INSTITUTE FOR MATHEMATICS AND ITS APPLICATIONS

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IMA Schedules via finger: `finger seminar@ima.umn.edu`
Newsletters, Updates and preprints available via
anonymous ftp: `ftp.ima.umn.edu`, www: `http://www.ima.umn.edu`

The IMA was founded by and receives major support from the National Science Foundation.

IMA UPDATE

Spring 2000

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

CONTENTS

PARTICIPATING INSTITUTIONS: Centrum voor Wiskunde en Informatica, Consiglio Nazionale delle Ricerche, Georgia Institute of Technology, Indiana University, Iowa State University, Kent State University, Michigan State University, Mississippi 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 Maryland, University of Michigan, University of Minnesota, University of Notre Dame, University of Pittsburgh, University of Wisconsin, Wayne State University.

PARTICIPATING CORPORATIONS: Ford, General Motors, Honeywell, IBM, Lockheed Martin, Lucent, Motorola, Schlumberger, Siemens, Telcordia Technologies, 3M.

Version of April 24, 2000

I. NEWS AND NOTES

a. CWI Joins as IMA Participating Institution

The Centrum voor Wiskunde en Informatica (CWI) located in Amsterdam, the Netherlands (see http://www.cwi.nl/) has recently joined the IMA as a Participating Institution. CWI is the National Research Institute for Mathematics and Computer Science in the Netherlands. CWI performs frontier research in mathematics and computer science and transfers new knowledge in these fields to society in general and trade and industry in particular.

From its inception, the IMA has been supported by a consortium of universities known as the IMA Participating Institutions. This program has grown from an initial core of 8 universities, all in the Big Ten, to 24 institutions from all parts of the country, plus 4 international members. In addition to the IMA programs that take place in Minnesota, the IMA runs programs with the Participating Institutions. See http://www.ima.umn.edu/pi-description.html for greater detail.

The IMA is interested in increasing the membership of Particpating Institutions and Particpating Corportations programs. Those interested should contact the IMA Director, Willard Miller, 612/624-6066 or miller@ima.umn.edu .

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b. Material from IMA Talks Online

The IMA has for some time been posting material derived from workshops tutorials and other programs on its web site. Theses may be found at

http://www.ima.umn.edu/talks/

They include papers, slides and for many recuent tutorials, audio recordings the RealAudio streaming audio format.

Highlights include:

- Audio recordings of the IMA Public Lecture by Alan Perelson on “Mathematics & AIDS: How Mathematics Coupled with Experiment Revealed the Nature of HIV Infection”,
- Audio recordings and notes from eight lectures on Introuductory Kinetic Theory and related topics by David Levermore and Christian Ringhofer.
- Audio recordings a slides of an eight lecture tutorial on “Low-speed Combstion” by John buckmaster and Moshe Matalon.

We intend to continue and expand these postings, so please check this page occasionally for new material.

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c. IMA Preprints Available Online

The IMA has for many years collected and distributed a preprint series. Much of that series, including all recent additions is available at our web-site at:

http://www.ima.umn.edu/preprints/new.preprintlist.html

We invite you to peruse the site occasionally both for new additions and for older papers that may be of interest. We are working on providing a search engine which will improve accessibility. In the future we will be deemphasizing distribution of this series on paper in favor of the web and CD-ROM.

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d. 2000–2001 Mathematics in Multimedia Postdocs Selected

With the advice of the organizers of the 2000–2001 year on **2000–2001 Mathematics in Multimedia**, the IMA has chosen seven postdoctoral members for the period September 1, 1999 to August 31, 2001. As was the case last year, all postdocs were offered two year appointments. These postdocs will be active participants in all activities of the annual program. They were chosen from a long list of well-qualified recent Ph. D. recipients.

