interpolation,Approximation, Quadrature, and Differential Equations
- CAM 384G, Computer Graphics
- CAM 386K, Numerical Treatment of Differential Equations
- CAM 393D, Topics in Numerical Analysis
- CAM 393M, Numerical Solution of Elliptic Partial Differential Equations
- CAM 393N, Numerical Methods forFlow and Transport Problems
- CAM 394F, Finite Element Methods
- CAM 394G, Computational Techniques in Finite Elements
- CAM 394H, Advanced Theory of Finite Element Methods
- CAM 195T, 295T, 395T, Topics in ComputerSciences: Parallel Cornputations
  - Parallel MethodsforNumerical Algorithms
  - Parallel Algorithms and Architecture Parallel Programming
- CAM 397, Topics in Computational and Applied Mathematics
  - Supercomputing in Computational Mechanics
  - Grid Generation, Adaptive Grids, and Multigrids
  - Advanced Computational Fluid Mechanics

5.3 Area C: Mathematical Modeling and Applications

Courses in mathematical modeling and applications are offered in several areas of science and engineering Four groups of courses from which this concentration area might be developed are given as examples below Other examples are fluid dynamics, control theory, semiconductors, celestial mechanics, chemistry, and the theory of relativity Concentrations in mathematical modeling and applications are also available in various departments; these may be included in computational and applied mathematics degree programs with the approval of the Graduate Studies Committee.

Solid and Continuum Mechanics

- Engineering Mechanics 380, Theory of Plasticity
- Engineering Mechanics 388, Solid Mechanics I

- Engineering Mechanics 388F, Fracture Mechanics
- Engineering Mechanics 388L, Solid Mechanics II
- Engineering Mechanics 394V, Wave Propagation I
- Engineering Mechanics 394W, Wave Propagation II

Fluid Mechanics

- Aerospace Engineering 382Q, Fluid Mechanics
  - Turbulent Fluid Mechanics
  - Finite Difference Methods in Computational Fluid Dynamics
  - Advanced Problems in Compressible Flow
- Aerospace Engineering 382R, Aerodynamics
  - Low-Speed Aerodynamics
  - High-Speed Aerodynamics
  - Hypersonic Aerodynamics
  - Theoretical Gas Dynamics
  - Advanced ComputationalAerodynamics
- Chemical Engineering 381N, Fluid Flow and Heat Transfer
- Engineering Mechanics 387, Foundations of Fluid Mechanics
- Engineering Mechanics 393K, Advanced Fluid Mechanics I: Inviscid Flow
- Mechanical Engineering 380Q, Mathematical Methods in Engineering
  - Perturbation Methods
  - Spectral Methods in Fl id Dynamics
  - Mechanical Engineering 381P, Dynamics of Fluids
  - Incompressible Flow I: Theory
  - Dynamics of Turbulent Flow
  - Incompressible Flow II. Applications
  - Modeling of Turbulent Flows

Nonlinear Dynamics

- Aerospace Engineering 388P, Celestial Mechanics
  - Hamiltonian Mechanics
  - Celestial Mechanics I
  - Celestial Mechanics II
  - Satellite Theory
  - Theory of Orbits I
  - Theory of Orbits II
  - Regularization
  - Engineering Mechanics 381,Advanced Dynamics

System and Control Theory

- Aerospace Engineering 381P, System Theory
  - Linear Systems Analysis
  - Multivariable Control Systems
  - Optimal Control Theory I
  - Optimal Control Theory II
  - Statistical Estimation Theory
  - Advanced Topics in Estimation Theory
  - Stochastic Estimation and Control
- Electrical Engineering 380K, Introduction to System Theory
- Electrical Engineering 380N, Topics in System Theory
  - Nonlinear Systems. Input-Output Properties
  - Nonlinear Systems: Geometric Theory
  - Stochastic Control Theory
  - Stochastic Dynamical Systems
- Mechanical Engineering 390R, Engineering Statistics and Probability
  - Time-Series Analysis
  - Applied Stochastic Processes
  - Regression and Analysis of Variance
  - Mechanical Engineering 391Q, OperationsResearch
  - Nonlinear Programming
  - Dynamic Programming

6 CAM Facilities

Extensive facilities support CAM graduate study. The Kuehne Physics- Mathematics-Astronomy Library contains 37,000 physics and astronomy volumes and 30,000 mathematics volumes, the McKinney Engineering Library maintains over 150,000 volumes and the Mallet Chemistry Library is one of the most complete chemistry libraries in the Southwest.

