APPLIED MATHEMATICAL AND COMPUTATIONAL SCIENCES

THE UNIVERSITY OF IOWA

Iowa City, Iowa 52242

PH.D. PROGRAM IN

APPLIED MATHEMATICAL AND COMPUTATIONAL SCIENCES

Applied Mathematical and Computational Sciences (AMCS) at The University of Iowa is a broad-based interdisciplinary Ph.D. program for students desiring to study mathematics and enough of a companion science so that they can apply their mathematical skills to significant scientific problems.

The main goal of the program is to develop applied mathematicians with sufficient professional experience and versatility to meet some of the research, teaching, and industrial needs of our technology-based society.

While building a base in the Division of Mathematical Sciences, which includes the Departments of Computer Science, Mathematics, and Statistics and Actuarial Science, students acquire skills in another area of their own interest, chosen typically from the behavioral, biological, business, engineering, medical, physical, or social science areas.

The program is designed to be flexible. For example, students can concentrate on applied mathematics, such as differential equations and numerical analysis, or alternatively, on statistics or computer science as their mathematical science base.

The University of Iowa has become a center for the computational sciences. Because of expertise in fields such as numerical analysis, mathematical programming, parallel and vector processing, hydraulics and fluid mechanics, heat transfer, dynamic simulation of mechanical systems, optimization in management sciences and industrial engineering, discrete event simulation, robotics, atmospheric and environmental studies, climate/ chemistry modeling, geographical decision making, theoretical and plasma physics, and pharmacological and biological modeling, the computational sciences are now an important part of the program. There is a demand for mathematical scientists who are trained to use a computational sciences approach in relevant problems. The University of Iowa already has been designated by the U.S. Department of Energy as one of a group of universities to offer the new DOE Computational Science Graduate Fellowship Program and now has one fellowship recipient.

The diversity of the areas of application is manifest in the descriptions provided by the 28 faculty associated with the program at the end of this brochure.

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Iowa City, Iowa
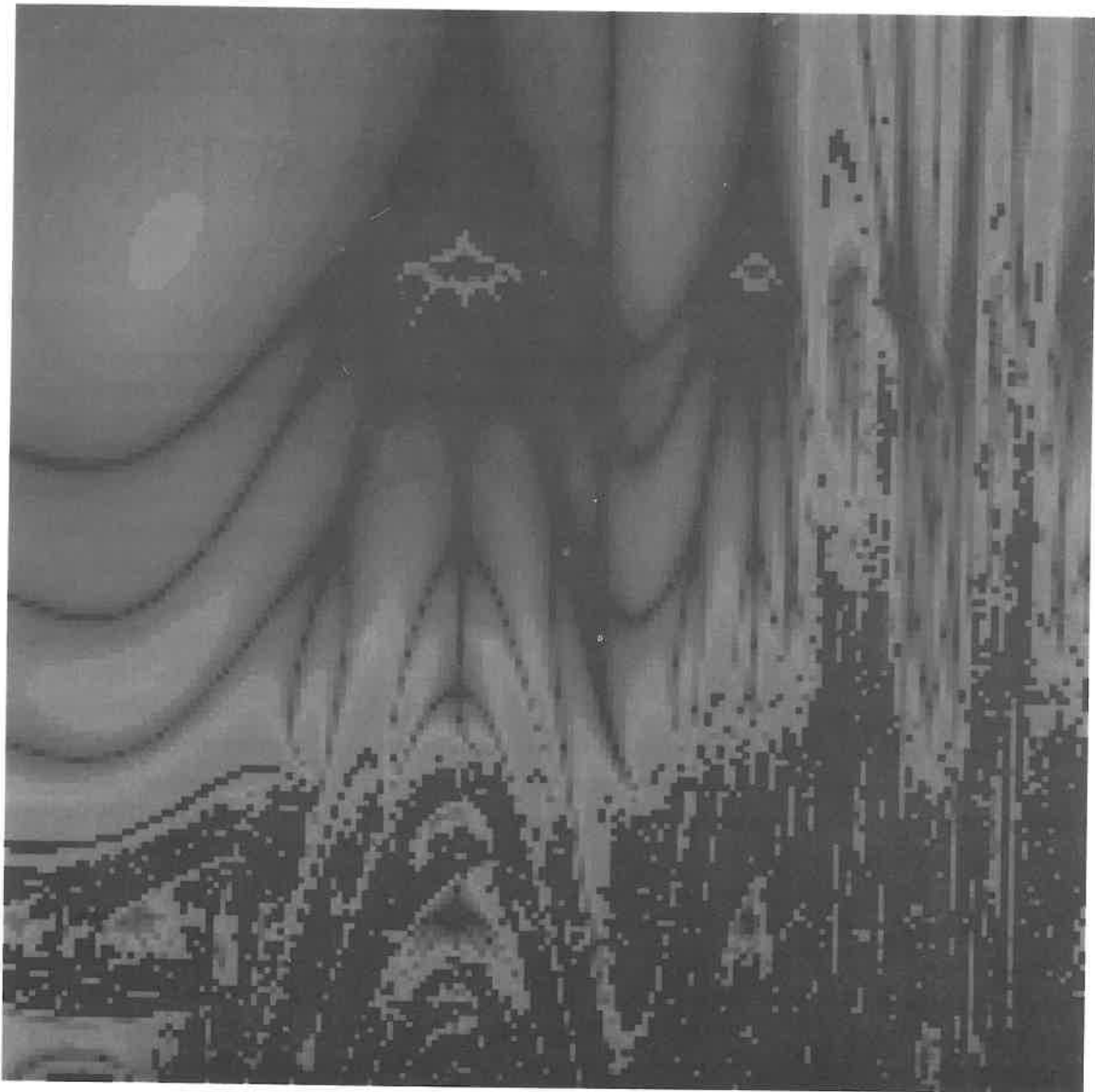
One slice from 3D Lyapunov Space
The grey area shows the amount of chaos, with the black area chaotic.
This program is used by Advanced Research Computing Services to benchmark high performance vector and parallel computers. Visualization done on a DECStation 5000 with AVS software. Program and visualization by John Knaack.

WHAT ARE THE APPLIED MATHEMATICAL AND COMPUTATIONAL SCIENCES?

The first step in a real-world problem is often the construction of a mathematical model—a description of the problem in mathematical terms. The model then is studied by using analytical or numerical methods to obtain exact or approximate solutions. Finally, the conclusions are interpreted in the language of the original problem in terms more familiar to a client or user. Often the model is changed to be more realistic or to include more features of the problem. Thus, the modeling process may involve false starts, modifications, and simplifications.

Mathematics enters primarily in the second stage: the solution of mathematically well-formulated problems and the development and analysis of the underlying theory. This stage may include analytical or numerical methods. The approach can range from specific algorithms and formal methods to abstract, general theories. It is often not clear which mathematical skills will be useful in the study of a new problem; thus, applied mathematicians need to be broadly trained so they will have a wide variety of mathematical tools available.

The mathematical scientist must not only be a competent mathematician but must be knowledgeable in the area to which mathematics is being applied. Thus, the applied mathematician must be concerned with the construction and interpretation of appropriate models. Students must communicate with scientists in that field in their language.

The art of formulating models requires that the modeler make choices about which factors to include and which to exclude. The goal is to produce a model that is realistic enough that it reflects the essential aspects of the phenomena being modeled, but simple enough that it can be treated mathematically.

Often the model is constructed to answer a specific question. Sometimes the modeler must either simplify the model so it can be analyzed or devise new mathematical methods that will permit an analysis of the model. Often a combination of analytical and numerical methods are used. The modeling process may involve a sequence of models of increasing complexity. Problems sometimes lead to new mathematical methods, and existing mathematical methods often lead to new insights into the problems. The successful applied mathematical scientist must be comfortable and confident in both mathematics and the field of application.

Applied mathematical and computational sciences is a name used to encompass the many analytical and numerical methods to solve classes of scientific problems. This name more accurately reflects the nature of modern "applied mathematics," since it explicitly includes the area of scientific computing, which includes many components of computational processes, such as numerical analysis, algorithms for machines with vector and parallel architectures, visualization, simulation, and computer-aided design.

Scientific computing already is being called a third science, complementing theoretical science and laboratory science. For example, in the design of automobiles and aircraft, many engineering issues are resolved through computer simulation rather than through costly prototypes, test models, and wind tunnel experiments. This trend toward design by computer simulation has been powered by computing hardware and software, computational methodologies and algorithms, and the availability and access to high-performance computing systems and infrastructure.

GRADUATE STUDY

The program name recently has changed to Applied Mathematical and Computational Sciences, which better describes the current nature of the program. Some aspect of the computational sciences has been a part of the dissertation research of nearly all recent graduates. Although it is a separate, independent academic unit, the program cooperates with the Departments of Mathematics, Computer Science, and Statistics and Actuarial Science. Many of the courses taken by students are in these departments, and most students in the program have teaching assistantships in these departments, particularly in the Department of Mathematics.

The AMCS program differs from other Ph.D. programs because it is flexible and individualized and because it requires study in both a science and a mathematical science. It is not designed to replace existing departmental Ph.D. programs at The University of Iowa. For example, individuals interested primarily in mathematical aspects of applicable mathematics should apply to the graduate program in the Department of Mathematics, which has many faculty members interested in ordinary and partial differential equations, numerical analysis, optimization, mathematical physics, and biomathematics. Students interested primarily in a science may fit into another departmental Ph.D. program since many of these programs involve some aspects of applied mathematics, statistics, or computer science.

The program is suitable for those who are capable of graduate study in both a mathematical science and another science and who want to do dissertation research on a problem in the scientific area which involves the use of graduate-level mathematics.

Currently, there are 15 students enrolled in the program. This small size means that students have more direct contact with faculty members. Each student's faculty committee helps plan a program consistent with the student's background, interests, and goals, which should develop expertise in methods of application of mathematics, build a good foundation in related topics of theoretical mathematics, and provide sufficient knowledge in a particular science so the student can use mathematical techniques in that science.

Each student takes comprehensive examinations in three areas: in a theoretical foundation area, in the applied mathematics that is useful in the student's chosen field, and in the particular area of the student's specialization. Each student's dissertation research should include the activities of a mathematical scientist. For example, this could involve formulation of a model, quantitative analysis of the model, and interpretation of the results.

Research topics of current students include geometric programming and entropy optimization problems, the computational finite analytic method for three-dimensional fluid mechanics problems, the effects of monetary policy on economic optimization problems, global optimization problems in manufacturing management, efficient algorithms for computer-aided design problems, effective numerical algorithms for mechanical systems simulation, a modified finite analytic method to solve concavity flow problems, computational exterior flow problems in fluid mechanics, digital signal processing, neural networks, computer-aided simulation of automobile performance, optimization in robotic trajectory design, and chaotic dynamics in physics.
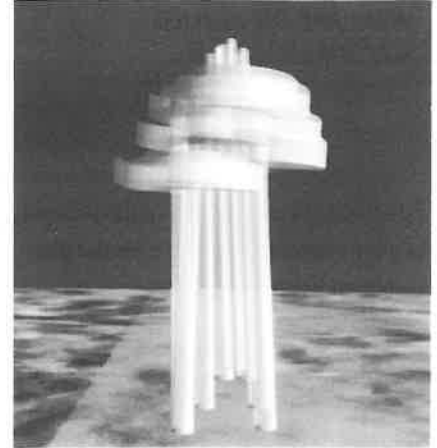
ADMISSION REQUIREMENTS

Students applying for admission should have a solid undergraduate training in a mathematical science and in another science so they can start graduate-level courses in both areas. A suitable background for admission is a bachelor's degree with a double major in mathematics and a science, or a major in mathematics with a strong minor in a science, or a major in a science with a substantial mathematics component including some theoretical courses in analysis and algebra. Students also may enter with a master's degree.

Applicants should have at least a B+ average (3.20 out of 4.00) in their previous course work and should take the Graduate Record Examination (GRE). Minimum GRE scores for admission are 500 verbal (350 for foreign applicants), 700 quantitative, and 660 analytical. Students should have a desire to apply mathematics to the solution of relevant scientific problems and should state their area of interest in their application.

Students for whom English is not their first language also should take the TOEFL examination. TOEFL scores are used to predict the ability of students to function effectively in courses taught in English and the ability to effectively use the English language as a teaching assistant. A TOEFL score of 550 is required for admission. The mean TOEFL score of foreign students entering the program in the past three years was 587. Official GRE and TOEFL scores must be sent to The University of Iowa by the testing service.

Admission decisions are made after careful examination of all submitted materials, including the application area of interest, transcripts of courses taken, grade-point average, test scores, and letters of recommendation. All information available is considered, so it is to the applicant's advantage to submit as complete an application package as possible.