First Year Postdocs

NAME	PH. D. INSTITUTION	ADVISOR
Santiago Betelu	Univ. Nacional del Centro de la Provincia de Buenos Aires)	Roberto Gratton
Jamylle Carter	UCLA	Tony Chan
Li-Tien Cheng	UCLA	Stanley Osher
Selim Esedoglu	Courant Institute of Mathematical Sciences	Robert Kohn
Bin Han	Princeton University	Rong-Qing Jia
Jianliang Qian	Rice University	William Symes

Second Year Postdocs

NAME	PH. D. INSTITUTION	ADVISOR
Javier Armendariz	Northwestern University	Moshe Matalon
Yalchin Efendiev	California Institute of Technology	Thomas Hou
Takumi Hawa	Rensselaer Polytechnic Inst.	Zvi Rusak
Alexei Novikov	Stanford university	George Papanicolaou
Yong Kim	University of Wisconsin	Anthanasios E. Tzavaras

Industrial Postdocs

NAME	Company	PH. D. INSTITUTION	ADVISOR
Christine Cheng	Telcordia Technologies	Johns Hopkins University	Lenore Cowen
Jay Gopalakrishnan	Medtronic	Texas A& M University	J. H. Bramble & J.E. Pasciak
Dimitri Kirill	Motorola	Northwestern University	Michael Miksis
Nilima Nigam	Seagate	University of Delaware	George Hsiao

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e. PI Conference: Millennial Conference on Number Theory May 21-26, 2000 at the University of Illinois at Urbana-Champaign

Conference web page: http://www.math.uiuc.edu/nt2000/millennial.

Scientific Program

Goals: The "Millennial Conference on Number Theory" is an international conference held at the conclusion of the Special Year in Number Theory 1999/2000 at the University of Illinois. The conference aims to bring together researchers in all areas of number theory to present recent developments in number theory, review the accomplishments of number theory in the past decades, and chart directions for research in number theory in the new millennium. The conference will also mark the eightieth birthday of Paul Bateman, a long time faculty member of the mathematics department at the University of Illinois, and head of the department for fifteen years, who has built the number theory program at this department into one of the largest and most highly regarded in the world.

Dates and location: The conference will be held on the campus of the University of Illinois at Urbana-Champaign. Lectures will begin at 9 am on Sunday, May 21, 2000, and end at approximately 6 pm on Friday, May 26, 2000. Some participants may want to stay longer in order to attend one of the two short satellite conferences that will be held immediately before and after the Millennial Conference (see below)

Plenary Talks: One hour plenary talks will be given by G. Andrews, J. Bourgain, J. Coates, K. Ford, R. Graham, A. Granville, D.R. Heath-Brown, C. Hooley, W.-C. Li, K. Murty, M. Nathanson, K. Ono, C. Pomerance, B. Poonen, W.

Schmidt, C. Skinner, K. Soundararajan, R. Tijdeman, R.C. Vaughan, and H. Williams. Several of the plenary talks will be in the form of broadly accessible survey lectures. Except for Bourgain's talk which is scheduled for Tuesday evening, all plenary talks will be given in the mornings.

Invited half-hour talks: About 80 number theorists have been invited to give 30 minute talks. These talks will take place in the afternoons in three or four parallel sessions. Contributed Talks: We can accommodate a limited number of contributed talks of 15 minutes length. To request a slot for a contributed talk, please submit an abstract following the procedures below.

Sponsors: Funding for the Millennial Conference has been provided by the Number Theory Foundation; the National Science Foundation; the National Security Agency; the Institute for Mathematics and Applications; and the University of Illinois.

Organizers: The Organizing Committee for the Conference consists of B.C. Berndt, N. Boston, H. Diamond, A.J. Hildebrand, from the University of Illinois Mathematics Department, and W. Philipp of the Statistics Department of the University of Illinois.

Email (preferred): millennial@math.uiuc.edu

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f. PI Conference: Workshop on Meshfree Methods October 21, 2000 at the University of Iowa

Conference Website: http://www.ima.umn.edu/PI/meshfree.html

October 21, 2000

Organizers: J.S. Chen, K.K. Choi, W. Han, S. Oliveira and D. Stewart

Recently, a next generation of numerical methods, collectively called meshfree methods or meshless methods, have attracted more and more researchers in computational sciences and engineering. The goal of the research on the meshfree methods is to modify the internal structure of the traditional finite element method to make it more flexible, versatile and robust. Meshfree methods have been successfully applied in several areas where the application of the traditional finite element method is limited: moving discontinuities such as cracks and shocks, multi-scale resolution, large material distortions, etc. A large variety of meshfree methods have been developed in the past few years, including Element-Free Galerkin Method, hp-Clouds, Partition of Unity Finite Element Method, Reproducing Kernel Particle Method.

