

# INSTITUTE FOR MATHEMATICS AND ITS APPLICATIONS

University of Minnesota

400 Lind Hall

207 Church Street S.E.

Minneapolis, Minnesota 55455

FAX (612) 626-7370

telephone (612) 624-6066

e-mail: [ima-staff@ima.umn.edu](mailto:ima-staff@ima.umn.edu)

IMA Schedules via finger: [finger\\_seminar@ima.umn.edu](mailto:finger_seminar@ima.umn.edu)

Newsletters, Updates and preprints available via

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## IMA UPDATE

Fall 1998

This is one of a series of quarterly notices concerning the activities  
of the Institute for Mathematics and its Applications.

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PARTICIPATING INSTITUTIONS: Centre National de la Recherche Scientifique, Consiglio Nazionale delle Ricerche, Georgia Institute of Technology, Indiana University, Iowa State University, Kent State University, Michigan State University, Northern Illinois University, Ohio State University, Pennsylvania State University, Purdue University, Seoul National University (RIM - GARC), Texas A&M University, University of Chicago, University of Cincinnati, University of Houston, University of Illinois (Urbana), University of Iowa, University of Kentucky, University of Manitoba, University of Maryland, University of Michigan, University of Minnesota, University of Notre Dame, University of Pittsburgh, University of Southern California, University of Wisconsin, Wayne State University.

PARTICIPATING CORPORATIONS: Bellcore, Eastman Kodak, EPRI, Ford, Fujitsu, General Motors, Honeywell, IBM, Lockheed Martin, Lucent Technologies, Medtronic, Motorola, Siemens, 3M.

Version of November 23, 1998

## I. NEWS AND NOTES

### a. IMA Facilities Expansion

The IMA main office is now located on the 4th floor of Lind Hall. Lind Hall is just to the East and across Church Street from Vincent Hall (the former location of the IMA main office) and adjacent to the EE/CS building which houses the IMA conference hall. Maps may be found on the web at <http://www.ima.umn.edu/local2/maps/>.

In addition, the IMA will continue to have visitor offices in Vincent Hall and staff will be available to provide visitor support from the former main office in Vincent 514.

This 7,000  $ft^2$  space was remodeled by the University (summer 1997) for mathematics research, at a cost of nearly \$2 million. It has an open architecture that is ideally suited for industrial research teams and other group research activities, and has an indoor connection to the IMA conference facility. Total space for IMA related activities has nearly doubled and in particular we are able to provide office space for more participants. Telephone and email addresses for the staff remain unchanged, but the geographic address is now

400 Lind Hall  
207 Church St SE  
Minneapolis, Minnesota 55455.

### b. Program Ideas

The IMA continually asks members of the mathematical sciences community for their ideas for future programs. This community includes—in addition to mathematicians—industrial scientists, scientists in government labs, university scientists, engineers, etc. whose work brings them in contact with problems involving mathematical challenges at all levels.

Future programs are sought which could be carried out through:

- a one-week workshop on a topic of mathematical/scientific interest;
- a one-month period of concentration bringing mathematicians and other scientists together to work on a topic of interest;
- a two- to seven-week Summer program consisting of a series of one-week workshops treating subtopics of a topic of interest; or
- a ten-month Annual Program including long-term senior visitors, eight postdocs, six to ten one-week workshops, three to ten tutorials, and weekly seminars.

Please contact the IMA Director, Willard Miller, with your ideas:

E-mail: [miller@ima.umn.edu](mailto:miller@ima.umn.edu)  
Institute for Mathematics and its Applications  
University of Minnesota  
400 Lind Hall  
207 Church Street S.E  
Minneapolis, Minnesota 55455  
phone: (612) 624-6066  
FAX: (612) 626-7370

**Please see the enclosed flyer or <http://www.ima.umn.edu/ideas.html> for more detailed information.**

### c. Funding support for IMA 1997 – 1998 programs

The IMA expresses its thanks to the funding agencies, institutions and corporations who provided financial support to the IMA during the programming period September 1, 1997 – August 31, 1998. Major support was provided by the National Science Foundation, which founded the IMA, and by the University of Minnesota, the host institution.

Support for the March 7th workshop on the NSF Knowledge and Distributed Intelligence (KDI) Initiative was provided by the National Science Foundation.

Support for the April 27 – May 1 workshop on “Nonlinear Identification and Control” and the May 7–9 workshop on “Dynamical Systems Techniques in Oceanography: Chaotic Advection in Ocean Mesoscale Structure” was provided by the Office of Naval Research.

Corporate support was received from the IMA Participating Corporations: Bellcore, Eastman Kodak, EPRI, Ford, Fujitsu, General Motors, Honeywell, IBM, Lockheed Martin, Lucent Technologies, Motorola, Siemens and 3M.

Institutional support was received from the IMA Participating Institutions: Centre National de la Recherche Scientifique, Consiglio Nazionale delle Ricerche, Georgia Institute of Technology, Indiana University, Iowa State University, Kent State University, Michigan State University, Northern Illinois University, Ohio State University, Pennsylvania State University, Purdue University, Seoul National University (RIM - GARC), Texas A&M University, University of Chicago, University of Cincinnati, University of Houston, University of Illinois (Chicago), University of Illinois (Urbana), University of Iowa, University of Kentucky, University of Manitoba, University of Maryland, University of Michigan, University of Minnesota, University of Notre Dame, University of Pittsburgh, University of Southern California, University of Wisconsin, and Wayne State University.

We, and the scientists who have participated in IMA programs, are very grateful to all these agencies, corporations and universities for making IMA programming possible.

### d. 1998–1999 Postdocs Selected

With the advice of the organizers of the 1998–99 year on **Mathematics in Biology**, the IMA has chosen nine postdoctoral members for the period September 1, 1998 to August 31, 2000. For the first time, all post-docs were offered two year appointments. These postdocs will be active participants in all activities of the Biology year. They were chosen from a long list of well-qualified recent Ph. D. recipients.

NAME	PH. D. INSTITUTION	ADVISOR
Kevin Anderson	University of Arizona	Joeseph Watkins
Bruce Ayati	University of Chicago	Todd F. Dupont
Trachette Jackson	University of Washington	James Murray
Bingtuan Li	Arizona State University	Yang Kuang
Maia Martcheva	Purdue University	F. Mimer
Xianfeng (Dave) Meng	Tulane University	Lisa Fauci
Patrick Nelson	University of Washington	James Murray
Ralf Wittenberg	Princeton University	Philip Holmes

#### Second Year Postdocs

Kathleen Rogers	University of Maryland	John Maddocks
Warren Weckesser	Rensselaer Polytechnic Inst.	Mark Levi

#### Industrial Postdocs

NAME	Company	PH. D. INSTITUTION	ADVISOR
Radu Balan	IBM	Princeton University	Ingrid Daubechies
Nicolas Coult	FMA&H	University of Colorado	Gregory Beylkin
Marina Osipchuk (2nd Year)	Honeywell	Kiev University	Fedir Garaschenko
Anthony Varghese	Medtronic	Univ. of Oxford (post-doc)	
Aleksandar Zatezalo	Lockheed Martin	University of Minnesota	Nicolai Krylov

### e. Participating Institution Conferences Selected for 1998–99

Nine IMA Participating Institution Conferences have been selected for funding during 1998–99:

DATES	LOCATION	TITLE
August 2-5, 1998	Iowa State University	Recent Trends and Advances in PDE's and Numerical PDE's
September 9-13, 1998	Georgia Institute of Technology	Third Americas Conference on Differential Equations and Nonlinear Analysis
October 2-3, 1998	University of Kentucky	Stochastic Control with Partial Observations and Financial Models of Incomplete Markets
October 7-11, 1998	University of Manitoba	International Conference on Operator Theory and Its Applications to Scientific and Industrial Problems
November 9-12, 1998	Indiana University	Mathematical Problems in Meteorology and Oceanography
January 7-11, 1999	University of Wisconsin	Singular and Oscillatory Integrals
April 1-4, 1999	University of Iowa	Nonlinear Partial Differential Equations
April 30-May 2, 1999	University of Minnesota	Nonlinear Partial Differential Equations and Applications to Materials
May, 1999	Iowa State University	Great Plains Operator Theory Symposium

Interested participants are urged to address their inquiries to the organizers at the Participating Institution where the conference will be held. Conference Participants from other Participating Institutions may use PI funds for their expenses, where these are available.

All faculty members of Participating Institutions of the IMA were encouraged to submit proposals for this annual competition. There is no restriction on the mathematical topic of the conferences, but they should be of interest to a number of Participating Institutions, and the organizing committee should contain some faculty members from these institutions. The faculties of the Participating Institutions were consulted about the proposals, and the final decision was made by a panel of four participating Institution department heads: Carl Cowen (Purdue University, Chair) Gary Mullen (Penn State), Boris Rozovskii (University of Southern California), James Osterburg (University of Cincinnati).

Proposals for 1999–2000 will be due on April 1, 1999.

### f. Board of Governors Selects Program Topics: Codes, Systems and Graphs for Summer 1999 and Mathematics in the Geosciences for the 2001-2002 Annual Program

The Board of Governors approved a proposal to devote the Summer 1999 Summer Program to the topic, **Codes, Systems and Graphs**. The organizing committee consists of G. David Forney (Motorola), Brian Marcus (IBM Almaden Research Center), Joachim Rosenthal (University Notre Dame) and Alexander Vardy (University of Illinois). The proposal outlines a two week program to be held August 2-13, 1999. The aim of the workshop is to bring together mathematicians, computer scientists, and electrical engineers in the area of coding theory, systems theory and symbolic dynamics so that the techniques from one area can be applied to problems in the other area. The two weeks of the workshop will be subdivided into two main focus areas “Codes on Graphs and Iterative Decoding” in week 1 and “Connections Among Coding Theory, System Theory and Symbolic Dynamics” in week 2.