Admission decisions are made throughout the year as applications become complete. Offers of admission are extended to those who have the best overall qualifications and most closely match the interests of the faculty at The University of Iowa.
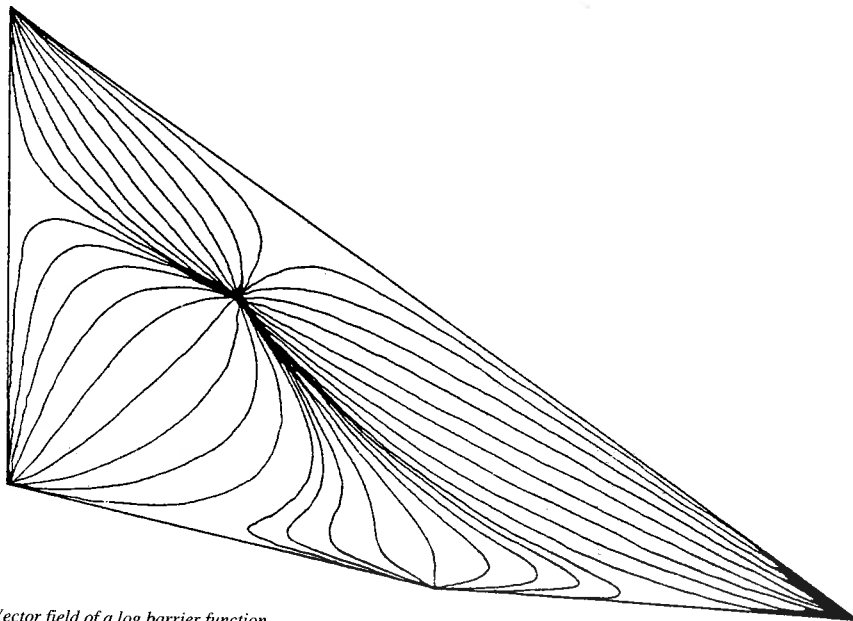
Vector field of a log barrier function

FINANCIAL SUPPORT

Teaching and research assistantships are available to qualified applicants. Teaching assistantships are usually in the Department of Mathematics and involve tutoring in the Mathematics Laboratory, grading homework and quizzes, teaching discussion sections for lecture courses, and teaching sections of precalculus and calculus courses. These teaching experiences are valuable training and improve the student's communications skills.

Through research assistantships, students conduct research on projects with faculty members. During the 1992-93 academic year, the teaching and research assistantships paid about $11,000 for 16-20 hours of work per week. Graduate students with assistantships pay resident-rate tuition, approximately $2,600 for two semesters. Some tuition scholarships and Graduate Fellowships are available. Fellowships for minority students also are available through the Opportunity at Iowa program, which is committed to increasing the diversity of the students and faculty at Iowa. Outstanding applicants are nominated to the Graduate College for University of Iowa Fellowships, which provide full tuition for four years plus a $15,000 stipend per year. Support for students as research assistants is available during the summer; currently, summer research assistantships pay $2,250 for two months of half-time work. Summer research fellowships also are available.

Applicants requesting financial support should apply for admission for the fall session, which begins in late August. Applications for fall semester admission and for financial aid should be completed by March 1 (earlier if possible). Financial support is offered to the most qualified applicants during February, March, and April. Most students admitted to the program are offered financial aid. Financial aid is renewed each year to those students who make good progress toward their degree.

COMPUTING FACILITIES

There is a wide variety of computers available to students. Graduate students in the mathematical sciences have access to a Hewlett-Packard computer network of Series 700 workstations. This network is a Unix system with powerful capabilities (57 MIPS, 4 gigabytes of disk storage). It includes the standard compiler languages (for example, Fortran), symbolic manipulation programs such as MAPLE and MATHEMATICA, numerical analysis programs such as MATLAB, the statistics package S-Plus, and other programs. For technical word processing on the network, Scientific Word, LATEX, and other variants of TEX are available.

A microcomputer laboratory of high-level personal computers, one of many on campus, is networked to the Weeg Computer Center (WCC), the University's central computing facility. Among the mainframes in WCC are an IBM-3090 (2 vector processors), two Encore Multimax computers (one of which can be operated as a shared memory, parallel processing computer), and several DEC Vax computers. In addition, many other types of computers (including vector and parallel computers) are located in laboratories throughout the University and can often be used by people not in the associated laboratory. By using NSFNET, students have ready access to the resources of the various NSF-funded supercomputer centers. Faculty in the program maintain close ties to NCSA at the University of Illinois, which has a large CRAY facility.

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EMPLOYMENT OPPORTUNITIES

There are many uncertainties in the national economy and in the funding of colleges and universities. However, our doctoral graduates have been successful in finding suitable professional positions. Of the six most recent graduates (see below), three found positions in colleges and universities, one took a job in industry, one took a postdoctoral position, and one maintains a statistical consulting business.

Future prospects for employment in mathematics and applied mathematics are difficult to predict, but the clear trend is toward quantitative and computational approaches to solving problems in numerous areas. One indication of the good opportunities for mathematical scientists is seen in the list of the fastest growing occupations (1990-2005) in a study by the Bureau of Labor Statistics (*Florida Leader,* Vol. 9, No. 4, 1992). It does appear that mathematical scientists with a sound training in mathematical and computational skills and with an interest and background in an area of application will find a demand for their services. The Ph.D. student can expect to find an intellectually challenging job in a healthy environment with stimulating colleagues and reasonably good wages.

RECENT GRADUATES

Richard A. Bernatz
May 1991, "Development of the Finite Analytic Method for Turbulent Forced and Free Convection," Professor Ching-Jen Chen (Mechanical Engineering), supervisor. **Current Employment:** Assistant Professor, Mathematics, Luther College, Decorah, Iowa.

Mei-Hsui Chi
December 1991, "Linear Semi-Infinite and Nondifferentiable Programming Methods for Robot Trajectory Planning Problems," Professor K.O. Kortanek (Management Sciences), supervisor. **Current Employment:** Postdoctoral Position, Institute of Applied Mathematics, National Chung-Cheng University, Chia-Yi, Taiwan.

Michael T. Suelzer
December 1991, "Analysis of Human Quantitative Judgement: Models of Sequential Magnitude Estimation," Professors Don Dorfman (Psychology) and Johannes Ledolter (Statistics), supervisors. **Current Employment:** Director of The University of Iowa Statistical Consulting Center and President of DataMasters of Iowa, Inc., Iowa City, Iowa.

Randall G. Wills
May 1990, "Resolution of the Multiplicity Problem for U(N) Using Shift Operators," Professors Bill Klink (Physics) and Tuong Ton-That (Mathematics), supervisors. **Current Employment:** Assistant Professor, Mathematics, Southeastern Louisiana University, Hammond, Louisiana.

Jeng Yen
May 1990, "Numerical Methods for Constrained Equations of Motion in Mechanical Systems Dynamics," Professors Ed Haug (Mechanical Engineering) and Florian Potra (Mathematics), supervisors. **Current Employment:** Development Engineer at Computer Aided Design Software Inc., Oakdale, Iowa.

Huang Zhen
August 1991, "Mathematical Models and Algorithms for Distribution System Design and Operation," Professor Dennis Bricker (Industrial and Management Engineering), supervisor. **Current Employment:** Assistant Professor, Mathematics, Atterbein College, Westville, Ohio.

Hui-Chun Tien
August 1993, "Finite Analytic Method for Two-Dimensional Flow with Irregular Boundaries," Professor Ching-Jen Chen (Mechanical Engineering), supervisor. **Current Employment:** Assistant Professor, Applied Mathematics Department, Kaoshoung Polytechnic University, Taiwan.

Hsiao-Ying Chang
August 1993, "The Analytic Center Method for Entropy Optimization and Smooth Convex Programming Problems," Professor Dennis Bricker (Industrial and Management Engineering), supervisor.
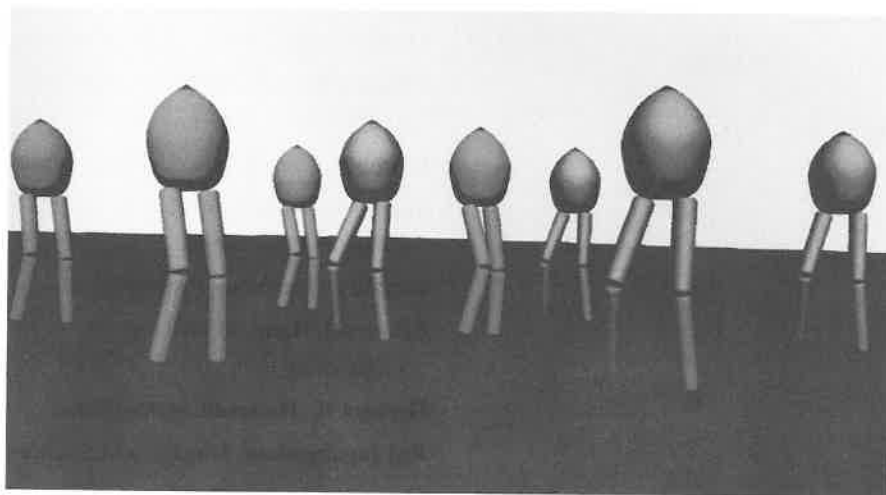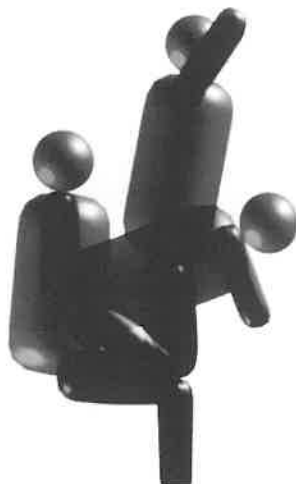
THE FACULTY

The director and the AMCS faculty help each student plan a course of study that is consistent with the student's background, interests, and goals. They advise the students about courses, committee members, comprehensive examinations, Graduate College requirements, financial support, and employment opportunities. They serve as dissertation advisers or help find advisers. The faculty are available to serve as dissertation supervisors, but students can choose other faculty at The University of Iowa who are using mathematics in their research and are knowledgeable about mathematical applications in their field. Many current faculty members became formally associated with the program after working with a student in the program.

The faculty list below reflects the breadth of the expertise in the mathematical and computational sciences at The University of Iowa. More detailed descriptions of the research activities of the faculty are given in a later section.

The faculty currently associated with our program are:

Kurt M. Anstreicher, Management Sciences

Marc P. Armstrong, Geography

Kendall E. Atkinson, Mathematics

Dennis L. Bricker, Industrial Engineering

Gregory R. Carmichael, Chemical and Biochemical Engineering

Kyung K. Choi, Mechanical Engineering

Soura Dasgupta, Electrical and Computer Engineering

Donald D. Dorfman, Psychology

Edward J. Haug, Mechanical Engineering

Herbert W. Hethcote, Mathematics

Raj Jagannathan, Management Sciences

Douglas W. Jones, Computer Science

Joseph K. Kearney, Computer Science

William H. Klink, Physics and Astronomy

Georg E. Knorr, Physics and Astronomy

Kenneth O. Kortanek, Management Sciences

Russell V. Lenth, Statistics and Actuarial Science

George R. Neumann, Economics

Gregg C. Oden, Psychology and Computer Science

Virendra C. Patel, Mechanical Engineering

Florian A. Potra, Mathematics

R. Rajagopal, Geography

Teodor Rus, Computer Science

Friedmar J. Schulz, Mathematics

Gerhard O. Ströhmer, Mathematics

Tuong Ton-That, Mathematics

George G. Woodworth, Statistics and Actuarial Science

Yinyu Ye, Management Sciences

FOR FURTHER INFORMATION

The University of Iowa is a gracious, friendly, culturally diverse, and intellectually stimulating community located in Iowa City, a small midwestern city in Iowa about 70 miles west of the Mississippi River. The quality of life in Iowa City has been rated as rather good with a low cost of living.