In addition, extensive computing facilities are available in the departments that support CAM for faculty and graduate students' research. An array of computer workstations are available including IBM RS6000s, Sun SPARC workstations, Alpha workstations, DECstation 5000s, DEC VAXstations, and SGI Indigo. Access is available to an Intergraph CAD Laboratory in the Civil Engineering Department, a Sequent Symmetry 81000 with 14 processors and a 4 processor Solborne for parallel processing in the Computer Sciences Department, and an Intel iPSC/860 with 32 processors and a CRAY Y-MP8/486 at UT-Austin's Center for High Performance Computing. Supercomputers located at national research centers are easily accessed. Internet, NSFnet, CSnet, and BITNET are also readily available.

7 TICAM

UT-AUSTIN has established the Texas Institute for Computational and Applied Mathematics to encourage interdisciplinary research in CAM's three component areas through the establishment of Research Centers in applied mathematics, engineering and computer sciences, and physics or an appropriate engineering discipline. Currently under development, these centers will furnish expertise for a changing collection of research groups called research clusters.

Projects related to fluid mechanics, thermodynamics and heat transfer, control theory and fusion are currently underway. One cluster focuses on parallel computing in computational fluid dynamics. Their goal is developing new algorithms for massively parallel computing of fluid dynamics phenomena which utilize experts or knowledge-based systems to improve effiency and accuracy. Their research involves calculations necessary to aircraft aerodynamic design to minimize drag. Another research cluster models black hole collisions to describe the gravitational waves emanating from them when they interact. Additionally, a research cluster investigates effects of scattering and radiation of sound waves on submerged bodies. Their research could lead to development of U.S. Naval software for submarine design.

TICAM features excellent facilities for joint work between graduate students and CAM faculty. This includes student offices, highperformance work stations, network connections to supercomputers, technical journals, and conference rooms. Students working with CAM faculty involved in institute programs are designated TICAM members and have access to TTCAM facilitie.s.

8 Faculty

8.1 ARISTOTLE ARAPOSTATHIS

Ph.D., Electrical Engineering,
University of California at Berkeley

Dr. Arapostathis has served on the electrical and computer engineering faculty since 1982. His teaching and research interests include analysis and estimation techniques for stochastic systems, application of differential geometric methods to design and analysis of control systems, stability properties of large-scale interconnected power systems, and stochastic and adaptive control theory. His main technical contributions are in the areas of adaptive control and estimation of stochastic systems with partial observations, adaptive control of nonlinear systems, geometric nonlinear theory, and stability of large scale interconnected power systems.

8.2 KENNETH S. BALL

Ph.D., Mechanical Engineering,
Drexel University

Dr. Ball has been a member of the UT-Austin mechanical engineering faculty since 1989. His teaching and research interests include computational fluid dynamics and heat transfer; hydrodynamical stability, transition and turbulence; chaos and dynamical systems theory; radiation heat transfer in participating media; buoyancy induced flows and transport phenomena; and numerical flow visualization.

8.3 ERIC B. BECKER

M.S., Architectural Engineering, University of Texas
Ph.D., Civil Engineering, University of California at Berkeley

Dr. Becker has been a member of the UT-Austin aerospace engineering and engineering mechanics faculty since 1966. His major areas of interest are in the development and application of finite element methods for non-linear problems in solid mechanics. His current research program involves study of elastomeric components, application of finite element methods to material damage at large strain, structural design and analysis of TOKAMAK vacuum vessels, and the modeling of coupled electromagnetic-mechanical systems.

8.4 WILLIAM BECKNER

Ph.D., Princeton University

Dr. Beckner joined the mathematics faculty in 1983. His teaching and research interests include Fourier analysis, differential geometry, partial differential equations, and probability. His work has centered on the proof of fundamental inequalities in Fourier analysis and the formulation of sharp limiting Sobolev inequalities with applications to geometric variational problems. His current research is directed toward the control of oscillatory phenomena by renormalization arguments, geometric analysis of higher-order differential operators with tensor structure, the conformal symmetry of critical phenomena and montonicity formulas in two-phase variational problems for partial differential equations. In addition, he is interested in symbolic computation and the development of mathematical software for scientific work stations.