The Board of Governors also approved a proposal to devote the year September 2001 – June 2002 to the topic, **Mathematics in the Geosciences**. The organizing committee consists of W. I. Newman (Department of Earth Sciences, University of California Los Angeles), J. M. Hyman (Los Alamos National Laboratory), W. W. Symes (Department of Computational and Applied Mathematics, Rice University), M. Ghil (Department of Atmospheric Sciences, UCLA), D. L. Turcotte (Department of Geological Sciences, Cornell University) and M. F. Wheeler (Center for Petroleum Geosystems and Engineering, University of Texas)

The proposal outlines tentative plans for workshops covering celestial mechanics and climatology, time series, spatio-temporal patterns, discrete models, subgrid-scale modeling, coupling in multiple time-scale models, nonlinear rheology, data assimilation, and uncertainty in inverse problems. As with all IMA programs, a primary goal of these workshops is to educate and interest mathematicians in the mathematical and scientific problems that arise in these dynamic and challenging areas of science and technology.

**g. PI Conference: “Conference on Singular and Oscillatory Integrals ”January 7-11, 1999 at University of Wisconsin - Madison**

(See also <http://conley.math.wisc.edu/seeger/soi1.html>)

The subject of Singular and Oscillatory Integrals is central to modern analysis. The methods and results have been applied in partial differential equations, integral geometry, complex analysis and mathematical physics. The conference will provide an opportunity for consolidation of recent progress and an easy exchange of new ideas.

The formal scientific activity of the conference will focus on a series of invited one hour talks by a distinguished list of mathematicians. The following have already agreed to speak:

**Partial List of Invited Speakers:**

William Beckner (University of Texas-Austin)	Michael Christ (Univ. of California-Berkeley)
Charles Fefferman (Princeton Univ.)	Robert Fefferman (Univ. of Chicago)
Allan Greenleaf (Univ. of Rochester)	Nets Katz (Univ. of Illinois-Chicago)
Carlos Kenig (Univ. of Chicago)	Detlef Müller (Christian-Albrechts-Universität Kiel)
Kate Okikiolu (Univ. of California-San Diego)	Duong H. Phong (Columbia Univ.)
Fulvio Ricci (Politecnico di Torino)	Christopher D. Sogge (Johns Hopkins Univ.)
Elias M. Stein (Princeton Univ.)	Wilhelm Schlag (Princeton Univ.)
Terence Tao (Univ. of California-Los Angeles)	Guido Weiss (Washington Univ.-St. Louis)
Thomas Wolff (California Institute of Technology)	Sarah Ziesler (Univ. College Dublin and Dominican Univ.)

There will also be opportunities for informal seminars and other communication. The participation of advanced graduate students and recent Ph.D.'s is strongly encouraged. There will be two instructional lectures by Anthony Carbery and James Wright targeted in particular at this group.

**h. Weekly IMA Seminar List Available by List Server**

The IMA is happy to offer its e-mail mailing list service. The mailing list “weekly” is a distribution each Thursday of the next week’s schedule of IMA seminars and events. If you wish to subscribe, simply send an e-mail message to `imalists@ima.umn.edu` whose first line is of the form

`subscribe weekly`

If your preferred e-mail address is different from the one from which you are sending the request, the first line should be

`subscribe weekly you@e.mail.address`

The subject line and the rest of the message are ignored. Questions or problems should be sent to

`owner-weekly@ima.umn.edu`

The current weekly schedule is also available on request via `finger seminar@ima.umn.edu`. An updated `.dvi` file of the IMA Newsletter (current and recent) is available by `ftp` or through the world-wide web.

## II. IMA CALENDAR

### 0. HOT TOPICS PROGRAMS for 1999

**April 24–27, 1999** HOT TOPICS Workshop on **Challenges and Opportunities in Genomics: Production, Storage, Mining and Use**

**July 20–24, 1999** HOT TOPICS Workshop on **Decision Making under Uncertainty: Energy and Environmental Models**

**October 22–24:** HOT TOPICS Workshop on **Scaling Phenomena in Communication Networks**

### 1. MATHEMATICS IN BIOLOGY, September 1998–June 1999

**Fall 1998: Theoretical Problems in Developmental Biology and Immunology**

For the Fall schedule, see the Winter 1998 update or <http://www.ima.umn.edu/biology/index.html#fall>

**Winter 1999: Mathematical Problems in Physiology**

**January 4–8:** Workshop on **Cell Adhesion and Motility**

**January 25–29:** Workshop on **Computational Modeling in Biological Fluid Dynamics**

**February 8–12:** Workshop on **Membrane Transport and Renal Physiology**

**February 13:** Tutorial on **Hormones**

**February 15–19:** Workshop on **Endocrinology: Mechanism of Hormone Secretion and Control**

**March 5:** Tutorial on **Audition**

**March 8–12:** Workshop on **Audition**

**Spring 1999: Dynamic Models of Ecosystems and Epidemics**

**April 19–23:** Workshop on **Local Interaction and Global Phenomena in Vegetation and other Systems**

**May 13–14:** Tutorial on **Introduction to Epidemiology & Immunology**

**May 17–21:** Workshop on **Mathematical Approaches for Emerging and Reemerging Infectious Diseases**

**June 7–11:** Workshop on **From Individual to Aggregation: Modeling Animal Grouping**

### 2. CODES, SYSTEMS and GRAPHICAL MODELS, August 2–13 1999

**August 2–6:** Week 1 on **Codes on Graphs and Iterative Decoding**

**August 9–13:** Week 2 on **Connections Among Coding Theory, System Theory and Symbolic Dynamics**

### 3. REACTIVE FLOW & TRANSPORT PHENOMENA, September 1999–June 2000

**Fall 1999: Combustion**

**September 23–24:** Tutorial on **Low-speed Combustion**

**September 27–October 1:** Workshop on **Low-speed Combustion**

**October 11–13:** Workshop on **Fires**

**October 14–15:** Minisymposium on **Mathematical and Computational Strategies for Simplifying Complex Kinetics**

**November 5:** Tutorial on **High-speed Combustion**

**November 8–12:** Workshop on **High-speed Combustion in Gaseous and Condensed-phase Energetic Materials**

**Winter 2000: Natural Resources and Environment**

**January 26–30:** Workshop on **Confinement and Remediation of Environmental Hazards**

**February 9–13:** Workshop on **Resource Recovery**

**March 15–19:** Workshop on **Air Quality Engineering**

**Spring 2000:** **Multiscale and Transition Regimes**

**May 1–5:** Workshop on **Dispersive Corrections to Transport Equations**

**May 18–19:** Tutorial on **Simulation of Transport in Transition Regimes**

**May 22–26:** Workshop on **Simulation of Transport in Transition Regimes**

**June 5–9:** Workshop on **Multiscale Models for Surface Evolution and Reacting Flows**

#### **4. MATHEMATICS IN MULTIMEDIA, September 2000–June 2001**

**Fall 2000:** **Vision, Speech and Language**

**Winter 2001:** **Compression, Communication and Retrieval**

**Spring 2001:** **Geometric Design and Computer Graphics**

#### **5. MATHEMATICS IN THE GEOSCIENCES, September 2001–June 2002**

**Fall 2001:** **Dynamical Systems and Ergodic Theory**

**Winter 2002:** **Multiscale Phenomena and Renormalization**

**Spring 2003:** **Inverse Problems and Quantification of Uncertainty**

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**1998–1999 Annual Program:**

### **III. MATHEMATICS IN BIOLOGY**

August 2–13, 1999

Organizers: Lisa Fauci, Tulane University

Simon A. Levin, Princeton University

James D. Murray, University of Washington

Alan Perelson (Chair), Los Alamos Natl. Lab.

Michael Reed, Duke University

See also <http://ww.ima.umn.edu/biology/>

#### **Introduction:**

Significant applications of mathematics to biology have occurred for nearly a century, starting from the early work of Vito Volterra and Alfred Lotka on interacting populations, and maturing through fundamental work in population genetics (Haldane, Fisher, and Wright), epidemiology (Ross, Kermack and MacKendrick), development (Turing) and neurobiology (Hodgkin and Huxley, Fitzhugh and Nagumo, McCulloch and Pitts). Much of this research stimulated important contributions by other mathematicians (Kolmogorov, Petrovsky, Piskunov, Karlin, etc.); in general, however, until the past 10–20 years, communication between mathematicians and biologists remained problematical; much work in mathematical biology was relatively sterile, unsullied by contact with data, while experimental work suffered from a lack of theoretical generality.

The situation has changed dramatically in the past decade or so. Today's biologists are, in many areas, very sophisticated mathematically; mathematicians have learned the importance of becoming immersed in data; and the spectrum of practitioners has filled in, providing a continuum of highly mathematical work to collaborations. New and exciting areas (*e. g.* molecular biology, epidemiology and immunology) have opened up to mathematical investigations. A century of research has elucidated fundamental mechanisms in evolution, collective phenomena and pattern formation, and laid the foundations for more specialized modeling; and the development of new computational tools has greatly expanded the potential both for fundamental studies and for communications.