A workshop on meshfree methods will be held at the University of Iowa on Saturday, October 21, 2000. The aim of this workshop is to bring together mathematicians, computer scientists and engineering researchers to exchange ideas, results and applications of the meshfree methods. The workshop will provide a good opportunity especially for numerical analysts as many fundamental issues related to the meshfree methods still need to be investigated. The workshop is organized by J.S. Chen, K.K. Choi, W. Han, S. Oliveira and D. Stewart.

Professor Ivo Babuska will give a keynote presentation. In addition, there will be some invited presentations. If you like to present your work on meshfree methods, or if you are interested in knowing more about the methods, you are cordially invited to participate the workshop.

The workshop is sponsored by IMA and NSF/DARPA. There is no registration fee for attending the workshop. Mathematicians from IMA Participating Institutions are eligible to receive IMA/PI funds for the workshop expenses, where available and if approved by the mathematician's own department chair. A limited amount is also reserved to partially support some other participants of the workshop.

If you are interested in giving a talk, or if you need some support for your expense, you are encouraged to contact Weimin Han (whan@math.uiowa.edu) as early as possible, preferably before the end of March.

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g. Solicitation for 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
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.

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h. IMA Newsletter and Update Distribution via the World Wide Web

The IMA is gradually implementing internet-based programs to improve our service to you. As a result, we have changed the way we send out the Newsletter and Update. We would like to e-mail you a notice when the next IMA Newsletter or Update is available on the IMA Web page, instead of mailing you a hard copy. The updated version of either publication are available on our IMA Web Page: http://www.ima.umn.edu/newsltrs/

The IMA will continue to mail a hard copy to specific departments, for posting purposes.

If for some reason you cannot retrieve either document from the Web, please call the IMA staff at 612-624-6066 or e-mail staff@ima.umn.edu if you would like to continue to receive a hard copy of the IMA Newsletter.

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i. 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 2000–2001
See http://www.ima.umn.edu/hot-topics.html

August 16–18, 2000: HOT TOPICS Workshop on **Mathematical Challenges in Global Positioning Systems (GPS)**

August 28-29, 2000: HOT TOPICS Workshop on **Modeling and Analysis of Noise in Integrated Circuits and Systems**

September 8–10, 2000: IMA Career Workshop on **Connecting Women in Mathematical Sciences to Industry**

January 10–13, 2001: HOT TOPICS Workshop on **Analysis and Modeling of Industrial Jetting Processes**

1. REACTIVE FLOW & TRANSPORT PHENOMENA, September 1999–June 2000
See http://www.ima.umn.edu/reactive/

Fall 1999: Combustion
For details of the Fall Schedule see http://www.ima.umn.edu/reactive/#fall

Winter 2000: Natural Resources and Environment
For details of the Fall Schedule see http://www.ima.umn.edu/reactive/#winter

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**

2. MATHEMATICS IN MULTIMEDIA, September 2000–June 2001
See http://www.ima.umn.edu/multimedia/

Fall 2000: Vision, Speech and Language

September 11-15 Short Course on **Mathematical Methods in Speech and Image Processing**
September 18–22 Workshop on **Mathematical Foundations of Speech Processing and Recognition**
October 11–14 Mini-symposium on **Brain Imaging**
October 16–20 Workshop on **Image Processing and Low Level Vision**
October 30–November 3 Workshop on **Mathematical Foundations of Natural Language Modeling**
November 13–17 Workshop on **Image Analysis and High Level Vision**

Winter 2001: Digital Libraries

January 17–19 Mini-symposium on **Fractals in Multimedia**

January 25–26 Tutorial on **Digital Libraries**

January 29–February 2 Workshop on **Digital Libraries - Data Modeling and Representation**

February 12–16 Workshop on **Digital Libraries - Digital Asset Management**

February 26–March 2 Workshop on **Digital Libraries - Classification, Retrieval and Visualization**