Applicants are encouraged to request application forms and further information about the program by writing to the Chair, Program in Applied Mathematical and Computational Sciences, The University of Iowa, Iowa City, IA 52242. Applicants also may call (319) 335-0790, use FAX (319) 335-0627, or use email (hethcote@math.uiowa.edu).
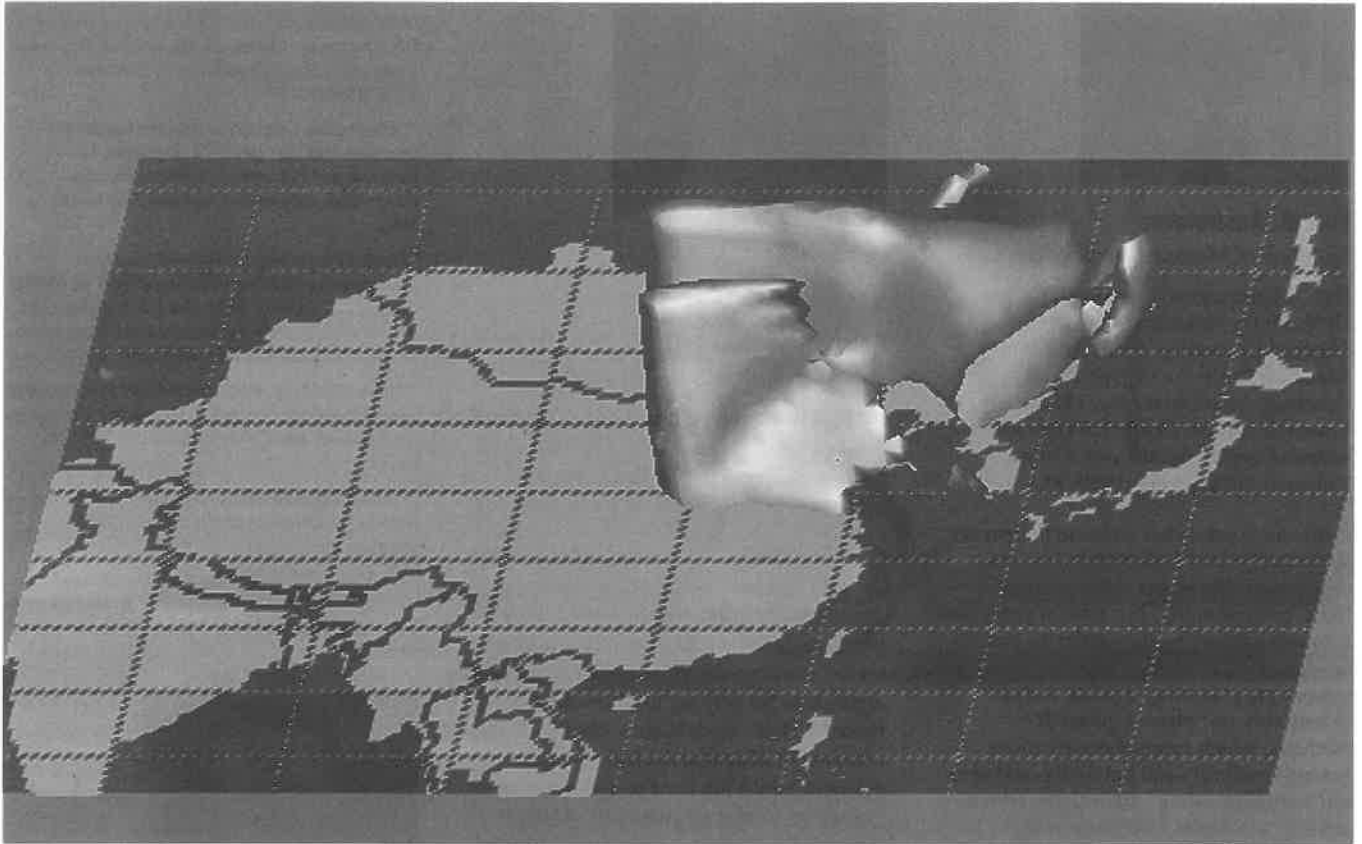
Dust Cloud Visualization over China
This image is one frame from an animation of a simulated dust storm over the Pacific Basin. The data is generated by a simulation on the IBM 3090 that uses windfields data from NCAR. Simulation by Greg Carmichael and Young Sun-Woo. Visualization by James Durchenwald and John Knaack on a DECStation 5000 using AVS software.

FACULTY RESEARCH AREAS AND PUBLICATIONS

Kurt M. Anstreicher
Professor of Management Sciences

B.A., Mathematics, Dartmouth College, 1978; Ph.D., Operations Research, Stanford University, 1983; Assistant/ Associate Professor of Operations Research, Yale University, 1982-91; Research Fellow, Center for Operations Research and Econometrics, Catholic University of Louvain, 1989-90.

Professor Anstreicher's research areas are optimization and mathematical programming, especially interior algorithms for linear programming. For several years his research has involved complexity analysis of interior point methods for linear and convex programming. He has worked extensively on "phase I–phase II" methods, which simultaneously move toward feasibility and optimally, and also on "partial updating" algorithms, which achieve a complexity reduction by performing rank-one updates to the factorization of the weighted least-squares matrix ADA', which is maintained by all interior point methods. In the past year, he has collaborated extensively with Florian Potra, Yinyu Ye, and a graduate student in mathematics to develop rigorous average-case analyses for several interior point methods. He is currently interested in the analysis of interior point algorithms, which allow for the addition and deletion of constraints.

SELECTED PUBLICATIONS
"On the Performance of Karmarkar's Algorithm over a Sequence of Iterations," *SIAM Journal on Optimization*, 1:22-29, 1991.

"A Combined Phase I–Phase II Scaled Potential Algorithm for Linear Programming," *Mathematical Programming*, 52:429-439, 1991.

"Crashing a Maximum-Weight Complementary Basis" (with J. Lee and T. Rutherford), *Mathematical Programming*, 54:281-294, 1992.

"On Partial Updating in a Potential Reduction Linear Programming Algorithm of Kojima, Mizuno, and Yoshise" (with R. Bosch), to appear in *Algorithmica*.

"A Monotonic Build-Up Simplex Algorithm for Linear Programming" (with T. Terlaky), to appear in *Operations Research*.

Marc P. Armstrong
Associate Professor of Geography

Ph.D., Geography, University of Illinois at Urbana-Champaign, 1986; Assistant Professor of Geography and Computer Science, The University of Iowa, 1984-90.

Several of Professor Armstrong's current areas of interest involve parallel processing of computationally intensive spatial problems. He has recently been working on the development of parallel heuristic algorithms for solving location–allocation models. These models are a central component of spatial decision support systems, which are used to address semi-structured locational problems. Another stream of research involves the design and implementation of parallel algorithms that identify and extract geomorphic features, such as ridges, passes, and valleys from digital (matrix) representations of a landscape. These extracted features are then used in spatially distributed simulation models of runoff and sediment yield. A key problem with many environmental simulation models, however, is that they fail to include interaction with other environmental phenomena. Vegetation models, for example, use climate parameters as input, but often fail to include feedback to climate models. Armstrong is working on the development of comprehensive models that attempt to capture interaction effects among these constituent elements. A final area of research involves the development of parallel spatial statistical methods, such as measures of autocorrelation and methods to visualize the results of such analyses.

SELECTED PUBLICATIONS
"Landscape Fragmentation and Dispersal in a Model of Riparian Forest Dynamics" (with J.S. Hanson and G.P. Malanson), *Ecological Modelling*, 49:277-296, 1990.

"A Bit-Mapped Classifier for Groundwater Quality Assessment" (with D.A. Bennett), *Computers and Geosciences*, 16:811-832, 1990.

"Decision Support for Regionalization: A Spatial Decision Support System for Regionalizing Service Delivery Systems" (with G. Rushton, R. Honey, B.T. Dalziel, P. Lolonis, S. De, and P.J. Densham), *Computers, Environment, and Urban Systems*, 15:37-53, 1991.

"Cartographic Displays to Support Locational Decision-Making" (with P.J. Densham, G. Rushton, and P. Lolonis), *Cartography and Geographic Information Systems*, 19:154-164, 1992.

"Parallel Processing for Network Analysis: Decomposing Shortest Path Algorithms on MIMD Computers" (with Y. Ding and P.J. Densham), in *Proceedings of the Fifth International Symposium on Spatial Data Handling*, 2:682-691, 1992.

"Domain Decomposition for Parallel Processing of Spatial Problems" (with P.J. Densham), *Computers, Environment and Urban Systems*, 16, 1992 (in press).

"Parallel Terrain Feature Extraction" (with D. Rokos), *Proceedings of GIS/LIS '92*, 1992 (in press).

"Small Area Student Projections Based on a Modifiable Spatial Filter" (with G. Rushton and P. Lolonis), *Socioeconomic Planning Sciences*, 1992 (in press).

Kendall E. Atkinson
Professor of Mathematics

Ph.D., Mathematics, University of Wisconsin–Madison, 1966; Visiting Professorships: Colorado State University, Australian National University, University of Queensland, University of New South Wales.

Professor Atkinson's research interests are in the numerical solution of integral equations. Recently, he has been studying the numerical solution of boundary integral equations (BIE), which are reformulations of boundary value

IOWA'S GRADUATE PROGRAMS

Through The University of Iowa's nationally recognized programs, students master a body of knowledge and ultimately contribute to it through their own scholarship and research.
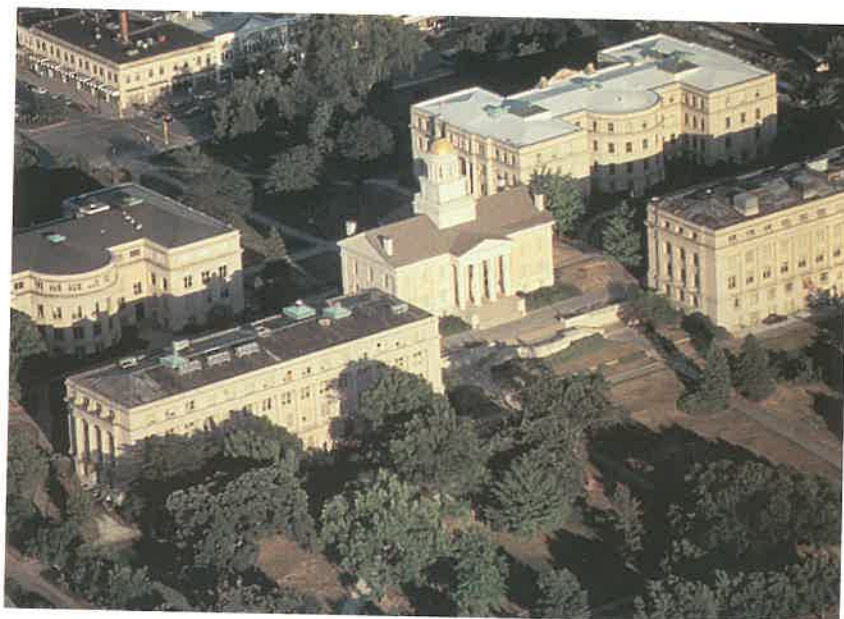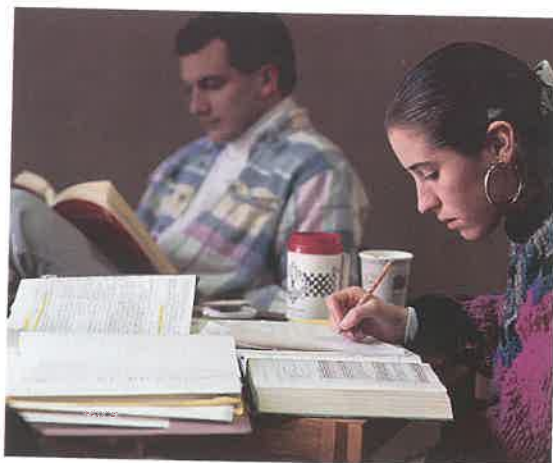
Iowa's graduate students work closely with a faculty of scholars who are committed to lives of learning. Together, faculty and students work in an atmosphere of academic freedom and intellectual verve that stimulates creative and innovative thinking.

Iowa's graduate programs have both depth and breadth. Iowa's graduate students actively participate in the life of a large and multifaceted university community. They receive specialized attention within their own disciplines while they exchange ideas with people from throughout the University's 10 colleges and more than 90 graduate degree programs.

DIVERSE THOUGHT AND CULTURE

The University of Iowa has a long history of offering learning opportunities for students of all races and backgrounds. In 1879, only 24 years after the University began continuous operation, the first African American in the country to earn a law degree did so at Iowa. Iowa was the first to offer the M.F.A. degree, and the first recipient was an African-American woman. The first Ph.D.'s earned by African Americans in history, music, and political science were at Iowa.

The richness of Iowa's academic environment has resulted in more than 1,500 underrepresented minorities earning degrees at the undergraduate, graduate, and professional level in the last seven years. Recent new efforts directed toward underrepresented groups in higher education have revitalized this endeavor. The University in 1987 established the Opportunity at Iowa program to provide a coordinated effort for the recruitment and retention of minority faculty and students.