Thus the time is right for this special year at the IMA, built upon a selected series of workshops highlighting some of the mathematical challenges emerging from the consideration of biological issues, and endeavoring to show how the mathematics can be applied to the resolution of those issues. This program focuses on some particularly rich areas of investigation,

complementing activities which have been carried out at the IMA in MRI, molecular biology and neurobiology in earlier years.

**FALL QUARTER** (September 1–December 31, 1998): **Theoretical Problems in Developmental Biology and Immunology**

**WINTER QUARTER** (January 1–March 31, 1999): **Mathematical Problems in Physiology**

**SPRING QUARTER** (April 1–June 30, 1999): **Dynamic Models of Ecosystems and Epidemics**

## Mathematical Problems in Physiology

### 1 Workshop (January 4-8, 1999) Cell Adhesion and Motility

**Organizers:** Wolfgang Alt (Universität Bonn), Robert T. Tranquillo (University of Minnesota)

**For current information see URL:** <http://www.ima.umn.edu/biology/winter/bio5.html>

Cell adhesion and motility are vital to many physiological processes, such as inflammation, wound healing and metastasis, as well as biotechnology applications (e.g. cell-adhesion-based separation and purification) and the nascent field of tissue engineering, where achieving and controlling the cellularity of bioartificial tissues is critical.

The advent of cell and molecular biology has enabled the development of mechanistic models relating molecular properties such as integrin-mediated adhesion and F-actin regulated motility to these cell functions. However, much remains to be accomplished, especially in developing models that make explicit account for the role of adhesion in cell migration, in external fields (e.g. gradients of adhesion or chemotactic factor molecules, or aligned extracellular matrix fibers). Exploiting the ability to now manipulate molecular properties of the cell and create such fields affords profound opportunities for model validation and development. In addition to assembling a group of investigators who can pioneer such models and their testing, another focus will be on examining the origin and role of stochasticity that is manifest in cell adhesion and motility and to discuss diffusion approximation methods that can be applied to stochastic mechanistic models in order to obtain more tractable PDE formulations.

#### CONFIRMED WORKSHOP PARTICIPANTS: January 4-8, 1999 (as of 11 November 1998)

ALT, WOLFGANG	Univ. Bonn (Abteilung Theoretische Biologie)	JAN 1 – 9
BENTIL, DANIEL	Univ. of Massachusetts (Mathematics & Statistics)	JAN 2 – 8
BEREITER-HAHN, JUERGEN	Frankfurt Univ. (Zoology)	JAN 2 – 8
BOTTINO, DEAN	Univ. of Utah (Mathematics)	JAN 2 – 8
BUETTNER, HELEN	Rutgers Univ. (Chemical and Biochemical Eng.)	JAN 2 – 8
CHOE, JUN	Korea Adv. Inst. of Science & Tech (Mathematics)	JAN 1 – FEB 28
DEMBO, MICAH	Boston Univ. (Biomedical Engineering)	JAN 2 – 9
DICKINSON, RICH	Univ. of Florida (Chemical Engineering)	JAN 2 – 8
DUNN, GRAHAM	Kings College London (Randall Inst.)	JAN 1 – 30
HAMMER, DANIEL A.	Univ. of Pennsylvania (Chemical Engineering)	JAN 2 – 8
HOCHMUTH, ROBERT	Duke Univ. (Mech. Engineering & Mat. Sci.)	JAN 2 – 8
ISRAELACHVILI, JACOB N.	Univ. of California Santa Barbara (Chemical Engineering)	JAN 2 – 8
JANMEY, PAUL	Harvard Univ. (Brigham and Womens Hospital)	JAN 2 – 8
LUBKIN, SHARON	North Carolina State Univ. (Biomathematics Program)	JAN 2 – 8
MOGILNER, ALEX	Univ. of California - Davis (Mathematics)	JAN 2 – 8
NOSSAL, RALPH	NIH (DCRT)	JAN 2 – 8
ODDE, DAVE	Michigan Tech (Chemical Engineering)	JAN 2 – 8
OTHMER, HANS	Univ. of Utah (Mathematics)	JAN 2 – 8
PALSSON, EIRIKUR	Univ. of Utah (Mathematics)	JAN 3 – 8
SCHMID-SCHOENBEIN, GEERT	Univ. of California, San Diego (Bioengineering)	JAN 2 – 8
SHEETZ, MIKE	Duke Univ. (Cell Biology)	JAN 2 – 8
TRANQUILLO, ROBERT	Univ. of Minnesota (Chem Eng. and Mat. Sci.)	JAN 3 – 8
WANG, Y.L.	Univ. Massachusetts (Medical School)	JAN 2 – 8
ZHU, CHENG	Georgia Tech (Mechanical Engineering)	JAN 2 – 8

## 2 Workshop (January 25-29, 1999) Computational Modeling in Biological Fluid Dynamics

**Organizers:** Lisa Fauci (Tulane University), Shay Gueron (Technion - Israel Institute of Technology)

**For current information see URL:** <http://www.ima.umn.edu/biology/winter/bio6.html>

A unifying theme in all biological fluid dynamics is the interaction of moving, elastic boundaries with surrounding fluid. This workshop will bring together biologists, zoologists, mathematicians and numerical analysts to focus on modeling and simulations of these complex systems. Topics covered include motility of microorganisms, mucociliary interaction, pulmonary airway reopening, red blood cell motion and leech swimming. Numerical methods well-suited to these systems, such as immersed boundary methods, boundary element methods and impulse methods will be explored.

### CONFIRMED WORKSHOP PARTICIPANTS: January 25-29, 1999 (as of 11 November 1998)

ALSCHER, CHRISTIAN	Univ. of Bielefeld (FSP Maathematisierung)	JAN 23 – 31
ARTHURS, KAYNE	Duke Univ. (Mathematics)	JAN 23 – 29
BLAKE, J.R.	Univ. of Birmingham (School Math and Statistics)	JAN 23 – 29
BLUM, JACOB J.	Duke Univ. Medical Center (Cell Biology)	JAN 23 – 29
CHOE, JUN	Korea Adv. Inst. of Science & Tech. (Mathematics)	JAN 1 – FEB 28
COOMBS, DAN	Univ. of Arizona (Applied Mathematics)	JAN 24 – 29
CORTEZ, RICARDO	Tulane Univ. (Mathematics)	JAN 23 – 29
DILLON, ROBERT	Washington State Univ. (Mathematics)	JAN 23 – 29
FAUCI, LISA	Tulane Univ. (Mathematics)	JAN 23 – 29
FOGELSON, AARON	Univ. of Utah (Mathematics)	JAN 23 – 25
GAVER, DON	Tulane University (Biomedical Engineering)	JAN 23 – 29
GUERON, SHAY	Technion-I.I.T. (Mathematics)	JAN 24 – MAR 7
HAIDER, MANSOOR	Duke Univ. (Mathematics)	JAN 23 – 29
HALPERN, DAVE	Univ. of Alabama (Mathematics)	JAN 23 – 29
HOPKINS, MATT	Rose-Hulman Institute (Mathematics)	JAN 23 – 29
JORDAN, CHRIS	Univ. of Colorado (Biology)	JAN 23 – 29
KOEHL, MIMI	Univ. of California at Berkeley (Integrative Biology)	JAN 23 – 29
LAYTON, HAROLD	Duke Univ. (Mathematics)	JAN 1 – MAR 31
LEVEQUE, RANDALL	Univ. of Washington (Applied Math)	JAN 23 – 29
LINDEMANN, CHARLES	Oakland Univ. (Biological Sciences)	JAN 23 – 29
LIRON, NADOV	Technion Univ. (Math)	JAN 23 – 29
LUBKIN, SHARON	North Carolina State Univ. (Biomathematics Program)	JAN 23 – 29
MCQUEEN, DAVID	New York Univ. (Courant)	JAN 23 – 29
MOORE, PETER	Tulane Univ. (Mathematics)	JAN 23 – 29
PEDLEY, TIM	Univ. of Cambridge	JAN 23 – 29
POZRIKIDIS, C.	Univ. of California-San Diego (AMES)	JAN 23 – 29
PRIEL, ZVI	Ben Gurion Univ. (Chemistry)	JAN 23 – 29
ROOT, ROBERT	Lafayette College (Mathematics)	JAN 23 – 29
SATIR, PETER	Albert Einstein College of Medicine (Jack and Peal Resnick Campus)	JAN 23 – 29
SLEIGH, MICHAEL	Univ. of Southampton (School Biological Sciences)	JAN 23 – 29
SMITH, CARL S.	Hennepin County Medical Center (Urology)	JAN 25 – 29
STOCKIE, JOHN M.	Simon Fraser Univ. (Mathematics & Statistics)	JAN 23 – 30
VERDUGO, PEDRO	Univ. of Washington (Center Bioengineering)	JAN 23 – 29
WANG, JANE	NYU-Courant Inst.	JAN 23 – 29
WEIHS, DANNY	Technion - I.I.T. (Aerospace Engineering)	JAN 23 – 29

### 3 Workshop (February 8-12, 1999) Membrane Transport and Renal Physiology

**Organizers:** Harold Layton (Duke University), Alan Weinstein (Cornell University Medical College)

**For current information see URL:** <http://www.ima.umn.edu/biology/winter/bio7.html>

This workshop will bring together physiologists and applied mathematicians who share a common interest in solute and water transport and its role in integrated renal function. Topics will include fiber-matrix theory, membrane transport, renal epithelial transport, the urine concentrating mechanism, and renal hemodynamic control. The workshop will seek to facilitate communication and cooperation among participants who may not be aware of each other's research and will provide an introduction to these topics for other biological and mathematical scientists.