Spring 2001: Geometric Design and Computer Graphics

April 9-13 Joing IMA-IDR Workshop on **Ideal Data Representation**

April 19–20 Tutorial on **Geometric Design**

April 23–27 Workshop on **Geometric Design**

May 10–11 Tutorial on **Computer Graphics**

May 14–18 Workshop on **Computer Graphics**

June 11–15 Workshop on **Haptics, Virtual Reality and Human Computer Interaction**

June 16–17 Capstone Symposium on Mathematics in Multimedia

3. MATHEMATICS IN THE GEOSCIENCES, September 2001–June 2002

See http://www.ima.umn.edu/geoscience/

Fall 2001: Dynamical Systems and Ergodic Theory

September 24, 2001 Tutorial on **Spatio-temporal Patterns in the Geosciences**

September 25-29, 2001 Workshop on **Spatio-temporal Patterns in the Geosciences**

October 8-12, 2001 Workshop on **Complexity in Geophysical Systems**

October 29-November 2, 2001 Workshop on **Dynamical Systems in Celestial Mechanics and Climate Dynamics**

November 12-16, 2001 Workshop on **Time Series Analysis and Applications to Geophysical Systems**

Winter 2002: Multiscale Phenomena and Renormalization

Spring 2002: Inverse Problems and Quantification of Uncertainty

4. OPTIMIZATION, September 2002–June 2003

See http://www.ima.umn.edu/optimization/

Fall 2002: Supply Chain and Logistics Optimization

Winter 2003: New Optimization Paradigms and Approaches

Spring 2003: Information Technology and Optimization

1999–2000 Annual Program:

III. REACTIVE FLOW AND TRANSPORT PHENOMENA

September 1, 1999 – August 31 2000
Organizers: John Chadam (University of Pittsburgh)
Ashwani K. Kapila (Chair) (Rensselaer Polytechnic Institute)
David Levermore (University of Arizona)
Christian Ringhofer (Arizona State University)

See also http://ww.ima.umn.edu/reactive/

Introduction:

Chemically reacting flows, and the associated transport of mass, momentum and energy, are fundamental to numerous areas of modern technology. These include the recovery, fabrication, and processing of materials; the design and operation of devices that use fossil or nuclear fuels; and the treatment and disposal of waste and toxins. Forces of economy, safety, efficiency and a concern for the environment dictate not only that the underlying science be advanced, but also that these advances be rapidly integrated into engineering, design, manufacturing and operation. It is broadly recognized that the challenge requires an interdisciplinary response, including, in particular, the deployment of modern techniques of applied mathematics: modeling, analysis and computation.

In this year of concentration, we have elected to emphasize three topics. Two of these, namely, Combustion, and Natural Resources and Environment, can be clearly identified as areas of application. The third, Multiscale and Transition Regimes, cuts across applications, focusing instead on processes where traditional and classical transport models no longer apply. Applications include thin, microstructured films, nanometer-scale semiconductor devices, and supercooled fluids.

The year has been divided into three segments, with a total of nine workshops. In each case, we aim to bring together researchers with overlapping interests who may move in disjoint scientific circles, and expose applied mathematicians to activity in the selected area of the workshop. The overall focus will be on identifying situations where an infusion of existing mathematical technology can lead to rapid progress, as well as recognizing areas where the existing theoretical framework needs to be

FALL QUARTER (September 1–December 31, 1999): **Combustion**
See http://www.ima.umn.edu/reactive/#fall

WINTER QUARTER (January 1–March 31, 2000): **Natural Resources and Environment**
See http://www.ima.umn.edu/reactive/#winter

[2ex] **SPRING QUARTER** (April 1–June 30, 2000): **Multiscale and Transition Regimes**

Spring Quarter 2000: Multiscale and Transition Regimes

1 Workshop (May 1-5, 2000) Dispersive Corrections to Transport Equations

Organizers:
C. David Levermore (University of Arizona)
Anton Arnold (Berlin Technical University)
Naoufel Ben Abdallah(University of Toulouse)
Ken T.-R. McLaughlin (University of Arizona)

For current information see URL: http://www.ima.umn.edu/biology/spring/rf8.html

Dispersive corrections to classical and semiclassical transport equations arise from the rudimentary incorporation of quantum effects into macroscopic flow descriptions. These models play an increasing role in the study of nanometer scale electronic devices and of fluids at extremely low temperatures. Advantages of dispersively corrected transport equations over fully quantum mechanical descriptions are that they are numerically more tractable and that they allow for a more classical coupling of the quantum system to the environment.