American students of Asian, African, Latino, and Native American background find many opportunities for support and cultural identification at the University. For more information about Opportunity at Iowa and its services and support programs for African American, Latino, and Native American students, contact the director of Opportunity at Iowa, Jessup Hall, 319-335-3555, or the Office of Special Support Services, Calvin Hall, 319-335-1416.

EXTENSIVE ACADEMIC SUPPORT

The University Libraries constitute the largest library system of any kind in Iowa and the 28th largest academic/research system in the United States. They contain over 3 million holdings including 93,000 rare books, 470 manuscript collections, and 10,000 catalogued manuscript letters. In addition to the Main Library, there are 12 specialty libraries: art and art history, biology, botany and chemistry, business administration, engineering, geology, mathematics, music, physics, psychology, law, and the health sciences.

University scholars benefit from a number of central research facilities such as the Electron Microscopy Facility, the Image Analysis Facility, and the High Resolution Mass Spectrometry Facility.

The Weeg Computing Center provides versatile computing support for the University's academic community. The main computing hardware serves more than 3,000 computer terminals located throughout the campus. Weeg's Personal Computing Support Center provides comprehensive support to campus microcomputer users on an on-call basis.

The University of Iowa Hospitals and Clinics, the nation's largest university-owned teaching hospital, offers unparalleled resources for study and training in the health sciences.

COMMITTED FACULTY

Iowa's faculty members rate high as teachers, scholars, and researchers. In most University departments and colleges, graduate students work one-on-one with faculty mentors. In studios, libraries, and laboratories, they engage in creative endeavors that build toward independent projects initiated by the students.

Faculty members successfully compete for research support, attracting more than $139 million annually from private and public sources. The University nurtures superior intellectual activity with outstanding facilities, fellowships, and assistantships that attract a critical mass of talented faculty and students.

At Iowa, 60 organized research units complement the activities of academic departments. A few examples are the Center for International and Comparative Studies, the Center for Computer-Aided Design, the Alzheimer's Disease Research Center, the Center for New Music, the Cardiovascular Research Center, the Dows Institute for Dental Research, and the Institute for Economic Research.

FINANCIAL ASSISTANCE

Teaching and research assistantships, available in many departments, offer stipends ranging from $9,000 to $11,000 for academic year, half-time assignments. Additional support for summer sessions is often available. In the Graduate College, students who hold assistantships pay in-state tuition regardless of their residency status.

The Iowa Fellows Program helps attract extraordinary doctoral students to the University. Twenty to thirty fellowships are available each year, awarding $15,000 to $16,000 per year for up to four years plus tuition.

The Graduate Opportunity Scholarship and Fellowship Programs and programs through the Committee on Institutional Cooperation offer valuable assistance for minority students.

The cost of living in Iowa City is moderate and comparable to most midwestern cities. Current financial aid information is available from the Office of Student Financial Aid, Calvin Hall, 319-335-1450.

A LIVELY CAMPUS

The campus caters to pedestrians and bicyclists: it's compact enough to cross in a 20-minute walk. A free ride on a campus bus can halve that time. Entertainment on campus and in Iowa City is geared toward student budgets, with many events offered at no charge.

Iowa City has more book shops, coffee shops, restaurants, record shops, and movie theaters in its downtown area—right next to campus—than you'll find in cities many times its size.

Local service agencies combine with campus programs to provide a wide range of helping services for students and student families.

Hancher Auditorium brings the world's finest musicians, dancers, actors, and entertainers to the University. It is part of the Iowa Center for the Arts, which includes the Museum of Art and cultural/educational programs in music, theatre, art and art history, dance, and literary arts.

Iowa City is alive with festivals and ethnic celebrations. Music, drama, and dance can be found on stage or on street corners. Sculptures adorn campus green spaces and plazas, and work by local artists and craftspeople entice visitors to outdoor markets.

American and foreign film classics are presented at the University's Bijou Theatre at modest rates, and each semester, the University community is energized by a full and diverse schedule of lectures, readings, and discussions that bring world notables to campus to interact with students and faculty members.

The University can help put enthusiasts on board a hot air balloon or a sailboat. Weight lifting, tennis, fencing, the martial arts, handball, soccer, rugby, football, spelunking, horseback riding, gymnastics, or golf—Iowa students do them all.

The University's Macbride Nature Recreation Area, located 15 miles from campus, offers hiking, cross-country skiing, sailing, and canoeing.

The University fields 10 varsity teams each for men and women. Iowa is a member of the Big Ten Athletic Conference, and University teams, from field hockey to football, enjoy fan support from the community and a large region of the state.

WHERE TO LIVE

Campus and community housing options can fit most every need, taste, and budget. University family housing provides efficiency and one- and two-bedroom apartments at affordable rates. Iowa City offers modern apartment complexes, rooms in charming older buildings, trailer parks, and cooperative housing. For off-campus housing information, contact the Campus Information Center, Iowa Memorial Union, 319-335-3055. For information about University family housing, contact the Family Housing Office, Housing Service Building, 319-335-9199.

CHILD CARE OPTIONS

Community Coordinated Child Care, a private, nonprofit agency known as 4-Cs, is a clearinghouse for information about licensed private child care providers, day care centers, preschools, and parent cooperative day care facilities. There are four University-affiliated day care centers overseen by The University of Iowa Student Association Daycare Commission. For information about child care, contact 4-Cs, 202 S. Linn St., Iowa City, IA 52240, 319-338-7684.
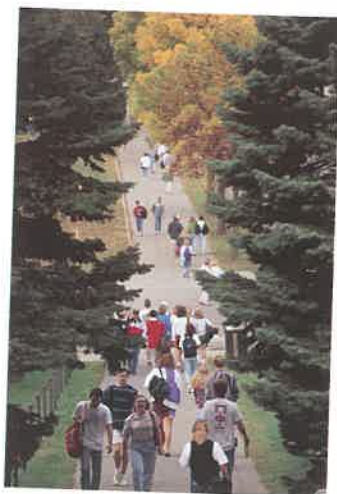
UNIVERSITY FACTS AT A GLANCE

Enrollment (1991): 27,881, including 6,714 enrolled in the Graduate College.

Colleges: Business Administration, Dentistry, Education, Engineering, Law, Liberal Arts, Medicine, Nursing, Pharmacy, and the Graduate College.

Degree Programs: More than 90 graduate degree programs; more than 55 leading to the doctorate.

Research Funding: $1.64 billion in external funding since 1966; $139.6 million during the 1990-91 academic year.

Faculty: 1,647 full-time faculty members.

History: Founded in 1847 as Iowa's first public institution of higher learning. Iowa was the first public university in the United States to admit women and men on an equal basis.

Location: Iowa City is within 300 miles of Chicago, St. Louis, Minneapolis, Omaha, and Kansas City. The Cedar Rapids Airport, served by national and regional airlines, is a 20-minute drive from campus.

For more information about the University or community, write to the chair of the department of interest or to:

Office of Graduate Admissions
Calvin Hall
or call 1-800-553-IOWA
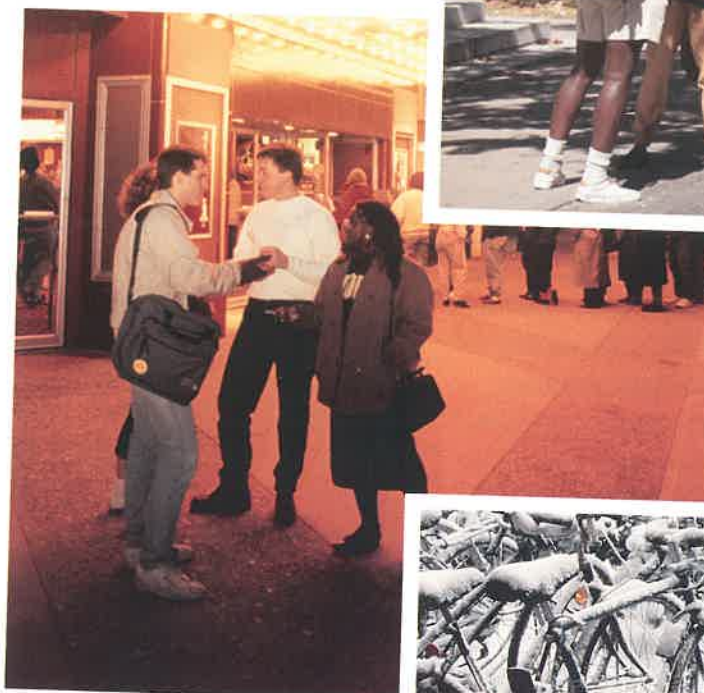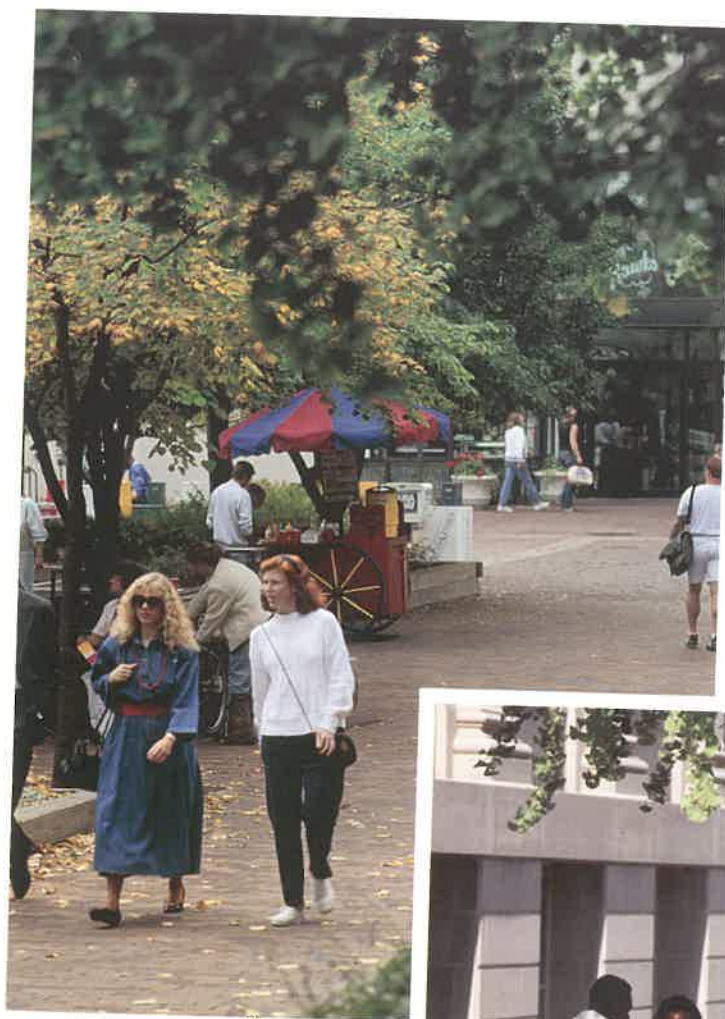
problems for partial differential equations. The associated physical problems include potential vector fields (electrostatic and gravitational fields and incompressible, irrotational fluid flow), electromagnetic and acoustic wave propagation, elastostatics, and other related problems. In a number of areas of engineering in recent years, there has been a large increase in the use of BIE for solving engineering problems. Atkinson's research mainly is involved with the numerical solution of these problems, as they involve a wide variety of interesting numerical analysis questions.

SELECTED PUBLICATIONS

A Survey of Numerical Methods for the Solution of Fredholm Integral Equations of the Second Kind, SIAM, 1976.

"Piecewise Polynomial Collocation for Integral Equations on Surfaces in Three Dimensions," *J. Integral Equations*, 9:25-48, 1985.

An Introduction to Numerical Analysis, 2nd edition, John Wiley & Sons, 1988.

"BIE Methods for Solving Laplace's Equation with Nonlinear Boundary Conditions: The Smooth Boundary Case" (with Graeme Chandler), *Math. of Computation*, 55:455-472, 1990.

"A Survey of Boundary Integral Equation Methods for the Numerical Solution of Laplace's Equation in Three Dimensions, in *Numerical Solution of Integral Equations*, ed. M. Golberg, Plenum, 1-34, 1990.

"Iterative Variants of the Nyström Method for Second Kind Boundary Integral Equations" (with Ivan Graham), *SIAM J. Scientific and Statistical Computing*, 14 (in press), 1993.

"A Survey of Numerical Methods for Solving Nonlinear Integral Equations," *Journal of Integral Equations & Applications*, 4:15-46, 1992.

Elementary Numerical Analysis, 2nd edition, John Wiley & Sons, 1993.