8.5 ROGER T. BONNECAZE

Ph.D., Chemical Engineering,
California Institute of Technology

Dr. Bonnecaze joined UT-Austin in 1992 teaching in the chemical engineering department. His teaching and research interests include fluid mechanics of multiphase flows, transport and rheology of suspensions and granular materials, material processing of composites, and environmental transport of particles.

8.6 ALAN C. BOVIK

Ph.D., Electrical and Computer Engineering,
University of Illinois–Urbana-Champaign

Dr. Bovik has been an electrical and computer engineering, biomedical engineering, and computer sciences faculty member since 1984. His teaching and research interests include image processing, computer vision, threedimensional microscopy, and computational aspects of biological visual perception.

8.7 JAMES C. BROWNE

Ph.D., Chemical Physics,
University of Texas at Austin

Dr. Browne joined the physics and computer sciences faculty in 1968. His teaching and research interests include parallel architectures and parallel programming, performance measurement and analysis, operating systems, software engineering and VLSI synthesis. His early research career in computational physics adds familiarity with large scale computational problems. He is currently focused on integration of computer science with application discipline expertise.

8.8 MICHAEL D. BRYANT

M.S., Mechanical Engineering, Northwestern University
Ph.D., Engineering Science and Applied Mathematics, Northwestern University

In 1988, Dr. Bryant became a mechanical engineering faculty member. His teaching and research interests include mechanics, tribology, electrical contacts, precision engineering, manufacturing, control, design, active attenuation of vibrations, and robotic actuation. His interests span most areas of mechanical and electrical engineering, design and manufacturing, and mechanics; his work is both theoretical and experimental.

8.9 GRAHAM F. CAREY

Ph.D., University of Washington at Seattle
Director, Computational Fluid Dynamics Laboratory

Dr. Carey has served on the aerospace engineering and engineering mechanics faculty since 1977. His main areas of interest are in computational fluid mechanics, transport processes, finite elements, and algorithms. His current research program is concerned with finite element methodology and analysis, applied mathematics and mechanics; NavierStokes problems, semiconductor devices and process simulation; coupled heat flow, mass transport and electromagnetic efforts in viscous flows; application of supercomputers in computational mechanics; and nonlinear computations.

8.10 E. WARD CHENEY

Ph.D., University of Kansas

Dr. Cheney joined the mathematics faculty in 1964. His teaching and research interests include approximation theory, numerical analysis and extremum problems. He has published numerous articles and been sponsored as an invited speaker at over 150 conferences and colloquiums. He has authored or coauthored eleven books which include, Introduction to Approximation Theory,Approximation Theory in TensorProduct Spaces and Numerical Analysis: Mathematics of Scientific Computinq.

8.11 ALAN K. CLINE

Ph.D., Mathematics,
University of Michigan

Dr. Cline has served on the mathematics and computer sciences faculty since 1975. His teaching and research interests include numerical analysis, scientific visualization and mathematical software. He is interested in the transformation of mathematics into tools which can be applied to scientific problems. This involves the construction of mathematical software and the exploration of methodologies for mathematical software. In particular, a major software development has been a package of over one hundred subprograms for curve and software fitting employing tension splines.

8.12 JAMES W. DANIEL

Ph.D., Mathematics,
Stanford University
Director, UT-Austin Actuarial Program

Dr. Daniel joined the faculty in 1970. His teaching and research interests include actuarial science and numerical computation. During 1983-85, he served as the U.S. Navy's chief scientist for basic research in Europe and the Middle East.

8.13 RAFAEL DE LA LLAVE

Ph.D., Princeton University

Dr. de la Llave has served on the mathematics faculty since l989. His teaching and research interests include finding ways to describe the long-term behavior of systems where rules of evolution are given, as well as finding mathematical constructive proofs that can be implemented as algorithms and estimating error in computations so they can become proofs. He also works in the mathematical problem of quantum mechanics.

8.14 LESZEK DEMKOWICZ

Ph.D., Technical University of Cracow (Poland)

In September, 1993 Dr. Demkowicz joined the aerospace engineering and engineering mechanics faculty. His teaching and research interests include computational mathematics and mechanics. This includes optimization theory, finite element methods, a priori and a posteriori error estimation, hp methods, partial differential equations, and applications in fluid and solid mechanics.