This workshop will have two thrusts. First, it will examine the mathematical derivation of dispersive correction terms both in linear and weakly nonlinear settings using Wigner transforms and in strongly nonlinear setting using tools from integrable systems. Second, the computational issues raised by the interplay between nonlinear and dispersive effects in, for example, quantum dots and wires, nonlinear optics, and superfluids.

CONFIRMED WORKSHOP PARTICIPANTS: May 1-5, 2000 (as of 22 April 2000)

ABDALLAH, NAOUFEL BEN	University Toulouse	APR 23 – MAY 6
ARNOLD, ANTON	Univ. des Saarlandes (Fachbereich Mathematik)	APR 27 – MAY 8
BARDOS, CLAUDE	Université de Paris VII	MAY 1 – 7

BLOCH, TONY	Univ. of Michigan (Mathematics)	APR 29 – MAY 5
BRONSKI, JARED	Univ. of Illinois Urbana Champaign (Mathematics)	MAY 1 – 8
ERCOLANI, NICHOLAS	Univ. of Arizona (Mathematics)	APR 29 – MAY 5
FRENSLEY, WILLIAM R.	Univ. of Texas-Dallas	APR 30 – MAY 2
GAMBA, IRENE	Univ. of Texas at Austin (Mathematics)	APR 2 – MAY 31
GARDNER, CARL	Arizona State Univ. (Mathematics)	APR 30 – MAY 4
GASSER, INGENUIN	Univ. of Hamburg (Applied Mathematics)	APR 28 – MAY 5
GERARD, PATRICK	Univ. of Paris-Sud (Mathematics)	APR 29 – MAY 5
GOLSE, FRANCOIS	Ecole Normale Superieure	APR 29 – MAY 10
JESCHKE, SABINA	Technische Univ. Berlin (Fachbereich Mathematik)	APR 27 – MAY 6
KAMVISSIS, SPYRIDON	Univ. of Patras (Mathematics)	APR 29 – MAY 6
KODAMA, YUJI	Ohio State Univ. (Mathematics)	APR 29 – MAY 4
LEVERMORE, DAVID	Univ. of Arizona (Mathematics)	APR 1 – JUN 30
LI, TONG	Univ. of Iowa (Mathematics)	APR 29 – MAY 2
LIU, TAI-PING	Stanford Univ. (Mathematics)	APR 29 – MAY 5
MAUSER, NORBERT	University of Vienna (Instf. Mathematik)	APR 30 – MAY 6
MCLAUGHLIN, DAVID	New York University-Courant	APR 30 – MAY 5
MCLAUGHLIN, KEN T.R.	Univ. of Arizona (Mathematics)	APR 29 – MAY 5
RINGHOFER, CHRISTIAN	Arizona State Univ. (Mathematics)	APR 4 – JUN 30
SHIPMAN, STEPHEN	Duke Univ. (Mathematics)	APR 29 – MAY 5
SLEMROD, MARSHALL	Univ. of Wisconsin (Mathematics)	MAY 1 – 12
SMITH, KENT	Lucent Technologies, Bell Laboratories	APR 29 – MAY 5
TIAN, FEI-RAN	Ohio State Univ. (Mathematics)	APR 29 – MAY 5

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2 Workshop (May 22-26, 2000) Simulation of Transport in Transition Regimes

Organizers:
Irene Gamba (University of Texas, Austin)
P. Roe (University of Michigan)
Robert Glassey (Indiana University)

For current information see URL: http://www.ima.umn.edu/biology/spring/rf9.html

Technology is increasingly advancing into regimes in which particle mean-free paths are comparable to the length scales of interest, and where traditional transport models therefore break down. For example, drift-diffusion models of electron-hole transport break down for submicron semiconductors because the scale of interest are very small, while Navier-Stokes approximations of fluid dynamics break down in outer planetary atmospheres or space shuttle reentry problem, where the mean free path are very large. Such situations can be described by particle simulations but the cost of carrying these out is much greater than that of small mean-free path models, often becoming prohibitive when one is near small mean-free path regimes. This makes the simulation of problems in which transition regimes coexist with small mean-free path regimes particularly difficult. This difficulty is compounded when the geometry is complicated or even random.