Dennis L. Bricker

Associate Professor of Industrial Engineering

B.S. and M.S., Mathematics, University of Illinois at Urbana-Champaign, 1965, 1966; M.S. and Ph.D., Industrial Engineering and Management Science, Northwestern University, 1972, 1975; Visiting Professorships: Tunghai University, Taiwan, 1983; Pohang Institute of Technology, Korea, 1990.

Professor Bricker's research interests lie in optimization models and algorithms. This includes geometric programming, a class of nonlinear optimization models with numerous applications in engineering design, and a well-developed duality theory, which can be utilized in the design of algorithms. Other applications in production planning, scheduling, and logistics provide a great variety of combinatorial optimization problems and a need for efficient algorithms.

SELECTED PUBLICATIONS

"Bounding a Class of Nonconvex Linearly-Constrained Resource Allocation Problems via the Surrogate Dual," *Mathematical Programming*, 18:68-83, 1980.

"Technical Efficiency in Nursing Homes" (with J. Nyman and D. Link), *Medical Care*, 28:541-551, 1990.

"On the Calculation of True and Pseudo Penalties in Multiple Choice Integer Programming" (with E. Y.-H. Lin), *European Journal of Operational Research*, 55:228-236, 1991.

"On Subsidiary Problems in Geometric Programming" (with Jayant Rajgopal), *European Journal of Operational Research* (in press).

"On Geometric Programming Problems Having Negative Degrees of Difficulty" (with Jae-Chul Choi and Jayant Rajgopal), *European Journal of Operational Research* (in press).

"Sequencing of Inspection Operations Subject to Errors" (with T. Raz), *European Journal of Operational Research* (in press).

"Teaching Dynamic Programming Using APL" (with E. Y.-H. Lin), *International Journal of Mathematical Education in Science and Technology* (in press).

Gregory R. Carmichael

Professor and Chair of Chemical and Biochemical Engineering, Codirector of the Center for Global and Regional Environmental Research

B.S., Chemical Engineering, Iowa State University, 1974; Ph.D., Chemical Engineering, University of Kentucky, 1979; Visiting Research Scientist Positions: National Institute of Environmental Studies, Tsukubu, Japan, 1983-89; Toyohashi University of Technology, 1983; NASA Langley, 1985; Center for Computations, University of Kentucky, 1988; NAEA, Rome, 1987; Max-Planck Institute for Chemistry, Mainz, Germany, 1991.

Professor Carmichael's research interests are in the areas of environmental engineering, high-speed computing, and biochemical engineering. Much of his work is focused on the applications of chemical engineering fundamentals to air pollution problems and involves the development and use of comprehensive models to quantify the chemical and physical processes affecting the distribution of pollutants in the lower atmosphere. His three-dimensional atmospheric chemistry models are being used to quantify the impact and fate of man-made pollutants emitted into the atmosphere on regional and global scales. Research on environmental issues such as acid deposition, regional-scale photochemical oxidant exposure, and the nature of future atmospheric environment under pending global environmental change are being conducted in his laboratories. In support of this research, he is conducting research in high-speed supercomputing (including parallel processing), visualization, sensitivity analysis, and air pollution control policy. He also is interested in biochemical engineering problems related to product recovery, fate and transport of hazardous and toxic chemicals in the environment, and cell modeling.

SELECTED PUBLICATIONS

"The Solution of Coupled Transport/Chemistry Calculations on the MPP Computer" (with D. Cohen, S. Cho, and F. Potra), *Computers in Chemical Engineering*, 9:1065-1073, 1989.

"Overview of the Development and Application of the STEM-II/ASM/RSM Model" (with L. Peters and R. Saylor), *Atmospheric Environment*, 25A:2077-2090, 1991.

"Sensitivity of Acid Deposition to Emission Reductions" (with W. Shin), *Environmental Science & Technology*, 26:715-725, 1992.

"Comprehensive Air Pollution Modeling on a Multiprocessor System" (with W. Shin), *Computers and Chemical Engineering*, 16:805-815, 1992.

"Acid Deposition Modeling," in *Environmental Modelling*, Computational Mechanics Publications, Elsevier Applied Science, 119-134, 1992.

"Analysis of Residual Ozone in East Asia" (with Y. Sunwoo and V. Kothamarthi), *J. Atmospheric Chemistry*, 14:248-295, 1992.

Kyung K. Choi

Professor of Mechanical Engineering

M.S., Mechanical Engineering, The University of Iowa, 1977; Ph.D., Applied Mathematics, The University of Iowa, 1980; Associate Director, Industry/University Cooperative Research Center for Simulation and Design Optimization, 1990; Industrial Positions: U.S. Army Tank-Automotive Command, Detroit, Mich., 1987; Ford Motor Company, Detroit, 1989.

There are many advanced state-of-the-art finite element analysis (FEA) codes that provide reliable tools for evaluation of complicated structural systems and machine components. However, these analysis codes provide little or no aid to a designer on how to obtain a best design. The objective of the research is to create advanced design tools for structural systems and machine components that will permit economical designs that are strong, safe, stable, reliable, and have a long service life. The design tools to be developed can be used by design engineers in industry and universities to obtain optimal structural designs for vehicles, space structures, aircraft, and ships. The research is focused on development of continuum-based sizing, shape, and configuration design sensitivity analysis methods for static and dynamic responses of linear and nonlinear structural systems. A key ingredient of the research is to develop a unified design sensitivity computational algorithm that can be implemented with a number of established FEA codes, in a computer-aided engineering environment for interactive design. To make the design sensitivity analysis capability useful to the design engineer, research is being carried out to develop a menu-driven user interface. The user interface will let the designer interactively define design variables, performance requirements, and optimal design problems. The designer also can carry out a four-step interactive design process: color display of sensitivity information, what-if study, trade-off determination, and interactive design optimization.

SELECTED PUBLICATIONS

"Design Sensitivity Analysis and Optimization of Nonlinear Structural Systems with Critical Loads" (with J.S. Park), *ASME Journal of Mechanical Design*, 114/2:305-312, 1992.

"Continuum Design Sensitivity Analysis of Transient Responses Using Ritz and Mode Acceleration Methods" (with S. Wang), *AIAA Journal*, 30/4:1099-1109, 1992.

"An Extension of Material Derivative Method for Configuration Design Sensitivity Analysis" (with S.L. Twu), *Mechanics of Structures and Machines*, 20/4:459-497, 1992.

"A Geometry Based Parameterization Method for Shape Design of Elastic Solids" (with K.H. Chang), *Mechanics of Structures and Machines*, 20/2, 215-252, 1992.

"Design Sensitivity Analysis of Dynamic Frequency Responses of Acousto-Elastic Built-Up Structures" (with I. Shim, J.H. Lee, and H.T. Kulkarni), *Optimization of Large Structural Systems*, ed. G. Rozvany, 1992 (in press).

Soura Dasgupta

Associate Professor, Electrical and Computer Engineering

Ph.D., Australian National University, 1985; Visiting Appointments: University of Notre Dame; Universite Catholique de Louvain-la-Neuve, Belgium; Australian National University.

There are three areas in which our research activities are focused: (1) robustness in controls and signal processing, (2) blind identification of communication channels, and (3) neural networks. No system is ever precisely known. The physics of the system supplies, at best, ranges within which the defining system parameters lie. One thus knows a *set of systems* to which the true system belongs; and to verify if the system satisfies a given property, or to design a controller or a processor that achieves design objectives with respect the true system, one must develop tools that work with sets of systems as oppose to a single system. Thus, for example, to check if a given system is stable, one mu devise procedures to verify if *every* member of a given set of systems is stabl. We are developing such tools tailored to problems motivated by controls and signa processing applications. Data transmitted through communication channels frequently undergo distortion caused by the channel dynamics. A major problem in communications theory is to recover the channel input, the data originally transmitted, from the channel output, the data actually received. This objective can be met only if one knows the channel. However, such information is rarely available and the channel needs to be separately identified. If over a period of time both the channel output *and the input generating it* are available, then there are many conventional techniques for effecting the required identification. Yet the very nature of the setting under consideration precludes the availability of input information. Accordingly, we are involved in the development of channel identifiers that do not require the knowledge of the channel input. We also are analyzing neural networks for error-correcting coding and associative memory applications.

SELECTED PUBLICATIONS

"Persistent Excitation in Bilinear Systems" (with Y. Shrivastava and G. Krenzer), *IEEE Transactions on Automatic Control*, 305-13, 1991.

"Frequency Domain Conditions for the Robust Stability of Linear and Nonlinear Dynamical Systems" (with P. Parker, B. Anderson, F. Kraus, and M. Mansour), *IEEE Transactions on Circuits and Systems*, 389-97, 1991.

"Guaranteed Convergence in a Class of Hopfield Networks" (with Y. Shrivastava and S.M. Reddy), *IEEE Transactions on Neural Networks*, 951-61, 1992.

"Minimality, Stabilizability and Strong Stabilizability of Uncertain Systems" (with G. Chockalingam), *IEEE Transactions on Automatic Control* (in press).

Donald D. Dorfman

Professor of Psychology and Radiology

Ph.D., Psychology, University of Michigan, 1961; Assistant/Associate Professor, San Diego State University, 1962-68; Associate Professor, The University of Iowa, 1968-74; Visiting Positions: Research Fellow, University of Pennsylvania, 1975-76; University Fellow, University of Liverpool, England, 1983; Visiting Professor, University of New South Wales, Australia, 1989.

A mathematical psychologist with research interests in the area of psychophysical and psychometric measurement, Professor Dorfman is engaged in the development of quantitative theory and methodology for the evaluation and measurement of observer performance in diagnostic systems; in particular, the development of models to describe detection and classification of images by diagnostic radiologists.

SELECTED PUBLICATIONS

"A Learning Model for a Continuum of Sensory States" (with M. Biderman), *Journal of Mathematical Psychology,* 8:264-284, 1971.

"The Likelihood Function of Additive Learning Models: Sufficient Conditions for Strict Log Concavity and Uniqueness of Maximum," *Journal of Mathematical Psychology,* 10:73-85, 1973.

"Group Testing," *Encyclopedia of Statistical Sciences,* 3:536-539, eds. S. Kotz and N.L. Johnson, Wiley, 1983.

"RSCORE-J: Pooled Rating-Method Data: A Computer Program for Analyzing Pooled ROC Curves" (with K.S. Berbaum), *Behavior Research Methods, Instruments, and Computers,* 18:452-462, 1986.

"Receiver Operating Characteristic Rating Analysis: Generalization to the Population of Readers and Patients with the Jackknife Method" (with K.S. Berbaum and C.E. Metz), *Investigative Radiology,* 27:723-731, 1992.

"Physical and Psychophysical Measurement of Images," *The Perception of Visual Information,* eds. W.R. Hendee and P. Wells, Springer-Verlag (in press).

Edward J. Haug

Carver Distinguished Professor of Mechanical and Civil and Environmental Engineering

B.S., University of Missouri at Rolla, 1962; M.S., Kansas State University, 1964; Ph.D., Kansas State University, 1966.

Professor Haug's current research involves development of multibody dynamics formulations suitable for high-speed and real-time simulation of complex mechanical systems that are composed of collections of kinematically connected rigid and/or flexible bodies; and automated generation and solution of equations of motion using parallel computers to achieve real-time operator-in-the-loop system simulation. He also is investigating the development of high-speed explicit and implicit numerical integration algorithms for differential-algebraic equations of mechanical system dynamics; development of theoretical and computational methods for workspace analysis of manipulators and robots; formulation of interdisciplinary simula-tion-based computer-aided engineering tools and integrated software system support; dynamic stress and life predic-tion of mechanical subsystems; simulation of large-scale dynamic systems with input from control and hydraulic subsystems; and concurrent engineering applications in design of mechanical systems.

SELECTED PUBLICATIONS

Computer Aided Kinematics and Dynamics of Mechanical Systems—Part 1: Basic Methods, Allyn & Bacon, 1989.

"Real-Time Multibody System Dynamic Simulation—Part I: A Modified Recursive Formulation and Topological Analysis" (with F.F. Tsai), *Mechanics of Structures and Machines,* 19/1:99-127, 1991.

"Real-Time Multibody System Dynamic Simulation—Part II: Parallel Algorithm and Numerical Results," (with F.F. Tsai), *Mechanics of Structures and Machines,* 19/2:129-162, 1991.

Real-Time Integration Methods for Mechanical System Simulation (with R.C. Deyo), Springer-Verlag, 1991.

Intermediate Dynamics, Prentice Hall, 1992.

Herbert W. Hethcote

Professor of Mathematics and Chair of Applied Mathematical and Computational Sciences

Ph.D., Mathematics, University of Michigan, 1968; Assistant/Associate Professor of Mathematics, The University of Iowa, 1969-79; Visiting Positions: M.D. Anderson Cancer Institute, Houston, 1974-75, Oregon State University, 1977-78, National Cancer Institute, 1980-81, University of Hawaii, 1992-93.