Fundamental to the operation of the kidney is the transport of water and solutes through and around cells. The pathways through the cells involve transit across two cell membranes. This membrane transport is often via specialized protein transporters resident within the membrane: ion channels, solute-specific facilitated transporters, or metabolically driven ion pumps. For each of these, there is substantial experimental investigation within the physiology and biophysics communities to characterize the transport dynamics and develop a mathematical theory of its function. These mathematical descriptions constitute the building blocks for models of epithelial transport. The fundamental unit of the kidney is the nephron, a cylinder lined by specialized epithelia which change axially. Hemodynamic control mechanisms enable distal nephron segments to control delivery of fluid by using renal arterial tone to modulate proximal fluid entry. Thus, the questions which relate to whole kidney function are those of interacting epithelia in a special geometry, both axially along the nephron and between apposed nephron segments. Consequently, mathematical models of integrated renal function consist of systems of ordinary or partial differential equations, which are solved numerically or from which qualitative information is extracted through analysis.

#### CONFIRMED WORKSHOP PARTICIPANTS: February 8-12, 1999 (as of 11 November 1998)

BENJAMIN, BRUCE A.	Oaklahoma State Univ. (Pharmacology)	FEB 6 – 12
BENTIL, DANIEL	Univ. of Massachusetts (Mathematics & Statistics)	FEB 7 – 12
BLANTZ, ROLAND C.	VA Medical Center (Nephrology)	FEB 6 – 12
CHOE, JUN	Korea Adv.Inst. of Science & Tech. (Mathematics)	JAN 1 – FEB 28
CUPPLES, WILLIAM A.	SMBD-Jewish General Hospital (Medicine)	FEB 6 – 12
DE WEER, PAUL	Univ. of Pennsylvania (Physiology)	FEB 6 – 10
DEEN, WILLIAM M.	MIT (Chemical Engineering)	FEB 6 – 12
FISCHBARG, JORGE	Columbia Univ. (Physiology and Ophthalmology)	FEB 6 – 12
FLESSNER, MICHAEL F.	Univ. of Rochester Medical Center	FEB 6 – 12
HILGEMANN, DONALD W.	Univ. of Texas Southwestern Med. Cntr.)	FEB 6 – 12
JAMISON, REX L.	Stanford Univ. (Medicine)	FEB 10 – 12
JORDAN, PETER C.	Brandeis Univ. (Chemistry)	FEB 6 – 12
KNAUF, PHILIP A.	Univ. of Rochester Medical Center (Biophysics)	FEB 6 – 12
LAYTON, HAROLD	Duke Univ. (Mathematics)	JAN 1 – MAR 31
LEVITT, DAVID	Univ. of Minnesota (Physiology)	FEB 6 – 12
LIEBOVITCH, LARRY S.	Florida Atlantic Univ. (Complex Systems)	FEB 6 – 12
LOO, DONALD	UCLA School of Medicine (Physiology)	FEB 6 – 12
MARSH, DONALD J.	Brown University	FEB 6 – 12
MEJIA, RAYMOND	National Institutes of Health (NIDDK)	FEB 6 – 12
MOORE, LEON C.	SUNY at Stony Brook (Physiology and Biophysics)	FEB 6 – 12
PALLONE, THOMAS L.	Univ. of Maryland at Baltimore (Medicine and Nephrology)	FEB 6 – 12
PITMAN, BRUCE E.	State Univ. of New York (Mathematics)	FEB 6 – 12
SANDS, JEFF M.	Emory Univ. School of Medicine (Medicine, Renal)	FEB 6 – 12
SHERMAN, ARTHUR	NIH (Mathematical Research Branch, NIDDK)	FEB 13 – 19
TEWARSON, REINALD P.	SUNY at Stony Brook (Applied Math and Stats.)	FEB 6 – 12
THOMAS, RANDALL	INSERM (France)	FEB 6 – 13
THOMSON, SCOTT C.	UCSD-San Diego VA Medical Center (Nephrology)	FEB 6 – 12
WEINBAUM, SHELDON	The City College of CUNY (Mechanical Engineering)	FEB 8 – 10
WEINSTEIN, ALAN M.	Cornell Univ. Medical College (Physiology)	FEB 6 – 12

## 4 Tutorial (February 13, 1999) Hormones

Speaker: James Sneyd (University of Michigan)

## 5 Workshop (February 15-19, 1999) Endocrinology: Mechanism of Hormone Secretion and Control

Organizers: Albert Goldbeter (Universite Libre de Bruxelles), Arthur Sherman (National Institutes of Health), James Sneyd (University of Michigan)

For current information see URL: <http://www.ima.umn.edu/biology/winter/bio8.html>

This workshop will study the mechanisms and control of hormone release, ranging from the receptor level through to whole body control, pulsatile secretions and dynamical disease. Although each of these topics has been studied in detail, there have been relatively few attempts to study the coordination and intersections of the mechanisms at different levels.

The workshop topics will include models for receptor adaptation, bursting electrical activity, action potentials in neuroendocrine cells, the importance of calcium for secretion, mechanisms of pulsatile hormonal secretion, hormonal control systems, whole-body feedback processes and dynamical diseases.

These topics are studied using a variety of mathematical techniques, of which ordinary differential equations, delay equations, bifurcation theory and qualitative analysis are the most important.

### CONFIRMED WORKSHOP PARTICIPANTS: February 15-19, 1999 (as of 11 November 1998)

ATWATER, ILLANI	NIH (NIDDK)	FEB 13 – 19
BERTRAM, RICHARD	Pennsylvania State Univ. (Behrend College)	FEB 13 – 19
BRABANT, G.	(Universitat Hanover (Clinical Endocrinology))	FEB 13 – 19
BROWN, DAVID	The Babraham Institute (Lab of Computational Neuroscience)	FEB 13 – 19
CHARLES, ANDREW	UCLA (Neurology)	FEB 1 – 28
CHOE, JUN	Korea Adv. Inst. of Science & Tech. (Mathematics)	JAN 1 – FEB 28
COSTANTIN, JIM	UCLA (Neurology)	FEB 13 – 19
DUPONT, GENEVIEVE	Univ. Libre de Bruxelles	FEB 1 – 28
GOLDBETER, ALBERT	Univ. Libre de Bruxelles (Faculté des Sciences)	FEB 13 – 19
IPP, ELI	Harbor-UCLA Medical Center (Medicine)	FEB 13 – 19
LACKER, H.M.	New Jersey Institute of Technology (Math)	FEB 13 – 19
LE BEAU, ANDREW	NIDDK (Mathematical Research Branch)	FEB 1 – 28
LI, YUE-XIAN	U. of British Columbia (Mathematics)	FEB 13 – 19
LIU, BING-ZHENG	Northeast Normal Univ. (Physics)	FEB 13 – 19
MACKEY, MICHAEL	McGill Univ. (Center Nonlinear Dynamics in Physiology)	FEB 1 – 28
MIURA, ROBERT	NIDDK (Mathematics Research Branch)	FEB 13 – 19
ORDOG, TAMAS	Univ. of Nevada School of Medicine (Physiology and Cell Biology)	FEB 13 – 19
PERNAROWSKI, MARK	Montana State Univ. (Mathematical Sciences)	FEB 1 – 28
POLIDORI, DAVID	Entelos, Inc. (Biological Systems Modeling)	FEB 13 – 19
PRANK, KLAUS	Universitat Hannover (Clinical Endocrinology)	FEB 13 – 19
QUON, MICHAEL	National Heart, Lung and Blood Institut (Hypertension-Endocrine Branch)	FEB 13 – 19
SHERMAN, ARTHUR	NIH (Mathematical Research Branch, NIDDK)	FEB 13 – 19
SNEYD, JAMES	Univ. of Michigan (Mathematics)	FEB 13 – 19
STOJILKOVICH, STANKO	NIH (Endocrine and Reproductive Research Branch)	FEB 14 – 19
SUSA, ISABELLA	Univ. Libre de Bruxelles (Faculté des Sciences)	FEB 13 – 19
TORNHEIM, KEITH	Boston Univ. Medical Center (Biochemistry)	FEB 13 – 19

## 6 Tutorial(March 5, 1999) Audition

Spekaer: Michael Reed (Duke University)

## 7 Workshop (March 8-12, 1999) Audition

**Organizers:** Michael C. Reed (Duke University), Eric D. Young (Johns Hopkins University)

**For current information see URL:** <http://www.ima.umn.edu/biology/winter/bio9.html>

The purpose of the workshop is to bring together mathematicians, biologists and engineers who work on different aspects of the auditory system. The entire auditory system will be covered, including:

- the mechanics of the outer, middle, and inner ear;
- hair cells and the eighth nerve;
- information processing in the brainstem, mid-brain, and cortex;
- behavioral and psychophysical correlates of auditory phenomena; and
- the design of prosthetic devices.

Mathematical modelling and computer simulation are playing a more and more significant role in auditory research. The goals of the workshop are to increase the communication and cooperation between experimentalists, mathematical modellers, and the designers of prosthetic devices and to introduce mathematicians with little previous experience in this area to the wide range of interesting mathematical problems in auditory science.