8.15 CHARLES N. FRIEDMAN

Ph.D., Mathematics,
Princeton University

Dr. Friedman has served on the mathematiesfaeultysineel973. His teaehing and researeh interests inelude mathematieal physies, funetional analysis, differential equations, eomputing and eomplexity theory and related subjeets.

8.16 DONALD S. FUSSELL

Ph.D., Computer Science,
University of Texas at Dallas

In 1980, Dr. Fussell joined the ComputerSciencesfaculty. His teaching and research interests include data bases, graphics and VLSI design as well as computer architecture, graphics and computer aided design. He has published over fifty papers aeross his researeh interests.

8.17 VIJAY K. GARG

Ph.D., Electrical Engineering and Computer Science,
University of California at Berkeley

Since 1989, Dr. Garg has served on the electrical and computer engineering faculty. His teaching and research interests include the supervisory control of discreet event dynamical systems and distributed systems, as well as software engineering. Recently, Dr. Garg and his students developed algorithms to detect global predicates in a distributed environment. These algorithms form the core of a distributed debugger.

8.18 JOHN E. GILBERT

Ph.D., Mathematics,
Oxford University (England)

Dr. Gilbert has served on the mathematics faculty since 1969. His teaching and research interests include harmonic analysis and functional analysis, particularly representation theory and wavelets.

8.19 LINDA J. HAYES

M.S. and Ph.D., Mathematics,
University of Texas at Austin
M.S., Engineering Mechanics,
University of Texas at Austin

Dr. Hayes joined the aerospace engineering and engineering mechanics faculty in 1978. Her teaching and research interests include computational mechanics, finite element/finite difference iterative methods, numerical modeling of heat transfer processes, algorithm design for vector and parallel processing, and heat transfer in biomedical applications. The latter includes cryopreservation of human tissues, laser interaction with tissue, radio frequency heating of tissue, and design of thermal probes.

8.20 JOHN KALLINDERIS

Ph.D., Aeronautics and Astronautics,
Massachusetts Institute of Technology

In 1989, Dr. Kallinderis joined the aerospace engineering and engineering mechanics faculty. His teaching and research interests include numerical algorithms development and application to flows of engineering interest, as well as implementation of computer codes with parallel computer architectures. He has been involved in past research where he developed a numerical scheme for the solution of Navier-Stokes equations and one of the first adaptive algorithms for turbulent flow problems, applying it to single and multielement airfoil flows.

8.21 HANS A. KOCH

Ph.D., University of Geneva (Switzerland)

Dr. Koch has served on the mathematics faculty since 1986. His teaching and research interests include statistical mechanics, quantum field theory, dynamical systems, mathematical physics, statistical mechanics, and neural networks. His favored technical tools are renormalization groups and computer-assisted proofs.

8.22 TAKIS KONSTANTOPOULOS

Ph.D., University of California at Berkeley

Dr. Konstantopoulos joined the electrical and computer engineering faculty in 1992. His teaching and research interests include stochastic processes, applied probability, random fields, control, communication networks, performance evaluation, queueing networks, simulation, and stochastic dynamical systems. His current interests include modeling and understanding the behavior of complex stochastic networks and systems, as well as applications to communication networks.

8.23 MICHAEL P. MARDER

Ph.D.. University of California at Santa Barbara

Dr. Marder joined the physics faculty in 1988. His teaching and research interests include statistical physics of solids. Most of his investigations are concerned with the development of form in complex classical systems, ranging from studies of dynamical phase transitions to the growth of river networks. He has also worked on phase transitions in correlated electron systems; and development of form in biological membranes, particle beams, metallic grains, and arrays of soap cells, among other systems. He is now concentrating on theory, computation and experiments having to do with fast fracture of brittle solids.

8.24 RICHARD A. MATZNER

Ph.D., University of Maryland

Director of the Center for Relativity

Dr. Matzner has served since 1967 on the physics faculty. His teaching and research interests include general relativity and cosmology, kinetic theory, black hole physics, gravitational radiation, and numerical relativity. He is the author of more than one hundred research publications in these fields.