Although he has worked in several areas of mathematical biology, Professor Hethcote's major research area is the mathematical analysis and application of models for the spread of infectious diseases. The epidemiological models analyzed are systems of differential, integral, or functional differential equations. Often the models have a threshold that determines whether the disease dies out or persists in the popula-tion. Understanding the mechanisms leading to periodicity in these models provides a systematic way to organize investigations of observed periodicities in data. These epidemiological models have been used to analyze vaccination and control procedures for diseases such as measles, rubella, influenza, and gonorrhea. Models for heterogeneous populations with homogeneous subpopulations are particularly relevant for sexually transmit-ted diseases such as gonorrhea and AIDS because there is great diversity in sexual behaviors. Recently, he has been working with colleagues in the Division of HIV/AIDS at the National Centers for Disease Control to develop models and associated computer simulation programs to describe the transmission of HIV and the incidence

of AIDS in numerous risk groups in the United States.

SELECTED PUBLICATIONS

"Nonlinear Incidence in Epidemiological Models" (with P van den Driessche), *J. Math. Biol.*, 29:271-287, 1991.

"Dynamic Models of Infectious Diseases as Regulators of Population Sizes" (with J Mena-Lorca), *J. Math. Biology*, 30:693-716, 1992.

"Disease Transmission Models with Density Dependent Demographics" (with L.Q. Gao), *J. Math. Biology*, 30:717-731, 1992.

"Modeling HIV Transmission and AIDS in the United States" (with J.W. Van Ark), *Lecture Notes in Biomathematics*, 95, Springer-Verlag, 1992.

Douglas W. Jones
Associate Professor of Computer Science

B.S, Physics, Carnegie-Mellon University, 1973; Ph.D., Computer Science, University of Illinois at Urbana-Champaign, 1980; Resident Visitor, Bell Labs Murray Hill, 1973; Assistant Professor, The University of Iowa, 1980.

Discrete event simulation is a powerful technique for studying the behavior of models of systems such as queuing networks, neural networks, and digital logic. The common characteristic of these systems is that, at some level of abstraction, they can be viewed as having a state that changes instantaneously at discrete points in time. At the point of each state change in such a system, it is possible to predict the times at which future state changes will occur, and the fundamental discrete event simulation algorithm advances time from state-change to state-change. At Iowa, we have developed a new algorithm for discrete event simulation on shared-memory parallel computers. We have achieved record speed-up measurements for some problems using this code, as described in "Concurrent Operations on Priority Queues," *Communications of the Association for Computing Machinery*, 32/1:132-137, 1989, and "Experience with Concurrent Simulation" (with Chien-Chun Chou, Debra Renk, and S.C. Bruell), *Proceedings of the 1989 Winter Simulation Conference*, Dec. 4-6, 1989, Washington, D.C., 756-764. This work continues, with an emphasis on combining the benefits of our algorithm with existing parallel discrete event simulation algorithms. In addition, we have begun an investigation of the problems that arise when expert systems are incorporated into a discrete event simulation model. This work focuses on models of systems that include human components, for example, a model of a nuclear reactor control room. To model such a system, we must model not only the

Raj Jagannathan
Professor of Management Sciences

Ph.D., Operations Research, Carnegie-Mellon University, 1969; Assistant Professor, Columbia University, 1969-73; Visiting Professorships: UCLA, 1979-80; University of Florida, 1980-81; SUNY at Stony Brook, 1987-88.

Professor Jagannathan's research involves the existence of myopic policy for stochastic dynamic programming, queuing models with gains as applied to manufacturing, dynamic production scheduling models, and dynamic programming models in game theory.

SELECTED PUBLICATIONS

"Storing Crossmatched Blood: A Perishable Inventory Model with Prior Allocation" (with T. Sen), *Management Science*, 36/3, March 1990.

"A Stochastic Geometric Programming Problem with Multiplicative Recourse," *Operations Research Letters*, 9/2:99-104, 1990.

"Linear Programming with Stochastic Processes as Parameters as Applied to Production Planning," *Annals of Operations Research*, 1990.

"Optimal Partial-Match Hashing Design," *ORSA Journal on Computing*," 1991.

physical system but also some of the mental processes of the human participants. In this context, we also have f need to include simple continuous simulation models within a discrete e simulation framework, and this has fo us to examine how such simulations c best be included into discrete event simulation models.

Joseph K. Kearney
Chair and Associate Professor of Computer Science

Ph.D., Computer Science, University of Minnesota, 1983; Assistant Professor of Computer Science, The University of Iowa, 1983; Visiting Scientist, Robotics Laboratory, Department of Computer Science, Cornell University, 1986.

Professor Kearney's research interests include animation, control, computer vision, mechanical simulation, robot programming, robot locomotion, and virtual environments. His recent work has focused on programming techniques for controlling complex behaviors of real and simulated robots including hopping, walking, throwing, and striking motions. The control programs developed encode general strategies that can be applied with many different kinds of robots. For example, hopping programs are expressed as constraints on the forces and moments generated by the robot as it pushes against the ground. The basic constraints apply to robots with different numbers of legs and with different leg anatomy. A new method to coordinate multi-link chains by using cascading gains was developed for generating throwing and striking motions. Working in collaboration with members of the Center for Computer-Aided Design, Kearney is developing methods to create dynamic scenarios for real-time, operator-in-the-loop driving simulation. They are currently investigating new paradigms based on concurrent, hierarchical state

machines that will simplify the programming and testing of complex behaviors and permit coordination of multiple vehicles to create critical situations important for testing driver performance.

SELECTED PUBLICATIONS

"Software Complexity Measurement" (with R. Sedlmeyer, W.B. Thompson, M.A. Grey, and M. Adler), *Communications of the ACM*, 1044-1050, 1986.

"An Error Analysis of Gradient-Based Methods for Optical Flow Estimation" (with W.B. Thompson and D.L. Boley), *IEEE Transactions on Pattern Analysis and Machine Intelligence*, PAMI-9, 2:229-244, 1987.

"Trinocular Correspondence for Particles and Streaks," *The SPIE Conference on Intelligent Robots and Computer Vision X: Algorithms and Techniques*, 1991.

"A Case Study of Flexible Object Manipulation" (with J. Hopcroft and D.B. Krafft), *The International Journal of Robotics Research*, 41-50, 1991.

"Generalizing the Hop: Object-Level Programming for Legged Motion" (with S. Hansen), *The IEEE International Conference on Robotics and Automation*, 136-142, 1992.

"Programming Mechnical Simulations" (with S. Hansen and J.F. Cremer), The Second Eurographics Workshop on Animation and Simulation, September 1-2, 1991, *The Journal of Visualization and Computer Animation* (in press).

"Efficient Generation of Whip-Like Throwing and Striking Motions" (with B. Bhat and B. Prasad), *Computer Animation '93* (in press).
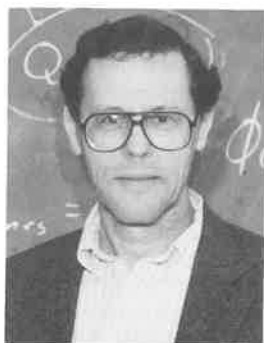
William H. Klink

Professor of Physics and Adjunct Professor of Mathematics

Ph.D., Johns Hopkins University, 1965; Member, Institute for Advanced Study, Princeton, 1969; Exchange Scientist, Institute for Nuclear Research, Warsaw, Poland, 1973; Visiting Professor, Tuebingen University, Germany, 1981.

Professor Klink's research is in the field of mathematical, nuclear, and elementary particle physics, with special emphasis on the use of symmetry, in both its mathematical and physical manifestations. Collaborations with mathematicians include work on the representation theory of groups and the nature of quantum mechanical systems such as anharmonic oscillators. Work in physics includes the formulation of a relativistic quantum mechanics using group theoretical techniques as well as collaborations with nuclear physicists working on scattering and bound state problems.

SELECTED PUBLICATIONS

"Quantum Mechanics and Nilpotent Groups: I. The Curved Magnetic Field (with P.E.T. Jorgensen), *Publ. RIMS*, 21:969-999, 1985.

"Scattering Operators on Fock Space: IV. The Algebra of Operators Commuting with an Internal Symmetry," *Journal of Physics A: Math. Gen.*, 21:4305-4321, 1988.

"The Structure of Poincaré Covariant Tensor Operators in Quantum Mechanical Models" (with W.N. Polyzou), *Ann. Phys. (NY)*, 185:356-400, 1988.

"Calculation of Clebsch-Gordan and Racah Coefficients Using Symbolic Manipulation Programs" (with T. Ton-That), *J. Comput. Phys.*, 80:453, 1989.

"Relativistic Quantum Mechanics, Production Reactions, and Unitarized Multiparticle Amplitudes," *Nucl. Phys.*, A508:293c-298c, 1990.

"Clebsch-Gordan and Racah Coefficients of the Poincaré Group," *Ann. Phys.*, 213:31-53, 1992.

Georg E. Knorr

Professor of Physics

Doctorate (Dr.rer.nat.), University of Munich, Germany, 1963; Research at Max-Planck-Institute for Plasmaphysics, Garching, Germany, 1963-67, UCLA, 1966; Visiting Professor and/or Summer Research: NRL 1969; ORNL, 1970, 1978; LANL, 1973, 1974; Bochum University, 1976; MPI for Plasmaphysics, 1976, 1990; Danish National Laboratory, 1985-90; Ben Gurion University, Israel, 1992.

Professor Knorr is interested in nonlinear phenomena in plasmas and hydrodynamics, in particular the transition to turbulence. The approach taken is an expansion of a given vector field in a complete set of appropriately chosen eigenfields such that the boundary conditions are automatically satisfied, and certain integral invariants are conserved. Knorr and other researchers were able to show that the nonlinear $v \cdot \nabla v$-term appearing in the Navier-Stokes equation possesses interaction terms which transport energy to larger wavelengths, thus giving occurrence of spatial structures under certain conditions in a turbulent state. An application of the method to Couette flow, the flow of a fluid between two concentric cylinders rotating with different velocities leads to a simple representation of the Taylor vortices and other experimentally observed modes. In magnetohydrodynamics, the methods allow one to compute the nonlinear equilibrium state of a plasma in a given external magnetic field, and this configuration has a striking resemblance to plasmas observed in the laboratory. The use of sophisticated numerical methods, dynamical systems theory as well as deterministic chaos, is a necessity.

SELECTED PUBLICATIONS

"Hilbert Space Methods in Hydrodynamics with Applications to Couette Flow" (with Gerhard Ströhmer), *Z. Naturforsch.*, 48a:679-691, 1993.

"Asymptotic State of the Finite-Larmor Radius Guiding Centre Plasma" (with H. Pecseli), *Journal of Plasma Physics*, 41:157-169, 1989.

"Self-Organisation in Three-Dimensional Hydrodynamic Turbulence" (with J.P. Lynov and H.L. Pecseli), *Z. Naturforsch.*, 45a:1059-1073, 1990.

"Relaxed States of an Ideal MHD Plasma with an External Magnetic Field" (with M. Mond), in press.

Kenneth O. Kortanek

John F. Murray Research Professor of Management Sciences

Ph.D, Engineering Science, Northwestern University, 1964; Fellow, Harvard Graduate School of Arts and Sciences,

1959-61; Professorships in Mathematical Sciences: Carnegie-Mellon University, 1969-86; Visiting Professorships: Virginia Polytechnic Institute and State University, 1979; University of North Carolina at Chapel Hill, 1981.

Research continues on optimization models with an infinite number of inequalities in a finite number of variables. Topics include solution of large-scale linear programming approximations of limit analysis for the collapse of a plastic material having unbounded yield set, and optimal statistical regression design, and complex variable approximation. Earlier algorithms focused on solving for selective least-cost air pollution abatement strategies and the design of air pollution networks. Extensions are under way to control problems in robot trajectory design where a parameterization of the robot path is sought subject to staying within the dynamic capabilities of the robot. For finite dimensions, a polynomial time algorithm has been developed for a class of linearly constrained convex optimizations with application to minimum entropy in statistics and geometric programming.

SELECTED PUBLICATIONS

"Computation of the Collapse State in Limit Analysis Using the LP Primal Affine Scaling Algorithm" (with E. Christiansen), *Journal of Computational and Applied Mathematics*, 34:47-63, 1991.

"A Note on a Potential Reduction Algorithm with Simultaneous Primal/Dual Updating" (with Siming Huang), *Operations Research Letters*, 10:501-507, 1992.