### **CONFIRMED WORKSHOP PARTICIPANTS: March 8-12, 1999 (as of 11 November 1998)**

BLUM, JACOB J.	Duke Univ. Medical Center (Cell Biology)	MAR 7 – 12
CARNEY, LAUREL	Boston Univ. (Biomedical Engineering)	MAR 7 – 12
CASEDAY, JOHN H.	Univ. of Washington (Psychology)	MAR 7 – 12
COLBURN, H. STEVEN	Boston Univ. (Biomedical Engineering)	MAR 7 – 12
COVEY, ELLEN	Univ. of Washington (Psychology)	MAR 7 – 12
DEAR, STEVEN	Penn State College of Medicine (Neuroscience)	MAR 7 – 12
GROTHER, BENEDIKT	Univ. of München (Zoologisches Inst.)	MAR 7 – 12
HYSON, RICHARD	Florida State Univ. (Psychology)	MAR 7 – 12
IMIG, THOMAS	Univ. of Kansas Medical Center (Physiology)	MAR 7 – 12
JOHNSON, DON	Rice Univ. (Electrical and Computer E)	MAR 7 – 12
MANIS, PAUL	Johns Hopkins Univ.	MAR 7 – 12
MARGOLIASH, DANIEL	Univ. of Chicago (Biology)	MAR 7 – 12
NELKEN, ISRAEL	Hadassah Medical School (Physiology)	MAR 7 – 12
OERTEL, DONATA	Univ. of Wisconsin (Neurophysiology)	MAR 7 – 12
PALMER, ALAN	Univ. of Nottingham (MRC Hearing Research)	MAR 7 – 12
PARK, TOM	Univ. of Illinois at Chicago (Biology Science)	MAR 7 – 12
POLLAK, GEORGE	Univ. of Texas (Zoology)	MAR 7 – 12
RADO, ANITA	Univ. of Arizona (Program in Applied Mathematics)	MAR 7 – 12
REED, MICHAEL C.	Duke Univ. (Math)	MAR 7 – 12
RUBEL, EDWIN	Univ. of Washington (VMB Hearing Research Center)	MAR 7 – 12
SANES, DAN	New York Univ. (Center for Neural Science)	MAR 7 – 12
SCHREINER, CHRISTOLF	Univ. of California San Francisco (Otolaryngology)	MAR 7 – 12
SHAMMA, SHIHAB A.	Univ. of Maryland (Electrical Engineering)	MAR 7 – 12
SIMMONS, JAMES	Brown Univ. (Neuroscience)	MAR 7 – 12
SUGA, NOBUO	Washington Univ. (Biology)	MAR 7 – 12
VAN TASELL, DIANNE	Starkey Laboratories (Advanced Research)	MAR 8 – 12
VOIGT, HERBERT	Boston Univ. (Biomedical Engineering)	MAR 7 – 12
WANG, XIAOQIN	Johns Hopkins Univ. (Biomedical Engineering)	MAR 7 – 12
YIN, TOM C.T.	University Wisconsin (Medical School)	MAR 7 – 12
YOUNG, ERIC D.	Johns Hopkins Univ.	MAR 7 – 12

### **CONFIRMED LONG-TERM WINTER 1999 PARTICIPANTS (as of 11 November 1998)**

Four Weeks or More

#### **Mathematical Problems in Physiology**

CASTILLO-CHAVEZ, CARLOS    Howard University    Feb 1–Jun 15 99

CHARLES, ANDREW	UCLA	Feb 1–Feb 28 99
CHOE, JUN	Korea Advanced Institute of Science & Technology	Jan 1 99–Feb 28 99
DILLON, ROBERT	Washington State University	Jan 3–Mar 20 99
DUNN, GRAHAM	Kings College London	Jan 1–Jan 30 99
DUPONT, GENEVIEVE	University Libre de Bruxelles	Feb–Feb 28 99
GUERON, SHAY	Technion-I.I.T.	Jan 24–Mar 7 99
LAYTON, HAROLD	Duke University	Jan 1–Mar 31 99
LE BEAU, ANDREW	NIDDK	Feb 1–Feb 28 99
MACKEY, MICHAEL	McGill University	Feb 1–Feb 28 99
PERNAROWSKI, MARK	Montana State University	Feb 1–Feb 28 99
SINKALA, ZACHARIAH	Middle Tennessee State University	Jan 2–Jul 5 99

## Spring 1999 Program: Dynamic Models of Ecosystems and Epidemics

### 1 Workshop (April 19-23, 1999) Local Interaction and Global Phenomena in Vegetation and Other Systems

**Organizers:** Simon A. Levin (Princeton University) Claudia Neuhauser (University of Minnesota)

**For current information see URL:** <http://www.ima.umn.edu/biology/spring/bio10.html>

There has been great progress in recent years in the development and analysis of deterministic and stochastic models ranging from general circulation models, which describe the dynamics of climate, to individual-based models which describe the spectral pattern of plant communities. This workshop will explore the effects of small-scale spatial interactions on the large-scale structure of communities. It addresses fundamental issues in scaling, renormalization, the interactions between levels of organization, and the interface between physical and biological processes. In particular, workshop participants will discuss how individual responses scale up to landscape levels and interact with climate systems. The workshop will bring together mathematicians with theoretical and experimental ecologists.

#### CONFIRMED WORKSHOP PARTICIPANTS: April 19-23, 1999 (as of 11 November 1998)

ARONSON, DON	Univ. of Minnesota (Math)	APR 19 – 23
BOLKER, BEN	Princeton Univ. (Ecology and Evolutionary)	APR 1 – 30
CASWELL, HAL	Woods Hole Oceanographic Institution (Biology)	APR 1 – 30
CHON, TAE-SOO	Pusan National Univ. (Biology)	APR 18 – 23
DEUTSCHMAN, DOUGLAS	San Diego State Univ. (Biology)	APR 18 – 23
DURRETT, RICHARD	Cornell Univ. (Mathematics)	APR 18 – 23
ELLNER, STEPHEN	North Carolina State Univ. (Statistics)	APR 1 – 30
GRAY, LAWRENCE	Univ. of Minnesota (Math)	APR 19 – 23
GRENFELL, BRYAN	Univ. of Cambridge (Zoology)	APR 18 – 23
GRUNBAUM, DANIEL	Univ. of Washington (Zoology)	APR 1 – 30
HARTVIGSEN, GREGG	Princeton Univ. (Ecology and Evolutionary Biology)	APR 18 – 23
IWASA, YOH	Kyushu Univ. (Biology)	APR 1 – 30
KEELING, MATTHEW	Univ. of Cambridge (Zoology)	APR 1 – 30
LEWIS, MARK	Univ. of Utah (Mathematics)	APR 1 – JUN 30
LIN, JUAN	Washington College (Physics)	APR 15 – 29
NEE, SEAN	Univ. of Oxford (Zoology)	APR 18 – 23
NEUHAUSER, CLAUDIA	Univ. of Minnesota (Mathematics)	SEP 1 – AUG 31
PASCUAL, MERCEDES	Univ. of Maryland (Center Marine Biotechnology)	APR 1 – 30
RAND, DAVID	Univ. of Warwick (Mathematics)	APR 18 – 23
ROOT, TERRY	Univ. of Michigan (School Natural Resources)	APR 18 – 23
SCHNEIDER, STEPHEN	Stanford Univ. (Biological Sciences)	APR 18 – 23
SHIGESADA, NANAOKO	Nara Women's Univ.	APR 18 – 23
TILMAN, DAVID	Univ. of Minnesota (Ecology)	APR 18 – 23
WEINBERGER, HANS	Univ. of Minnesota (Mathematics)	APR 19 – 23

## **2 HOT TOPICS Workshop (April 24-27, 1999): Challenges and Opportunities in Genomics: Production, Storage, Mining and Use**

**Organizers:** Sangtae Kim (Parke Davis), Vipin Kumar (University of Minnesota), David Misemer (3M), Dennis Polla (University of Minnesota), Isidore Rigoutsos (IBM TJ Watson Research Center)

See also <http://www.ima.umn.edu/genomics.html>

Spurred by progress in the Human Genome Project, and driven by the need for cheap, fast and accurate gene sequencing, there has been an explosion of interest in the development and usage of the laboratory-on-a-chip for such purposes as gene testing, high throughput drug screening, and infectious disease diagnostics. This workshop will focus on scientific and mathematical issues arising in production, storage, and mining of genomic data, and the use of the knowledge in application. It will be an opportunity for the scientific community to see a snapshot of the state of the arts in this field. Invited participants will be mathematicians, chemists, medical researchers and engineers; in particular, members of the bioinformatics community. Among the topics considered will be:

- Data Production - discovery, sequencing, detection
- Storage - format, data size, combining heterogeneous data bases
- Usage - domain experts, patterned search, interaction with mining

The purpose of the meeting is to assemble an interdisciplinary working group in this fast moving field, to assess the state of the art and, in particular, gaps that need filling, and to define a set of pre-competitive research problems to be worked on. This will be accomplished through a series of talks and panel discussions. We intend to hold follow-up meetings at regular intervals (involving many of the original participants) as the field progresses.