8.25 CHRISTINE M. MAZIAR

Ph.D., Electrical Engineering,

Purdue University

In 1987, Dr. Maziar joined the electrical and computer engineering faculty. Her teaching and research interests include developing models and computer simulation tools that describe semiconductor transport and device phenomena in ultra-small structures, structures under high electric fields, and structures composed of superlattices or novel materials. Her research programs address problems associated with charge transport in submicron semiconductor device structure.

8.26 DAENE C. MCKINNEY

Ph.D., Civil Engineering,
Cornell University

Dr. McKinney has served on the civil engineering faculty since 1990. His teaching and research interests include developing and applying numerical methods for simulation, optimization and uncertainty analysis for groundwater problems. He is currently engaged in research on optimizing the design and operation of remediation systems for aquifers contaminated by singleor multiphase contaminants, development of parallel algorithms for flow in porous media and the use of tracers to characterize NAPL contamination in aquifers.

8.27 PHILIP J. MORRISON

Ph.D., Physics
University of California at San Diego

Dr. Morrison joined UT-Austin in 1981 and is a faculty member in physics and the Institute for Fusion Studies. He is a theorist who has worked on a wide range of fluid mechanics and plasma physics problems. His specialty is Hamiltonian dynamics with both few and infinite degrees of freedom. He is best known for work on the noncanonical Hamiltonian formulation. This fundamental work reveals how plasma and fluid theories in Eulerian variables are Hamiltonian in terms of generalized or non-canonical Poisson

8.28 J. TINSLEY ODEN

Ph.D., Engineering Mechanics,
Oklahoma State University
Director, TICAM

Dr. Oden has been a faculty member of the department of aerospace engineering and engineering mechanics since 1973 and of mathematics since 1987. His teaching and research interests span the areas of nonlinear partial differential equations, finite element numerical analysis, continuum mechanics, and computational fluid dynamics. His current research program is concerned with computational acoustics, fluid- structure interaction, a posteriori error estimation and parallel adaptive procedures in computational fluid dynamics, mathematical theory, and numerical analysis of nonlinear hyperbolic systems of conservative laws. He has authored over 300 papers and 22 books, and is editor of 24 other volumes on these subiects.

8.29 JAMES B. RAWLINGS

Ph.D., Chemical Engineering,
University of Wisconsin at Madison

Dr. Rawlings joined the chemical engineering faculty in 1986. His teaching and research interests include chemical process control, nonlinear model-predictive control, particulate systems modeling, crystallization, and ceramic materials sintering.

8.30 PETER J. ROSSKY

M.A., Chemistry,
Harvard University
Ph.D., Chemical Physics,
Harvard University

In 1979, Dr. Rossky joined UT-Austin and is currently a chemistry and biochemistry faculty member. His teaching and research interests include statistical mechanics applied to elucidate the molecular description of structure and dynamics in liquids, with emphasis on polar liquids and solutions. Specific aspects include chemical reaction dynamics, spectroscopy in solution, and biophysical systems. Emphasis is on the development and implementation of computer simulation techniques, particularly emerging quantum mechanical methods.

8.31 WILLIAM F. SCHELTER

Ph.D., Mathematics,
McGill University

Dr. Schelter joined the mathematics faculty in 1979. His teaching and research interests include regular and quantum algebras, computational algebra and compilers.

8.32 KAMY SEPEHRNOORI

Ph.D., Petroleum Engineering,
University of Texas

Since 1975, Dr. Sepehrnoori has served on the petroleum engineering faculty. His teaching and research interests include reservoir simulation, computational methods, applied mathematics, enhanced oil recovery, database application in petroleum engineering, and vector/parallel computations.

8.33 JEFF S. SHAMMA

Ph.D., Systems Science and Engineering,
Massachusetts Institute of Technology

Dr. Shamma joined the aerospace engineering and engineering mechanics faculty in 1992. His general teaching and research interests are in the area of guidance and control. His recent research efforts have focused on nonlinear systems theory, robust multivariable control, adaptive control, and nonlinear control design with application to missile autopilot design.

8.34 LAWRENCE C. SHEPLEY

Ph.D., Princeton University
Associate Director Center for Relativity

Dr. Shepley has served on the physics faculty since 1967. His teaching and research interests include mathematical relativistic cosmology, particularly the nature of cosmic singularities and foundations of classical mechanics. He is currently investigating the usefulness of the Ashtekar formulation of general relativity for numerical studies of colliding gravitational waves.