"A Second Order Affine Scaling Algorithm for the Geometric Programming Dual with Logarithmic Barrier" (with Hoon No), *Optimization*, 23:303-322, 1992.

"A Polynomial Barrier Algorithm for Linearly Constrained Convex Programming Problems" (with Jason Zhu), *Mathematics of Operations Research* (in press).

"Semi-Infinite Programming: Theory, Methods, and Applications" (with R. Hettich), *SIAM Review* (in press).

Russell V. Lenth
Associate Professor of Statistics and Actuarial Science

Ph.D., Mathematics, University of New Mexico, 1975; Assistant Professor, The University of Iowa, 1975-81; Visiting Professorships: University of Wisconsin–Madison, 1982-83; University of Wyoming, 1985-86; Consulting: Los Alamos Scientific Laboratories, Lawrence Livermore Laboratory, Procter and Gamble, Cherry-Burrell, John Deere and Company, Oral-B Laboratories, others.

Professor Lenth's research interests include experimental design, statistical computing, robust statistics, statistical graphics, and scale estimation. Current research includes work on robust scale estimation based on the modulus of the sample characteristic function. These methods have interesting connections with earlier work on directional data. Applications include robust analogs of analysis of variance and variance component estimation. Additional work on longitudinal data based on a robust Kalman filter is forthcoming. Other research includes developing a GUI environment for statistical power and sample-size problems, built on the XLISP-STAT platform.

SELECTED PUBLICATIONS

"Quick-and-Easy Analysis of Unreplicated Factorials," *Technometrics*, 31:469-473, 1989.

"Robust Confidence Intervals for the Center of a Symmetric Distribution" (with A.R. Padmanabhan), *Journal of Statistical Computation and Simulation*, 33:183-196, 1989.

"Alg AS 243—Cumulative Distribution Function of the Noncentral t Distribution," *Applied Statistics*, 38:185-189, 1989.

"A Robust Scale Estimator Based on the Empirical Characteristic Function" (with M.M. Markatou and J.L. Horowitz), *The University of Iowa Department of Statistics Technical Report #197*, 1991.

"Robust Analysis of Variance Based on the Sample Characteristic Function" (with M. Markatou and J. Tsimikas), *The University of Iowa Department of Statistics Technical Report #202*, 1992.

"Two Case Studies Involving an Optical Emission Spectrometer" (with J. Inman, J. Ledolter, and L. Niemi), *Journal of Quality Technology*, 24:27-36, 1992.

George R. Neumann
Professor of Economics

Ph.D., Economics, 1974, Northwestern University; taught for two years in the Department of Economics at Pennsylvania State University and ten years at the Graduate School of Business at the University of Chicago; Visiting Research Professor at the University of Aarhus in Denmark, and Visiting Research Professor at Princeton, University, 1990-91.

Professor Neumann's current research deals with the solution and estimation of matching models in labor markets using dynamic programming methods. Frequently, optimal search models can be characterized by integral equations of a certain kind, and well-known methods can be used in computing a solution. In other cases, particularly in two-sided search models (workers search for jobs, employers search for workers), complete characterization of equilibrium behavior remains open.

SELECTED PUBLICATIONS

Studies in Labor Market Dynamics (with N. Westergaard-Nielsen), Springer-Verlag, 1984.

"Earnings, Unemployment, and the Allocation of Time Over Time" (with K. Burdett, N. Kiefer, and D. Mortensen), *Review of Economic Studies*, 51:559-578, 1985.

Search Theory and Applied Labor Economics (with N.M. Kiefer), Cambridge University Press, 1988.

"A Conditional Moments Test of the Proportional Hazards Model" (with Joel L. Horowitz), *Journal of the American Statistical Association*, 87/417:234-240, 1992.

Gregg C. Oden

Professor of Psychology and Computer Science

Ph.D., Psychology, University of California–San Diego. Professor of Psychology and Computer Sciences, University of Wisconsin, 1973-90; Postdoctoral Fellow, University of Chicago, 1981.

Professor Oden's research involves the modeling of cognitive processes, with particular regard to how they are able to function under normally adverse conditions. This work emphasizes the massive exploitation of systematic continuous variation in patterned input as a means to robustness in cognitive systems. This work has specifically addressed such issues as speech perception and reading, syntactic ambiguity resolution in natural language, and knowledge representation and categorization with natural categories. The modeling of phenomena in these areas has been couched in terms of fuzzy set theory and fuzzy logic, and, in recent years, artificial neural networks. In turn, this has led to an ongoing active interest in computational neuroscience and in the relationship between symbolic and subsymbolic models.

SELECTED PUBLICATIONS

"FuzzyProp: A Symbolic Superstrate for Connectionist Models," *Proceedings of the IEEE International Conference on Neural Networks,* I:293-300, 1988.

"Fuzzy Implication Formation in Distributed Associative Memory" (with R.L. Jenison), *Proceedings of the Twelfth Annual Conference of the Cognitive Science Society,* 860-867, 1990.

"Making Sentences Make Sense, or Words to That Effect" (with J.G. Rueckl and T. Sanocki), *Understanding Word and Sentence,* ed. G.B. Simpson, North-Holland, 1991.

"Direct, Incremental Learning of Fuzzy Propositions," *Proceedings of the Fourteenth Annual Conference of the Cognitive Science Society,* 48-53, 1992.

Virendra C. Patel

University of Iowa Foundation Distinguished Professor of Mechanical Engineering

B.Sc. (Hons), Aeronautics, Imperial College, London, England, 1962; Ph.D., Aeronautics, Cambridge, England, 1965; Postdoctoral Research, Cambridge, 1965-69; Consultant, Lockheed-Georgia Co., 1969-70; University of Iowa Institute of Hydraulic Research Staff, 1970-present; Visiting Professorships: IIT, Karagpur, India, 1966-67; University of Karlsruhe, Germany, 1980-81; University of Nantes, France, 1984; Chalmers University, Sweden, 1988.

Professor Patel's principal area of research is fluid mechanics, with emphasis on computational fluid dynamics for turbulent flows, and applications of experimental and numerical methods to problems in hydraulic engineering, ship hydrodynamics, vehicle aerodynamics, and biofluid dynamics. Results of this research are applied to practical fluids-engineering problems, including prediction of wind loading on hyperbolic cooling towers and similar structures, winds due to hurricanes, flow separation on vehicles, and viscous flow over ship hulls, in ship wakes, and over marine propellers. Current research projects include development of numerical methods for simulation of unsteady three-dimensional turbulent flows with separation, sediment transport in ice-covered water channels, aerodynamics of the larynx and human voice generation, and flow through hydraulic machinery and hydropower plants. This research is supported by high-speed access to supercomputers at NCSA (Illinois), NAS (NASA Ames), and EG&G (Idaho), among others.

SELECTED PUBLICATIONS

"Viscous Effects on Propagation and Reflection of Solitary Waves in Shallow Channels" (with C.J.

Tang and L. Landweber), *J. Comp. Phy.,* 86:86-113, 1990.

"Solutions of Reynolds-Averaged Navier-Stokes Equations for Three-Dimensional Incompressible Flows" (with H.C. Chen and S. Ju), *J. Comp. Phy.,* 88:305-336, 1990.

"Ship Stern and Wake Flow: Computations and Comparison with Experiments" (with H.C. Chen and S. Ju), *J. Ship Research,* 34:171-193, 1990.

"Stern Flows at Full-Scale Reynolds Numbers" (with S. Ju), *J. Ship Research,* 35:101-113, 1991.

"Turbulent Flow in a Channel with a Wavy Wall" (with J.T. Chon and J.Y. Yoon), *ASME Journal of Fluids Engineering,* 113:579-586, 1991.

Florian A. Potra

Professor of Mathematics and Computer Science

Ph.D., Mathematics, University of Bucharest, 1980; Andrew W. Mellon Postdoctoral Fellow and Visiting Assistant Professor, University of Pittsburgh, 1982-84; Associate Professor of Mathematics, The University of Iowa, 1984-90; Visiting Positions: University of Karlsruhe, Germany, 1987-92; Lawrence Livermore National Laboratory, 1990; Rice University, 1990; Argonne National Laboratory, 1991.

Professor Potra's research continues on numerical solution of nonlinear problems and mathematical programming. Topics include numerical integration of mixed differential algebraic equations, solution of nonlinear systems, and interior point methods for constrained optimization. Efficient algorithms for solving mixed differential algebraic equations have been proposed with good potential for application in many areas of science and technology, including simulation of mechanical systems, robotics, circuit design, and computational chemistry. Interior point methods have better computational complexity and superior practical performance on large problems than classical optimization methods. New results have been obtained on interior point

methods for convex programming and on interior point methods for solving linear programs from infeasible starting points. Applications to image reconstruction, transportation distribution, and optimal control are contemplated.

SELECTED PUBLICATIONS

"On Q-Order and R-Order of Convergence," *Journal Optimiz. Theory Appl.*, 63/3:415-431, 1989.

"On the Numerical Solution of Euler-Lagrange Equations" (with W.C. Rheinboldt), *Mech. Struct. Mach.*, 19/1:1-18, 1991.

"Some Efficient Methods for Enclosing Simple Zeroes of Nonlinear Equations" (with G. Alefeld), *BIT*, 32/2:334-344, 1992.

"ODAE Methods for the Numerical Solution of Euler-Lagrange Equations" (with Linda R. Petzold), *Appl. Numer. Math.*, 10:397-413, 1992.

"Multistep Methods for Solving Constrained Equations of Motion," *SIAM J. Numer. Anal.*, 30/3:774-789, 1993.

R. Rajagopal
Professor of Geography

Ph. D., Water Resources Systems, University of Michigan, 1973; Senior Project Coordinator, Office of the Vice President for Research, The University of Iowa, 1981; Visiting Scientist, Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, 1986-88.

Professor Rajagopal's completed or currently funded research projects include the utility of screening concepts at selected Department of Energy waste sites; a policy framework for environmental priorities (comparative risk assessment); problems, risk perceptions, and priorities of U.S. water resources; knowledge-based systems for groundwater quality assessments; an approach for evaluating the utility of large databases in ecological monitoring and assessment; information-integration software for groundwater quality assessments; and design of optimal groundwater quality monitoring strategies.

SELECTED PUBLICATIONS

"Economics of Screening in the Detection of Organics in Ground Water," *Chemometrics and Intelligent Laboratory Systems*, 9:261-272, 1990.

"Fluoride in Drinking Water: A Survey of Expert Opinions" (with G.A. Tobin), *Environmental Geochemistry and Health*, 13/1:3-13, 1991.

"Comparison of Two Screening Methods for the Detection of VOC's in Ground Water" (with P.C. Li), *Journal of Chemometrics*, 5/3:321-331, 1991.

"Modeling the Occurrence of Volatile Organic Compounds in Ground Water" (with P.C. Li), *Proceedings of the International Conference on Computer Applications in Water Resources*, Tamkang University, Taiwan, 1991.

"On the Selection of Computational Problems in Water Resources: Why Are Some Problems Far More Important than Others?" *Proceedings of the International Conference on Computer Applications in Water Resources*, Tamkang University, Taiwan, 1991.

"Information Integration for Environmental Monitoring and Assessment: An Annotated Bibliography" (with U. Natarajan and J. Wacker), *The Environmental Professional*, 14/2:151-177, 1992.

"Economics of Ground-Water Quality Monitoring: A Survey of Experts" (with G.A. Tobin), *Environmental Monitoring and Assessment*, 22/2:39-56, 1992.

"A Three-Part Series: Pesticide in Water: What Do We Know?; Do We Need to Test for Everything?; and Do We Need to Test Samples Individually?" (with U. Natarajan), *Environmental Testing & Analysis*, 1993 (in press).

Teodor Rus
Associate Professor of Computer Science

Ph.D., Computer Science, Romanian Academy, 1965.

Professor Rus's current research interest is in formal tools for language specification, algebraic methodology for compiler design and implementation, operating system design and implementation, parallel programming, parallel programming environments for high-performance computer systems, and integrating parallel programming environments by algebraic compiler.

SELECTED PUBLICATIONS

"Parallel Implementations of the Simplex Algorithm" (with R. Marciano), *Proceedings of 2nd Symposium on the Frontiers of Massively Parallel Computation, October 10-12, 1988,* George Mason University, Fairfax, Virginia, 85-92.

"Language Support for Parallel Programming," *Proceedings of COMPSTAN '88, The Computer Standards Conference 1988*, March 21-23, Washington, D.C., 91-99, 1988.

TwoLev: A Two Level Scanner (with J. Knaack), *Workshop in Computing Series*, Springer-Verlag, 1991.