## **3 Tutorial (May 13–14, 1999): Introduction to Epidemiology and Immunology**

**Speakers:** Horst Thieme, Carlos Castillo-Chavez, Denise Kirschner, Jorge Velasco-Hernandez

## **4 Workshop (May 17–21, 1999): Mathematical Approaches for Emerging and Reemerging Infectious Diseases**

**Organizers:** Sally Blower (Univ. of California, San Francisco), Carlos Castillo-Chavez (Howard Univ.), Kenneth Cooke (Pomona College), Denise Kirschner (Univ. of Michigan), Pauline van den Driessche (Univ. of Victoria)

**For current information see URL:** <http://www.ima.umn.edu/biology/spring/bio11.html>

The world population has passed the six billion mark. This population explosion is accompanied by the growth of urban centers and a global economy. Increased interactions of individuals across the world have facilitated the transmission of well known diseases while creating ample opportunity for the emergence and re-emergence of infectious diseases. The global spread of HIV, the continued expansion of Lyme disease, the reemergence of tuberculosis and Dengue fever, and the appearance of resistant strains of cholera and malaria provide just a few examples of the challenge that we face today.

This workshop will focus on the study of ecological and evolutionary models in epidemiology and immunology using the theory of dynamical systems and stochastic analysis. Critical questions in these areas will be presented and discussed by researchers with diverse approaches and perspectives, ranging from applied mathematics and statistics to theoretical biology, epidemiology and immunology. The workshop will bring together established and young theoreticians from these fields and will be of interest to those working in epidemiology and immunology, coevolutionary biology and the ecology of vector-transmitted diseases.

### **CONFIRMED WORKSHOP PARTICIPANTS: May 17–21, 1999 (as of 11 November 1998)**

ADLER, FRED	Univ. of Utah (Mathematics)	MAY 16 – 21
ALLEN, LINDA	Texas Tech (Mathematics)	MAY 16 – 21
ANDERSON, ROY	Univ. of Oxford (Zoology)	MAY 16 – 21

ANDREASEN, VIGGO	Roskilde Univ. (Matematik)	MAY 16 – 21
BALL, FRANK	Univ. of Nottingham (Mathematics)	MAY 16 – 21
BLOWER, SALLY	Univ. California San Francisco (Microbiology & Immunology)	MAY 16 – 21
BRADLEY, MARY E.	Univ. of Louisville (Mathematics)	MAY 16 – 23
BRAUER, FRED	Univ. of British Columbia (Mathematics)	MAY 15 – 21
CASTILLO-CHAVEZ, CARLOS	Howard Univ. (Mathematics)	FEB 1 – JUN 15
DOBSON, ANDREW	Princeton Univ. (Ecology and Evol. Biology)	MAY 16 – 21
DUSHOFF, JONATHAN	Academia Sinica (Physics)	MAY 1 – 30
FENG, ZHILAN	Purdue Univ. (Mathematics)	MAY 16 – 21
FERGUSON, NEIL	Oxford Univ. (Zoology)	MAY 16 – 21
FISTER, K. RENEE	Murray State Univ. (Mathematics and Statistics)	MAY 16 – 22
GERBERDING, JULIE	Centers Disease Control	MAY 16 – 21
GYLLENBERG, MATS	Univ. of Turku (Applied Mathematics)	MAY 16 – 21
HETHCOTE, HERB	Univ. of Iowa (Mathematics)	MAY 16 – 21
HORN, MARY ANN	Vanderbilt Univ. (Mathematics)	MAY 16 – 21
HUANG, WENZHANG	Univ. of Alabama, Huntsville (Math Sci)	MAY 16 – 21
INABA, HISASHI	Univ. of Tokyo (Mathematical Sciences)	MAY 16 – 21
KIRSCHNER, DENISE	The Univ. of Michigan Medical School	MAY 11 – 21
KRETZSCHMAR, MIRJAM	RIVM (Netherlands)	MAY 16 – 21
KRONE, STEVE	Univ. of Idaho (Math)	MAY 16 – 21
LENHART, SUZANNE	Univ. of Tennessee (Mathematics)	MAY 16 – 21
LI, JIA	Univ. of Alabama, Huntsville (Math Science)	MAY 16 – 21
LI, MICHAEL	Mississippi State Univ. (Mathematics and Statistic)	MAY 16 – 21
MARTINEZ-MECKLER, GUSTAVO	Instituto de Fisica, UNAM (Laboratorio Cuernavaca)	MAY 16 – 21
MILNER, FABIO	Purdue Univ. (Mathematics)	MAY 16 – 21
NASELL, INGEMAR	Royal Institute of Technology (Mathematics)	MAY 16 – 21
PUGLIESE, ANDREA	Univ. degli Studi di Trento (Dipartimento di Matematica)	MAY 16 – 21
SATTENSPIEL, LISA	Univ. of Missouri (Anthropology)	MAY 16 – 21
SIMON, CARL	Univ. of Michigan (Mathematics)	MAY 16 – 21
THIEME, HORST	Arizona State Univ. (Mathematics)	MAY 12 – 21
VAN DEN DRIESSCHE, PAULINE	Univ. of Victoria (Mathematics & Statistics)	MAY 12 – 21
VELASCO-HERNANDEZ, JORGE X.	UNAM- Iztapalapa (Mathematics)	APR 1 – JUN 30
ZHIEN, MA	Xi an Jiaotong Univ. (Applied Mathematics)	MAY 16 – 21

## 5 Workshop (June 7–11, 1999): From Individual to Aggregation: Modeling Animal Grouping

**Organizers:** Rick Durrett (Cornell University), Leah Edelstein-Keshet (University of British Columbia), Simon A. Levin (Princeton University), Mark Lewis (University of Utah)

**For current information see URL:** <http://www.ima.umn.edu/biology/spring/bio12.html>

Patterns of aggregation, including schools of fish, flocks of birds, and herds of ungulates, are among the most striking patterns in biology. How do such patterns arise from decisions taken at the level of individuals? A promising approach begins from Lagrangian (e.g. Newtonian) descriptions of individual responses to the environment and to each other, derives macroscopic descriptions, and proceeds to Eulerian descriptions. The mathematical issues will involve Lagrangian/Eulerian connections, moment closure and other methods for proceeding from small to large scales.

### CONFIRMED WORKSHOP PARTICIPANTS: June 7–11, 1999 (as of 11 November 1998)

ARONSON, DON	Univ. of Minnesota (Math)	JUN 7 – 11
BONABEAU, ERIC	Santa Fe Institute	JUN 1 – 30
CAPASSO, VINCENZO	Univ. of Milan (Mathematics)	JUN 6 – 11
COSNER, CHRIS	Univ. of Miami (Mathematics & Computer Science)	JUN 6 – 11
DIEKMANN, ODO	Utrecht University (Vakgroep Wiskunde)	JUN 6 – 15
EDELSTEIN-KESHET, LEAH	Univ. of British Columbia (Mathematics)	APR 1 – JUN 30
GORDON, DEBORAH M.	Stanford Univ. (Biological Sciences)	JUN 6 – 11
GRUNBAUM, DANIEL	Univ. of Washington (Zoology)	JUN 1 – 30
GUERON, SHAY	Technion-I.I.T. (Mathematics)	JUN 1 – 30

HADELER, KARL	Univ. Tubingen (Lehrstuhl fur Biomathematik)	JUN 6 – 11
HOLMES, ELI	Univ. of Washington (Zoology)	JUN 6 – 11
LEVIN, SIMON A.	Princeton Univ. (Ecology and Evol. Biology)	JUN 6 – 11
LEWIS, MARK	Univ. of Utah (Mathematics)	APR 1 – JUN 30
LUBKIN, SHARON	North Carolina State Univ. (Biomathematics Program)	JUN 7 – 11
LUTSCHER, FRITHJOF	Univ. Tubingen (Lehrstuhl fur Biomathematik)	APR 15 – JUN 15
MOLLISON, DENIS	Univ. Edinburgh (Math)	JUN 1 – 30
NEUHAUSER, CLAUDIA	Univ. of Minnesota (School Mathematics)	SEP 1 – AUG 31
PADRON, VICTOR	Univ. de Los Andes	JUN 1 – 30
STEVENS, ANGELA	Univ. Heidelberg (fuer Angewandte Mathematik)	JUN 1 – 30
WEINBERGER, HANS	Univ. of Minnesota (Math)	JUN 7 – 11
YAMAZAKI, HIDEKATSU	Tokyo Univ. of Fisheries (Ocean Sciences)	JUN 6 – 11

**CONFIRMED LONG-TERM SPRING 1999 PARTICIPANTS** (as of 11 November 1998)

Four Weeks or More

**Dynamic Models of Ecosystems and Epidemics**

BOLKER, BEN	Princeton University	APR 1–30 99
CASWELL, HAL	Woods Hole Oceanographic Institution	APR 1–30 99
EDELSTEIN-KESHET, LEAH	University of British Columbia	APR 1–JUN 30 99
ELLNER, STEPHEN	North Carolina State University	APR 1–30 99
GRUNBAUM, DANIEL	University of Washington	APR 1–30 99
IWASA, YOH	Kyushu University	APR 1–30 99
KEELING, MATTHEW	University of Cambridge	APR 1–30 99
PASCUAL, MERCEDES	University of Maryland	APR 1–30 99
LUTSCHER, FRITHJOF	Universitat Tubingen	APR 15–JUN 15 99
DUSHOFF, JONATHAN	Academia Sinica	MAY 1–30 99
BONABEAU, ERIC	Santa Fe Institute	JUN 1–30 99
GRUNBAUM, DANIEL	University of Washington	JUN 1–30 99
GUERON, SHAY	Technion-I.I.T.	JUN 1–30 99
MOLLISON, DENIS	University of Edinburgh	JUN 1–30 99
STEVENS, ANGELA	Universitaet Heidelberg	JUN 1–30 99

**Summer Program:**

**IV. CODES, SYSTEMS and GRAPHICAL MODELS**

August 2–13, 1999

Organizers: G. David Forney, Motorola  
 Brian Marcus, IBM Almaden Research Center  
 Joachim Rosenthal, University Notre Dame  
 Alexander Vardy, University of Illinois

The invention of turbo codes and other capacity-approaching codes has led to an exciting cross-fertilization of ideas between researchers from different backgrounds.