8.35 RALPH E. SHOWALTER

Ph.D., Mathematics,
University of Illinois–Champaign-Urbana

Dr. Showalter joined the mathematics faculty in 1968. His teaching and research interests include singular or degenerate nonlinear evolution equations and partial differential equations, related variational inequalities and free-boundary problems, and applications to initial-boundary-value problems of mechanics and diffusion. Among his technical contributions are the development of existence-uniqueness-regularity theory for pseudo-parabolic and Sobolev-type partial differential equations, and existence theory of degenerate evolution equations particularly the doubly-nonlinear cases. More applied contributions include the formulation and existence theory for Stefan free-boundary problems for a parabolic system, pseudo- parabolic equation and hyperbolic telegraphers' equation. He has introduced and initiated the theory of the fissured medium equation and the layered medium equation as models for diffusion in a heterogeneous medium.

8.36 JACK B. SWIFT

Ph.D., Physics,
University of Illinois

Dr. Swift has served on the physics faculty since 1971. His teaching and research interests include fluid mechanics, pattern formation, and nonlinear dynamics.

8.37 HARRY L. SWINNEY

Ph.D., Johns Hopkins University
Director, Center for Nonlinear Dynamics

In 1978, Dr. Swinney joined the physics faculty. He teaches and conducts experiments on instabilities, chaos and pattern formation in nonequilibrium systems. Other current experiments are examining instabilities and turbulence in different fluid flows, instabilities in convecting fluids, growth of fractal metallic clusters in electrodeposition, and the propagation of cracks in amorphous materials.

8.38 TOSHI TAJIMA

Ph.D., Physics,
University of California at Irvine

Dr. Tajima worked as a research physicist at UCLA until 1980, when he accepted a physics faculty position at UT-Austin. Dr. Tajima is also a Senior Staff Member at the Institute for Fusion Studies. His teaching and research interests include computational plasma physics, massively parallel computation and numerical TOKAMAK/astrophysics. He is a group leader in the Institute for Fusion Studies computational physics projects and leader in the Numerical TOKAMAK Project, which is one of six Department of Energy Grand Challenge problems in high performance computation and communication.

8.39 JOHN L. TASSOULAS

Ph.D., Civil Engineering,
Massachusetts Institute of Technology

Dr. Tassoulas has served on the civil engineering faculty since 1981. His teaching and research interests include structural analysis, numerical methods, dynamics of foundations, wave propagation in layered media, dynamics of concrete gravity dams, interaction of fluids and solids, stability of pipelines and tubular members,andplasticity. Hehas developed analytical and computational techniques for a variety of problems in civil engineering and applied mechanics, including nonlinear finite element analysis of reinforced and prestressed concrete structures, analysis of dynamic soil-structure interaction using finite elements and boundary elements, analysis of concrete gravity dams subjected to earthquakes, analysis of soils and foundations taking into account material and geometric nonlinearities, and nonlinear analysis of shells recognizing large elasto-plastic deformations with emphasis on applications to deep-water pipelines.

8.40 LAURETTE S. TUCKERMAN

Ph.D., Mathematics,
Massachusetts Institute of Technology

In 1988, Dr. Tuckerman joined the mathematics faculty. Her teaching and research interest is the intersection of computational fluid dynamics with dynamical systems theory specifically, numerical solution of the two- or threedimensional nonlinear Navier-Stokes equations governing fluid flows as followed by bifurcation- theoretical analysis of the results. She has also studied bifurcations in chemical reaction-diffusion equations and phase transition and is developing new numerical algorithms for time- integration and steady-states solving. She has published over twenty articles in scholarly journals and translated the book Order withirl Chaos by Berge, Pomeau and Vidal.

8.41 JACK S. TURNER

Ph.D., Physics,
University of Indiana

Dr. Turner has served on the physics faculty since 1969. His teaching and research interests include chaos, computer aided instruction, theoretical physics, and thermodynamics.

8.42 KAREN UHLENBECK

Ph.D., Mathematics,
Brandeis University

Dr. Uhlenbeck joined the mathematics faculty in 1987. Her teaching and research interests are primarily the application of nonlinear partial differential equations to problems in differential geometry. She has done basic work on the minimal surfaces and YangMills equations, as well as work which has general applicability to elliptic scale-invariant problems. She presently has a grant from the NSF supporting current projects of gauge theory and the quantization of harmonic maps. In addition, she is a principal organizer of one of the regional geometry institlltes !)o1 ;ored by the NSF.