This workshop will explore a variety of advanced models such us moment based models, Chapmann-Enskog and Burnett type expansions, or models derived from asymptotic limits. These models, both deterministic and stochastic in origin, will be studied in the context of the simulation of high-altitude flight, charged particles in natural plasmas, man-made plasmas (electric propulsion for satellites), electron and holes in semiconductor devices, and radiation through inhomogeneous media. Hybrid numerical schemes that properly match transition with small mean-free path regimes will also be examined.

CONFIRMED WORKSHOP PARTICIPANTS: May 22-26, 2000 (as of 22 April 2000)

AGARWAL, RAMESH	Wichita State Univ. (Aerospace Engineering)	MAY 21 – 26
BALSARA, DINSHAW	Univ. of Illinois (NCSA)	MAY 20 – 26
BARDOS, CLAUDE	University Paris VII	MAY 22 – 26
BENTIL, DANIEL	Univ. of Vermont (Mathematics and Statistist)	MAY 17 – 26
BOBYLEV, ALEXANDER	Karlstad Univ. (Matematik)	MAY 13 – 27
BORGERS, CHRISTOPH	Tufts Univ. (Mathematics)	MAY 20 – 26
CARRILLO, JOSE	Univ. of Texas at Austin (Mathematics)	MAY 13 – 26

CHARRIER, PIERRE	Univ. Bordeaux I (Mathematiques Applquées)	MAY 20 – 26
DEGOND, PIERRE	Univ. Paul Sabatien (UFR MIG)	MAY 14 – 28
EU, B.C.	McGill Univ. (Chemistry)	MAY 20 – 26
FISCHETTI, MAX	IBM (Research)	MAY 21 – 26
GAMBA, IRENE	Univ. of Texas at Austin (Mathematics)	APR 2 – MAY 31
GILLESPIE, DIRK	Univ. of Texas (Mathematics)	MAY 13 – 27
GLASSEY, ROBERT	Indiana Univ. (Mathematics)	MAY 20 – 26
GOBBERT, MATTHIAS	Univ. of Maryland, Baltimore Count (Mathematics & Statistics)	MAY 17 – JUN 16
GOUDON, THIERRY	Univ. de Nice - Sophia Antipolis (Laboratoire JA. Dieudonne)	MAY 18 – JUN 9
GROTH, CLINTON	Univ. of Toronto (Aerospace Studies)	MAY 20 – 26
HITTINGER, JEFFREY	Univ. of Michigan (Aerospace Engineering)	MAY 20 – 26
ILLNER, REINHARD	Univ. of Victoria (Mathematics & Statistics)	MAY 20 – 26
JEROME, JOSEPH	Northwestern Univ. (Mathematics)	MAY 21 – 26
JIN, SHI	Georgia Tech (Mathematics)	MAY 20 – 26
JUNGEL, ANSGAR	Univ. Konstanz (Fachbereich Mathematik und Statistik)	MAY 19 – 26
JUNK, MICHAEL	Univ. of Kaiserslautern (Fachbereich Mathematik)	MAY 21 – 29
KLAR, AXEL	FU Berlin (FB Mathematik und Informatik)	MAY 20 – 28
LEMOU, MOHAMMED	Univ. Paul Sabatier	MAY 21 – 27
LEVERMORE, DAVID	Univ. of Arizona (Mathematics)	APR 1 – JUN 30
LIU, HAILIANG	UCLA (Mathematics)	MAY 21 – 26
MASMOUDI, NADER	NYU-Courant	MAY 20 – 26
MAUSER, NORBERT	University of Vienna	MAY 20 – 24
MUSCATO, ORAZIO	Univ. di Catania (Dipartimento di Matematica)	MAY 20 – 26
NOURI, ANNE	INSA-Lyon Scientific & Technical Univer	MAY 21 – 26
PARESCHI, LORENZO	Univ. of Ferrara (Mathematics)	MAY 21 – 27
PERTHAME, BENOIT	Ecole Normale Superieure	MAY 21 – 26
RINGHOFER, CHRISTIAN	Arizona State Univ. (Mathematics)	APR 4 – JUN 30
RUDAN, MASSIMO	Univ. di Bologna (DEIS)	MAY 20 – 26
RYZHIK, LENYA	Univ. of Chicago (Mathematics)	MAY 20 – 26
SARANITI, MARCO	Illinois Institute of Technology (Electrical & Computer Engineer)	MAY 20 – 26
SCHAEFFER, JACK	Carnegie Mellon Univ. (Mathematical Sciences)	MAY 20 – 26
SCHMEISER, CHRISTIAN	TU Wien (Inst fuer Angewandte und Numerische Ma)	MAY 13 – 27
SHU, CHI-WANG	Brown Univ. (Applied Mathematics)	MAY 17 – 26
SLEMROD, MARSHALL	Univ. of Wisconsin (Mathematics)	MAY 22 – 26
SOLER, JUAN	Univ. of Granada (Aplicada)	MAY 20 – 26
SONE, YOSHIO	University Kyoto	MAY 20 – 27
STRAUSS, WALTER A.	Brown Univ. (Mathematics)	MAY 20 – 26
STRUCKMEIER, JENS	Univ. of Hamburg (Mathematics)	MAY 20 – 26
XIN, ZOUPING	Univ. of New York-Courant (Courant Mathematical Scien)	MAY 20 – 26
XU, KUN	Hong Kong Univ. (Mathematics)	MAY 20 – 26
XU, WEN-QING	Univ. of Massachusetts Amherst (Mathematics and Statistic)	MAY 20 – 27