The aim of the workshop is to bring together mathematicians, computer scientists, and electrical engineers in the area of coding theory, systems theory and symbolic dynamics so that the techniques from one area can be applied to problems in the other area. The two weeks of the workshop will be subdivided into two main focus areas:

**August 2–6: Week 1 on Codes on Graphs and Iterative Decoding**

Belief propagation in Bayesian networks has been extensively studied in artificial intelligence since the work of Pearl a decade ago, and turbo codes have recently become a subject of much research in coding theory. In the past year or

two it has been recognized that the iterative decoding algorithm used for turbo codes and other capacity-approaching schemes is an instance of belief propagation. This has led to an explosion of work devoted to understanding and exploiting this connection. A related problem is that of representing a given code by a graph, such as a Bayesian network. A central impetus of much of this work is to understand why iterative algorithms work so well empirically on graphs with cycles, where practically no theoretical results are known. Experts in the dynamics of algorithms have also begun to be drawn into this work. The major focus of week 1 of the IMA workshop will be to bring together researchers in these various fields to better understand these emerging connections. This will be a natural follow-on to a special session on this subject at the upcoming 1998 MTNS conference (Mathematical Theory of Networks and Systems, among the most mathematical of the systems theory conferences).

*Topics for week 1 include:* Codes defined on graphs, iterative decoding algorithms, factor graphs, turbo codes, connections with Bayesian networks.

### **August 9–13: Week 2 on Connections Among Coding Theory, System Theory and Symbolic Dynamics**

Coding Theory, System Theory and Symbolic Dynamics have much in common as evidenced by the following list of research topics that play a prominent role in each:

1. Construction of various types of finite- and finite-dimensional state representations of sequence spaces.
2. Investigation of fundamental structural properties of sequence spaces, such as observability and controllability.
3. Construction of input/output systems, i.e. mappings (or encoders) between sequence spaces.
4. Understanding the special role that algebraic structure (in particular, linearity and duality) plays in 1,2 and 3.

Yet these subjects have developed somewhat independently, and each has its own language and points of view. Until recently there has been very little communication among researchers in these subjects. A main purpose of week 2 of the IMA workshop is to further the communication among researchers and stimulate connections among these subjects. Week 2 will aim to continue a successful series of interdisciplinary meetings that has included an IEEE Information Theory Workshop on Coding, Systems and Symbolic Dynamics in 1993 (Mansfield, MA), a special invited session at the IEEE Conference on Decision and Control in 1995 (New Orleans), and two special sessions at the MTNS in 1998 (Padova).

*Topics for week 2 include:* Behavioral system theory, input/output mappings between spaces of sequences, state space representations, group codes, trellis codes, multi-dimensional systems and codes.

The organizers plan a number of invited tutorial lectures specifically for interspecialty communication. Leading workers in each field will also be invited to present surveys of current research, with less emphasis on solved problems than on open ones. Finally, there will be both invited and contributed papers presenting recent research results.

We expect the attendees to represent electrical engineering, mathematics and computer science departments in both academia and industry. As coding theory is the glue that holds the two weeks together, we expect that it will mostly be a subset of the coding theory participants who will attend both weeks.

### **CONFIRMED SUMMER PROGRAM VISITORS: August 3–18, 1988** (as of 5 November 1998)

#### **Summer Program: Coding and Cryptography**

ADLER, ROY	IBM (Watson Research Center)	AUG 7 – 13
AGRAWAL, DAKSHI	Univ. of Illinois at Urbana-Champa (Coordinated Science Laboratory)	JUL 31 – AUG 6
ALLEN, BRIAN	Univ. of Notre Dame (Mathematics)	JUL 31 – AUG 13
ANDERSON, JOHN	Lund Univ. (Information Technology)	JUL 31 – AUG 6
BEAL, MARIE-PIERRE	Univ. de Marne-la-Vallee (Gaspard Monge)	AUG 7 – 14
BOND, JAMES	SAIC Inc.	JUL 31 – AUG 6
BOYLE, MIKE	Univ. of Maryland (Mathematics)	AUG 7 – 13
CALDERBANK, ROBERT	AT&T Labs (Research)	JUL 31 – AUG 6
COSTELLO, DAN	Univ. of Notre Dame (Electrical Engineering)	JUL 31 – AUG 6
COVEN, ETHAN	Wesleyan Univ. (Mathematics)	AUG 7 – 13
FAGNANI, FABIO	Torino (Scuola Normale Superiore)	AUG 7 – 13
FORNEY, DAVID	Motorola	JUL 31 – AUG 13
FROUGNY, CHRISTIANE	LIAFA	AUG 7 – 13

FUHRMAN, PAUL	Ben Gurion Univ. of the Negev (Mathematics)	AUG 7 – 13
JOHANNESSON, ROLF	Univ. of Lund (Information Theory)	AUG 2 – 13
KIM, SAEJOON	Cornell Univ. (Electrical Engineering)	AUG 1 – 14
KITCHENS, BRUCE	IBM (Watson Research Center)	AUG 7 – 13
KOETTER, RALF	University Illinois	JUL 31 – AUG 13
KSCHISCHANG, FRANK	Univ. of Toronto (Electrical & Computer Eng)	JUL 31 – AUG 13
KUIJPER, MARGREET	Univ. of Melbourne (Electrical & Electronic Engine)	AUG 7 – 13
LAFFERTY, JOHN	Carnegie Mellon Univ. (School Computer Science)	JUL 31 – AUG 6
LIND, DOUGLAS	Univ. of Washington (Mathematics)	AUG 7 – 13
LOELIGER, HANS-ANDREA	Endora Tech AG	JUL 31 – AUG 13
MACKAY, DAVID	Univ. of Cambridge (Physics)	JUL 31 – AUG 6
MARTIN, CLYDE	Texas Tech Univ. (Mathematics)	AUG 7 – 13
MCELIECE, ROBERT	Caltech (Electrical Engineering)	JUL 31 – AUG 13
MITTELHOLZER, THOMAS	Zurichstr. 151 (R3 Security Engineering AG)	AUG 7 – 13
ORMES, NICHOLAS S.	Univ. of Texas at Austin (Mathematics)	AUG 7 – 13
PERRIN, DOMINIQUE	Université Marne la Vallee	AUG 7 – 13
PETERSEN, KARL	Univ. of North Carolina (Mathematics)	AUG 7 – 13
RAVI, M.S.	East Carolina Univ. (Mathematics)	AUG 7 – 13
RICHARDSON, TOM J.	600 Mountain Avenue (Bell Labs)	JUL 31 – AUG 6
ROSENTHAL, JOACHIM	Room 379 (University Notre Dame)	JUL 31 – AUG 13
SIEGEL, PAUL	Univ. of California - San Diego (Electrical and Computer E)	JUL 31 – AUG 13
SOLJANIN, EMINA	Bell Laboratories	AUG 7 – 13
TAYLOR, THOMAS	Arizona State Univ. (Mathematics)	AUG 7 – 13
TROW, PAUL	Univ. of Memphis (Mathematical Sciences)	AUG 7 – 13
TUNCEL, SELIM	Univ. of Washington (Mathematics)	AUG 7 – 13
VALCHER, MARIA	Univ. di Padova (Dipartimento Elettronica)	AUG 7 – 13
WAN, ZHE-XIAN	Lund University	AUG 1 – 13
WILLEMS, JAN C.	Univ. of Groningen (Mathematics)	AUG 7 – 13
ZAMPIERI, SANDRO	Univ. di Padova	AUG 7 – 13

## V. THE IMA VOLUMES IN MATHEMATICS AND ITS APPLICATIONS

### THE IMA VOLUMES IN MATHEMATICS AND ITS APPLICATIONS

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Volume 105: Algorithms for Parallel Processing

Editors: Robert S. Schreiber, Michael T. Heath, and Abhiram Ranade

This book's chapters offer a wide-ranging tour of recent developments in the very rapidly growing and changing field of parallel algorithms. They cover the following general areas:

- models and mechanisms for parallel machines (Chapters 1–4),
- discrete and combinatorial algorithms (Chapters 5–7),
- mathematical issues in parallelizing compilers (Chapter 8),
- parallel algorithms for matrix computation, differential equations, random number generation, and Fourier methods (Chapters 9–14),
- new parallel computer systems and software (Chapters 15–16).

Volume 106: Parallel Processing of Discrete Problems

Editor: Panos Pardalos

In the past two decades, breakthroughs in computer technology have made a tremendous impact on optimization. In particular, availability of parallel computers has created substantial interest in exploring the use of parallel processing for solving discrete and global optimization problems. The collection of articles in this volume covers a broad spectrum of recent research in parallel processing of discrete and related problems. The topics discussed include distributed branch-and-bound algorithms, parallel genetic algorithms for large scale discrete problems, simulated annealing, parallel branch-and-bound search under limited-memory constraints, parallelization of greedy randomized adaptive search procedures, parallel optical models of computing, randomized parallel algorithms, general techniques for the design of parallel discrete algorithms, parallel algorithms for the solution of quadratic assignment and satisfiability problems. The book will be a valuable source of information to faculty, students and researchers in combinatorial optimization and related areas.