"Algebraic Construction of Compilers," *Theoretical Computer Science*, 90:271-308, December 1991.

"Parallel Programming Environments for High Performance Computing Systems" (with R. Marciano), *6th ACM International Conference on Parallel and Distributed Computing Systems*, Pittsburgh, October 1-3, 1992.

"Algebraic Methodology and Software Technology," invited paper, *Encyclopedia of Computer Science and Technology*, ed. James G. Williams, Marcel Dekker, Inc., 1992.

Friedmar J. Schulz
Professor of Mathematics

Doctorate (Dr.rer.nat.), University of Göttingen, Germany, 1979; Assistant Professor, University of Göttingen, Germany, 1979-85; Received Habilitation with venia legendi (Dr. habil.), The University of Iowa, 1985; University of Bonn, 1983; Australian National University, Canberra, 1983-84, 1990; University of Kentucky–Lexington, 1988; Distinguished Ethel Raybould Fellow, University of Queensland–Brisbane, 1991.

Professor Schulz's research areas are in mathematical analysis and geometry, in particular in nonlinear elliptic partial differential equations: equations that arise in differential geometry such as the minimal surface and prescribed mean curvature equations, the prescribed Gauss curvature equation and other Monge-Ampère equations such as the Hamilton-Jacobi-Bellman equation and Monge-Ampère equations that arise in meteorol-

ogy. Examples of systems are the harmonic map system and other Euler-Lagrange systems that arise in the calculus of variations and that are satisfied by the stationary solutions of certain variational problems, such as the problem of minimizing the energy of an elastic medium. A main concern is the question of regularity of solutions and the derivation of estimates for a priori given solutions. Such estimates usually yield part of an existence theorem, the other part usually being a functional analytic argument involving linearization and an implicit function type argument to complete the continuation or increment method.

Schulz has done work on bendings of surfaces with applications to the theory of convex shells in mechanics. An important result is the solution of the Weyl embedding problem in the Hölder class $C^{2,\alpha}$: Given is a Riemannian metric ds^2 on the unit 2-sphere S^2 with positive Gauss-Kronecker curvature K of class $C^{2,\alpha}$ for some α, $0 < \alpha < 1$. Then there exists an ellipsoid S in three space of class $C^{2,\alpha}$, which is isometric to (Σ^2, ds^2), i.e., the metric tensor of Σ is equal to ds^2. Other work in mathematical physics involves eigenvalues, unique continuation, modal sets, and symmetrization.

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"On the Differential Equation rt - s² = f and Weyl's Embedding Problem," *Math. Z.*, 179:1-10, 1982.

"A priori Estimates for Solutions of Monge-Ampère Equations," *Arch. Ration. Mech. Anal.*, 89:123-133, 1985.

"Univalent Solutions of Elliptic Systems of Heinz-Lewy Type," *Ann. Inst. Henri Poincaré, Anal. Non Linéaire*, 6:347-361, 1989.

"Regularity Theory for Quasilinear Elliptic Systems and Monge-Ampère Equations in Two Dimensions," *Lect. Notes Math.*, 1445:123+, Springer-Verlag, 1990.

"Regularity or Certain Quasilinear Elliptic Systems of Divergence Structure," *Indiana Univ. Math. J.*, 39:303-314, 1990.

Gerhard O. Ströhmer
Associate Professor of Mathematics

Doctorate (Dr.rer.nat.), Göttingen, Germany, 1978; Habilitation, Institute of Technology, Aachen, Germany, 1984; Wissenschaftlicher Assistant, Aachen, 1977-86; Assistant Professor of Mathematics, The University of Iowa, 1986-88; Visiting Positions: University of Bonn, Germany, 1990; University of Bayreuth, Germany, 1991.

Topics of Professor Strohmer's research include magnetohydrodynamics, abstract parabolic systems, numerical approximation of viscous incompressible flows, hydrodynamic stability, and the onset of turbulence in the flow between rotating cylinders.

SELECTED PUBLICATIONS

"About an Initial-Boundary Value Problem from Magnetohydrodynamics," *Mathematische Zeitschrift*, 209:345-362, 1992.

"An Existence Result for Partially Regular Weak Solutions of Certain Abstract Evolution Equations, with an Application to Magnetohydrodynamics," *Mathematische Zeitschrift* (in press).

"Hilbert Space Methods in Hydrodynamics with Applications to Couette Flow" (with Georg Knorr), *Z. Naturforsch.*, 48a:679-691, 1993.

"An Eigenvalue Problem Related to Viscous Flow," Preprint.

Tuong Ton-That
Professor of Mathematics

Ph.D., Mathematics, University of California–Irvine, 1974; Matrise es Sciences & Applications Fondamentales, Universite de Grenoble, France, 1969; Postdoctoral Research Fellow, Harvard University, 1974-75; Visiting Professorships: University of California–Irvine, 1981-82; University of Southern California, 1982-83; University of Heidelberg, Germany, 1988; Nankai Institute of Mathematics, China, 1991.

Professor Ton-That's research continues on the theory of representations of Lie groups, abstract harmonic analysis, and their applications to physics. Topics include decomposition of tensor products of representations of Lie groups; the theory of polynomial invariants and the Casimir invariants which, in physical terms, determine the observable quantum numbers of a physical system; and the resolution of the multiplicity problem in tensor products representations.

SELECTED PUBLICATIONS

"n-Fold Tensor Products of GL (N,C) and Decomposition of Fock Spaces" (with W.H. Klink) *Jour. of Funct. Anal.*, 84/1:1-18, 1989.

"Representations of $S_n \times U(N)$ in Repeated Tensor Products of the Unitary Group" (with T. Ton-That), *J. Phys. A: Math. Gen.*, 23:2751-2763, 1990.

"Representations of SO(k, C) on Harmonic Polynomials on a Null Cone" (with O. Debarre), *Proceedings of the Am. Math Society*, 112/1:31-44, 1991.

"Invariant Theory of the Block Diagonal Subgroups of GL (N,C) and Generalized Casimir Operators" (with W.H. Klink), *Journal of Algebra*, 145/1, 1992.

"Invariant Theory of the Dual Pairs (SO*(2n), Sp(2k,C)) and (Sp(2n, R), SO(N))" (with E.Y. Leung), *Proceedings of the Am. Math Society*, 1993 (in press).

George G. Woodworth

Associate Professor of Statistics and Biostatistics

Ph.D., Statistics, University of Minnesota, 1966; Assistant Professor of Statistics, Stanford University, 1966-71; Visiting *Assistent* (Assistant Professor), Lund Institute of Technology, Sweden, 1970-71.

Professor Woodworth's research interests include problems arising in collaborative work in law and justice statistics and the behavioral and biomedical sciences. Active areas are bootstrapping variable selection in logistic regression, quantile regression in small samples, growth models with irregularly spaced observations, and context effects in speech discrimination tests.

SELECTED PUBLICATIONS

Equal Justice and the Death Penalty: A Legal and Empirical Analysis (with David Baldus and Charles Pulaski, Jr.), Northeastern University Press, 1990.

"Effect of Repair Strategies on Visual Identification of Sentences" (with N. Tye-Murray, S. Purdy, and R.S. Tyler), *Journal of Speech and Hearing Disorders*, 55:621-627, 1990.

"Genetic and Environmental Factors in Adoptee Antisocial Personality" (with R.C. Cadoret, E.P. Troughton, and J.A. Bagford), *European Archives of Psychiatry and Neurological Sciences*, 239:231-240, 1990.

"Screening for Interactions Between Design Factors and Demographics in Choice-Based Conjoint" (with Chakraborty, et. al.), *Journal of Business Research*, 23:219-238, 1991.

"Psychological Predictors of Audiological Outcomes of Multichannel Cochlear Implants: Preliminary Findings" (with John F. Knutson, James V. Hinrichs, Richard S. Tyler, Bruce J. Gantz, and Helen A. Schartz), *Annals of Otology, Rhinology & Laryngology*, 100:817-822, 1991.

Yinyu Ye

Professor of Management Sciences

Ph.D., Engineering-Economic Systems and Operations Research, Stanford University, 1988; Postdoctorate, Industrial Engineering and Operations Research, Cornell University, 1988; Visiting Professorships: Rice University, 1991; Academia Sinica, China, 1992.

Professor Ye's research interests lie in the areas of complexity theory, algorithm design and analysis, and application of mathematical programming, computer science, management sciences, and operations research. Currently, research work deals with the development of Karmarkar-type interior-point algorithms for linear, quadratic, and nonlinear programming. These topics include the worst-case complexity of potential reduction algorithms, the quadratic asymptotic convergence for linear and quadratic programming, and the probabilistic analysis of interior-point algorithms. Applications include communication, transportation, and other industries. Research also includes an optimal algorithm for computing the roots of a class of real functions, an improved complexity bound for the Von Neumann economic growth problem, an efficient algorithm for the ball-constrained quadratic optimization problem, a polynomial approximation algorithm for some global optimization problems, and an optimization model in certain economic problems. Most of these results are aimed at developing efficient computational algorithms with powerful and parallel computers to solve various scientific and engineering problems, under NSF support.
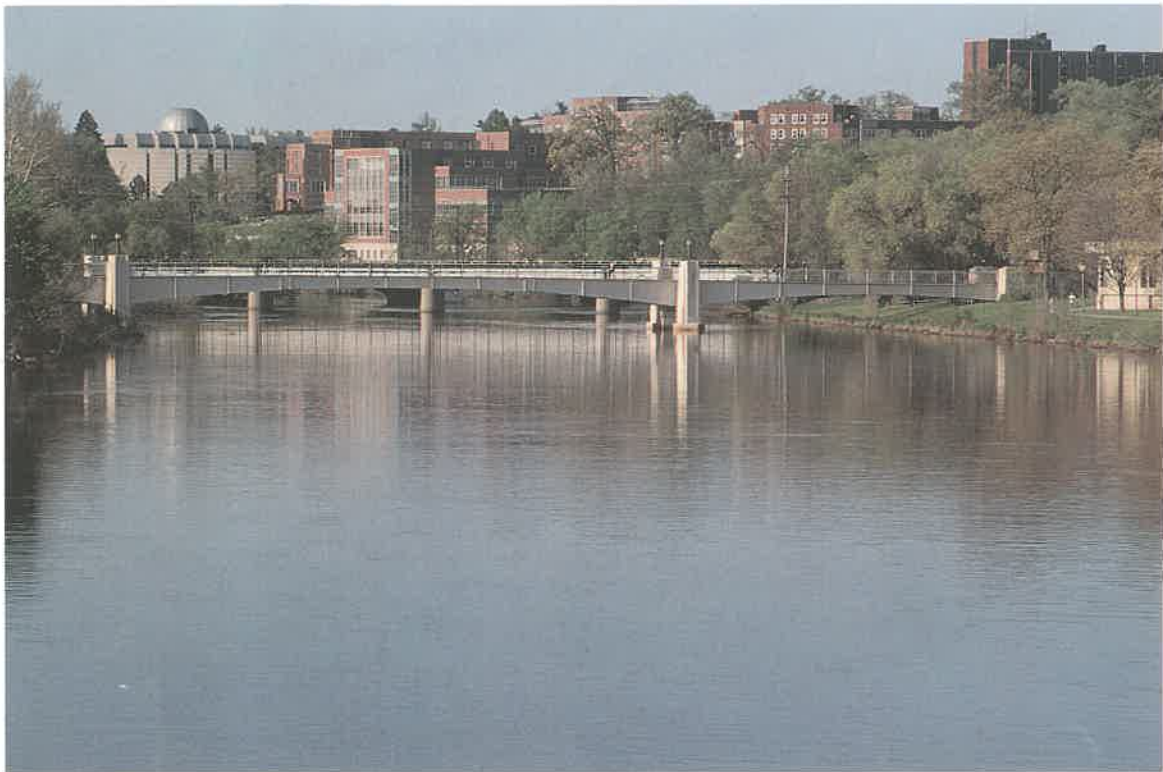
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"An $O(n^3 L)$ Potential Reduction Algorithm for Linear Programming," *Contemporary Mathematics* 114:91-108, 1990.

"A Class of Projective Transformations for Linear Programming," *SIAM J. on Computing* 19:457-466, 1990.

"A Fully Polynomial-Time Approximation Algorithm for Computing a Stationary Point of the General LCP," *Mathematics of Operations Research* (in press).

"A Quadratically Convergent $O(\sqrt{n}L)$-iteration Algorithm for Linear Programming" (with O. Güler, R. Tapia, and Y. Zhang), *Mathematical Programming* (in press).

"Toward Probabilistic Analysis of Interior-Point Algorithms for Linear Programming," *Mathematics of Operations Research* (in press).

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