8.43 ROBERT A. VAN DE GEIJN

Ph.D., Applied Mathematics,
University of Maryland-College Park

Dr. van de Geijn joined the computer sciences faculty in 1987. His teaching and research interests include parallel scientific computing, numerical analysis and linear algebra. Much of his work is in close collaboration with computational scientists at the University of Texas, other major universities, government laborat()l if l and industry.

8.44 MIKHAIL M. VISHIK

Ph.D., Mathematics,
Moscow University (former U.S.S.R.)

In 1992, Dr. Vishik joined the mathematics faculty. His teaching and research interests include mathematical problems of fluid dynamics and magneto hydrodynamics. For the past several years he has studied spectral problems of hydrodynamic stability and dynamo theory using tools from dynamical systems and asymptotic techniques.

8.45 ROBERT F. WILLIAMS

Ph.D., Mathematics,
University of Virginia

Dr. Williams has served on the mathematics faculty since 1987. His teaching and research interests are dynamical systems, including the first papers written on "strange attractors;" the concept of shift equivalence, central to the study of Symbolic Dynamics; the study of knotted periodic orbits in chaotic ordinary differential equations; and the introduction of "branched manifolds" and their use in dynamics, including the analysis of Lorenz attractors and Anosov Diffeomorphisms.

8.46 GARY L. WISE

Ph.D., Electrical Engineering and Mathematics,
Princeton University

Dr. Wise has served on the electrical and computer engineering faculty since 1976. His teaching and research interests are applied probability, signal processing and real analysis. He has achieved results in quantization, detection and estimation theories, and in convergence rates. He is perhaps best known for counterexamples. With a recent student, Eric Hall, he coauthored the book Colbnterexarnples in Probability and Real Analysis published by Oxford University Press during the summer of 1993. The two are currently working on a second book, Beginning Probability: Basic Ideas and Selected Topics.

8.47 ROBERT E. WYATT

Ph.D., Chemistry,
Johns Hopkins University

Since 1967, Dr. Wyatt has served on the chemistry and biochemistry faculty. His teaching and research interests include quantum dynamical study of chemical reactions, methods and theories for treating energy transfer in reactive collisions, theory of molecular excitation in intense laser fields, and intramolecular dynamics.

8.48 DAVID M. YOUNG

Ph.D., Mathematics,
Harvard University
Director, Center for Numerical Analysis

Dr. Young has served on the mathematics faculty since 1958 and on the computer sciences faculty since the department was established in 1968. His teaching and research interests include numerical analysis, numerical methods for solving partial differential equations, and numerical linear algebra specifically, iterative solution of large sparse linear systems. His recent work has been directed toward iterative algorithms which are suitable for use on vector and parallel computers. He has written two books on iterative methodsone in collaboration with L.A. Hagemanand has coauthored a two-volume numerical analysis textbook with Robert T. Gregory.

9 Admissions

Graduate students in CAM may enter the program from any relevant degree program in Computer Sciences, Mathematics, Physics, Engineering, or other physical science. Qualified applicants usually meet or exceed the following requirements:

- GPA: 3.67,
- GRE: 1400, and
- TOEFL: 550.

Applications for financial aid should be submitted by February 1 for fall admission. Formal application must be made both to the Graduate School and to the CAM graduate program. The Graduate School application must include complete transcripts of previous academic work, GRE scores for the General Test and TOEFL scores for international students whose native language is not English.

The CAM application must include a statement of purpose and three reference letters that describe the applicant's academic potential for this program. Applicants are encouraged to submit GRE scores for the Subject Test in Mathematics. Requests for program information and application forms can be obtained using the "Helpful Numbers" listed at the back of this brochure.

10 Financial Aid

Tuition at UT-Austin is among the least expensive of any U.S. graduate school of its caliber. Typical tuition and required fees for 12 semester hours are $1025 for Texas residents and $2,585 for nonresidents (figures subject to change).

Various types of financial support are available to qualified graduate students. UT-Austin and College fellowships are awarded to students on a competitive basis and range from full support to supplementary stipends. Students holding competitive scholarships qualify for resident tuition.

Graduate research assistantships are available to CAM students through faculty research grants. Salaries usually range from \$10,200 to \$14,400 per year and may include payment of tuition and fees.