Volume 107: The Mathematics of Information Coding, Extraction, and Distribution

Editors: George Cybenko, Dianne O’Leary, and Jorma Rissanen

High performance computing consumes and generates vast amounts of data, and the storage, retrieval, and transmission of these data are major obstacles to effective use of computing power. Challenges inherent in all of these operations are security, speed, reliability, authentication, and reproducibility. This workshop focused on a wide variety of technical results aimed at meeting these challenges. Topics ranging from the mathematics of coding theory to the practicalities of copyright preservation for Internet resources drew spirited discussion and interaction among experts in diverse but related fields. We hope this volume contributes to continuing this dialogue.

Volume 108: Rational Drug Design

Editors: Donald G. Truhlar, W. Jeffrey Howe, Anthony J. Hopfinger, Jeff Blaney, and Richard A. Dammkoehler

Drug research and discovery are of critical importance in human health care. Computational approaches for drug lead discovery and optimization have proven successful in many recent research programs. These methods have grown in their effectiveness not only because of improved understanding of the basic science – the biological events and molecular interactions that define a target for therapeutic intervention – but also because of advances in algorithms, representations, and mathematical procedures for studying such processes. This volume surveys some of those advances. A broad landscape of high-profile topics in computer-assisted molecular design (CAMD) directed to drug design are included.

Subject areas represented in the volume include receptor-based applications such as binding energy approximations, molecular docking, and de novo design; non-receptor-based applications such as molecular similarity; molecular dynamics simulations; solvation and partitioning of a solute between aqueous and nonpolar media; graph theory; non-linear multidimensional optimization, processing of information obtained from simulation studies, global optimization and search strategies, and performance enhancement through parallel computing.

Volume 109: Emerging Applications of Number Theory

Editors: Dennis A. Hejhal, Joel Friedman, Martin C. Gutzwiller, and Andrew M. Odlyzko

Most people tend to view number theory as the very paradigm of pure mathematics. With the advent of computers, however, number theory has been finding an increasing number of applications in practical settings, such as in cryptography, random

number generation, coding theory, and even concert hall acoustics. Yet other applications are still emerging — providing number theorists with some major new areas of opportunity.

The 1996 IMA summer program on *Emerging Applications of Number Theory* was aimed at stimulating further work with some of these newest (and most attractive) applications.

Concentration was on number theory's recent links with:

- (a) wave phenomena in quantum mechanics (more specifically, quantum chaos); and
- (b) graph theory (especially expander graphs and related spectral theory).

This volume contains the contributed papers from that meeting and will be of interest to anyone intrigued by novel applications of modern number-theoretical techniques.

Volume 110: Computational Radiology and Imaging: Therapy and Diagnostics  
Editors: Christoph Börgers and Frank Natterer

The articles collected in this volume are based on lectures at the IMA Workshop “Computational Radiology and Imaging: Therapy and Diagnostics”, March 17–21, 1997. Introductory articles by the editors have been added. The focus is on inverse problems involving electromagnetic radiation and particle beams, with applications to X-ray tomography, nuclear medicine, near-infrared imaging, microwave imaging, electron microscopy, and radiation therapy planning.

Mathematical and computational tools and models which play important roles in this volume include the X-ray transform and other integral transforms, the linear Boltzmann equation and, for near-infrared imaging, its diffusion approximation, iterative methods for large linear and non-linear least-squares problems, iterative methods for linear feasibility problems, and optimization methods.

The volume is intended not only for mathematical scientists and engineers working on these and related problems, but also for non-specialists. It contains much introductory expository material, and a large number of references. Many unsolved computational and mathematical problems of substantial practical importance are pointed out.

Volume 111: Evolutionary Algorithms  
Editors: Lawrence David Davis, Kenneth De Jong, Michael D. Vose and L. Darrell Whitley

The IMA Workshop on Evolutionary Algorithms brought together many of the top researchers working in the area of Evolutionary Computation for a week of intensive interaction. The field of Evolutionary Computation has developed significantly over the past 30 years and today consists a variety of subfields such as genetic algorithms, evolution strategies, evolutionary programming, and genetic programming, each with their own algorithmic perspectives and goals.

The workshop did a great deal to clarify the current state of the theory in Evolutionary Algorithms. The existing theory might be characterized as deriving from two principal approaches. There is a high level macro-theory that looks at the processing of “building blocks” and “schemata” that are shared by many good solutions when searching a problem space. There is also a low level micro-theory that builds exact Markov models of the search process. It is sometimes hard for researchers working at such different levels of abstraction to interact. The IMA workshop allowed researchers working at these different levels to present their points of view and to move toward common ground.

There was real progress was in communication between theorist and practitioners in the evolutionary computation field. Speakers presented applications across a wide range of problem areas. In some of those cases, theoretically motivated methods work quite well. In other cases, practitioners used domain-based methods to obtain better performance than could be achieved by using a “pure” evolutionary algorithm. Individuals on both sides went away with a better appreciation of the successes and failures of current theory. The workshop should help to change what practitioners say about the current state of theory in the field.

Volume 112: Statistics in Genetics  
Editors: M. Elizabeth Halloran and Seymour Geisser

This volume contains refereed papers from a workshop on Statistics in Genetics held as part of the six-week symposium on Statistics in the Health Sciences held by the Institute of Mathematics and its Applications in the summer of 1997. The week on genetics provided a forum for lively discussion among an unusual mix of statistical scientists and population geneticists.

The field of statistical genetics is growing and expanding. Though the Genome Project will eventually result in the sequencing of the human genome, as well as the genomes of several other organisms, there will still be a need for good statistics for family studies of complex diseases. Of special interest is the growing recognition of the potential role of interaction of mitochondrial genes with nuclear genes to produce many chronic or degenerative disorders. There is still much room for improving model building in phylogenetics analysis, particularly in understanding inference in this arena. The use of statistics for assessing identification in criminal and paternity cases through DNA is also becoming more widespread. The controversy over these methods are likely to rage for many years to come.

The papers in this volume are contributions by some of the leading researchers in the field to the current topics in in statistical genetics. One section deals with DNA sequence matching and issues related to forensics. Another group of papers deals with statistical problems of modeling phylogenies and inferential difficulties related to the complex tree structures produced, as well as the method of coalescence. Another group of papers are concerned with human genetics, including the identification of disease genes, and the genetics of cancer.

Volume 113: Grid Generation and Adaptive Algorithms

Editors: Marshall Bern, Joseph E. Flaherty, and Mitchell Luskin

The papers in this volume are based on lectures given at the IMA Workshop on Grid Generation and Adaptive Algorithms held during April 28–May 2, 1997. Grid generation is a common feature of many computational tasks which require the discretization and representation of space and surfaces. The papers in this volume discuss how the geometric complexity of the physical object or the non-uniform nature of the solution variable make it impossible to use a uniform grid. Since an efficient grid requires knowledge of the computed solution, many of the papers in this volume treat how to construct grids that are adaptively computed with the solution.

This volume will be of interest to computational scientists and mathematicians working in a broad variety of applications including fluid mechanics, solid mechanics, materials science, chemistry, and physics. Papers treat residual-based error estimation and adaptivity, repartitioning and load balancing for adaptive meshes, data structures and local refinement methods for conservation laws, adaptivity for hp-finite element methods, the resolution of boundary layers in high Reynolds number flow, adaptive methods for elastostatic contact problems, the full domain partition approach to parallel adaptive refinement, the adaptive solution of phase change problems, and quality indicators for triangular meshes.

Volume 114: Diagnosis and Prediction

Editors: Seymour Geisser

This volume contains refereed papers submitted by participants of the third week of a six week workshop on Statistics in the Health Sciences held by the Institute of Mathematics and its Applications in Minneapolis, Minnesota during July of 1997. This week was devoted to the closely related topics of Diagnosis and Prediction.

Theoretical and applied statisticians from Universities, Medical and Public Health Schools, government and private research institutions, and pharmaceutical companies involved in prediction problems in the life and social sciences and in diagnostic and screening tests were brought together to discuss and exchange new results and information on these important issues. A number of papers with applications were presented and especially lively discussions ensued involving the critical issues and difficulties in using and interpreting diagnostic tests and implementing mass screening programs. Both frequentist and Bayesian approaches were employed.

The importance of predicting or controlling future events such as survival, comparative survival and survival post intervention for a disease or even for certain biological or natural events is growing rapidly. This area of concern was also represented by participants who presented work that devised predictive methodology for a variety of problems mainly from a Bayesian perspective.

**Forthcoming Volumes:**

1996–1997: *Mathematics in High Performance Computing*

Structured Adaptive Mesh Refinement Grid Methods

Parallel Solution of Partial Differential Equations

1997 Summer Program:

Statistics in the Health Sciences

Week 2: Imaging

Weeks 4 and 5: Design and Analysis of Clinical Trials

Week 6: Statistics and Epidemiology: Environment and Health

1997–1998: Emerging Applications of Dynamical Systems

Numerical Methods for Bifurcation Problems

Large Scale Dynamical Systems

Multiple-Time-Scale Dynamical Systems

Dynamics of Algorithms

Algorithmic Methods for Semi-Conductor Circuitry

Pattern Formation in Continuous and Coupled Systems

1998–1999: Mathematics in Biology

Pattern Formation and Morphogenesis in Developmental Biology