Additionally, a \$3 million endowment supports the CAM Graduate Fellowship Fund for U.S. citizens. Each CAM Fellowship carries an annual stipend of at least \$25,000 per year. Up to 12 qualified graduate students are supported annually on these fellowships. Fellowships are awarded solely on the basis of merit.

Application forms are available from the Graduate Coordinator for the CAM program. Complete application forms and fees must be returned directly to the Graduate Coordinator. Deadlines for financial aid requests are:

- February 1 for fall semester, or
- October 1 for spring semester.

11 Austin, Texas

Nestled in the heart of the Texas Hill Country, the city of Austin has the rich diversity of a large city and, despite its nearly one half million population, the friendly charm of a small town. A temperate climate, 28 miles of urban hike-and-bike trails and more than 11,000 acres of parkland encourage outdoor activities and a relaxed, casual lifestyle. Austin has political and intellectual stature as the seat of Texas government and the home of a world class university. During the last decade, the city's advanced technology research and development sector has blossomed into a billion-dollar market. Populated in part by UT- Austin alumni who fell in love with the city's unique beauty and character, Austin has one of the most highly educated populations in the nation.

The Colorado River forms Lake Austin and Town Lake as it flows through downtown Austin. Upstream, dams create five large lakes where sailors, skiers, campers, swimmers, and sunbathers enjoy Austin's temperate climate from March through October. Not far from downtown Austin, the Barton Springs swimming pool is formed by a natural spring gushing 27 million gallons of water a day into a limestone bed. The Hill Country winds south and west from Austin laced with sparkling rivers and breathtaking vistas, a welcome respite to weary urbanites and exhausted graduate students.

Austin supports both traditional and avant garde theater, dance and opera, and the Austin Symphony plays a full concert season from September to May. Austin's legendary live music scene is where many popular rock and roll, blues, jazz, and country and western singers got their start.

Fortune magazine describes Austin's business climate as one of the nation's best. Its high technology sector includes more than 400 companies. Many of these companies, such as Dell Computer Corporation, are nationally recognized Austin-based businesses. Two consortia, MCC and SEMATECH, foster critical links between academia and industry.

Mountains, deserts, hills, lakes, beaches, vast high plains, and bustling cities comprise the landscape of the nation's second largest state. In central Texas, Austin sits within a 250-mile radius of the Texas Gulf Coast, the Mexican border and the cities of Dallas, Houston and San Antonio. One of Texas's most stunning sights is Big Bend National Park in west Texas where 8,000-ft. mountains rise dramatically from the floor of the Chihuahua Desert. In the Davis Mountain range, UT-Austin's McDonald Observatory, with one of the world's largest telescopes, perches on a mountaintop.

Cost of Living Living expenses in Austin – food, housing and transportation – compare favorably to the country's larger metropolitan areas. Affordable housing exists within walking distance of campus, or is accessible by UT-Austin's 12 shuttle bus routes which interconnect with the city's extensive bus system. UT-Austin provides some residence halls with restricted areas for graduate students. In addition, apartments for married students are conveniently located on a UT-Austin shuttle bus route.

12 Helpful Numbers

Office of Admission

Main Building, Room 7
The University of Texas at Austin
Austin, TX 78712
(512) 471-1711

Office of Graduate Studies

Main Building, Room 101
The University of Texas at Austin
Austin, TX 78712
(512) 471-7151

Graduate Coordinator

Computational and Applied Mathematics Graduate Program
The University of Texas at Austin
3500 W. Balcones Center Drive
Austin, TX 78759
(512) 471-3312
(512) 471-8694 (Fax)

Director of Graduate Studies Committee

Dr. Ralph E. Showalter
Department of Mathematics
The University of Texas at Austin
RLM 12.118
Austin, TX 78712
(512) 471-0175

Graduate Advisor

Professor Linda J. Hayes
Department of Aerospace Engineering and Engineering Mechanics
The University of Texas at Austin
WRW 305
Austin, TX 78712
(512) 471-4208
(512) 471-3788 (Fax)

Division of Housing and Food Service

The University of Texas at Austin
Applications (UT-Austin residence halls and apartments)
200 W. 26th Street
Austin, TX 78712
(512) 471-3136 or (512) 471-6023 (512) 471-9101 (Fax)