3 Workshop (June 5-9, 2000) Multiscale Models for Surface Evolution and Reacting Flows

Organizers:
Leonard Borucki (Motorola)
Christian Ringhofer (Arizona State University)

For current information see URL: http://www.ima.umn.edu/biology/spring/rf10.html

Multilayered compound materials with microscopically structured surfaces play a key role in semiconductor manufacturing. These structures are produced by a variety of processes, such as the deposition of thin films, etching techniques and controlled crystal growth.

The topic of this workshop is the integration of different models describing these processes on different spatial and temporal scales. Well-developed models exist for each stage of the above processes on the microscopic-atomistic and macroscopic-fluid scale. However, in order to describe completely the whole process, it is necessary to link these models via an

appropriate mathematical description of the transition regimes. This involves a mixture of boundary layer and homogenization techniques as well as a mathematical analysis of the transition process from the atomistic description of the early stages of thin film growth to the evolution of continuous films. Computational issues covered by this workshop will be the deterministic and probabilistic representation of film surfaces and numerical methods for the transitional models.

CONFIRMED WORKSHOP PARTICIPANTS: June 5-9, 2000 (as of 22 April 2000)

BOON, JEAN-PIERRE	Univ. Libre de Bruxelles ()	JUN 3 – 9
BORUCKI, LEN	Mail Stop M360 (Motorola)	JUN 3 – 9
CALE, TIMOTHY S.	Rensselaer Polytechnic Institute (Chemical Engineering)	JUN 3 – 9
DEMKOV, ALEX	(Motorola)	JUN 3 – 9
DULLES, FRED	400 Lind Hall (Mathematics and its Appli)	SEP 1 – AUG 31
FRIEDMAN, AVNER	Univ. of Minnesota (MCIM)	SEP 1 – AUG 31
GHONIEM, NASR M.	UCLA (Engineering)	JUN 3 – 9
GOBBERT, MATTHIAS	Univ. of Maryland, Baltimore Count (Mathematics & Statistics)	MAY 17 – JUN 16
HUANG, HANCHEN	Hong Kong Polytechnic Univ. (Mechanical Engineering)	JUN 3 – 9
KAPRAL, RAY	Univ. of Toronto (Chemistry)	JUN 3 – 9
KATSOULAKIS, MARKOS A.	Univ. of Massachusetts (Mathematics and Statistics)	JUN 3 – 9
KING, JOHN	Univ. of Nottingham (Theoretical Mechanics)	JUN 1 – 14
LEVERMORE, DAVID	Univ. of Arizona (Mathematics)	APR 1 – JUN 30
MEYYAPPAN, MEYYA	Mail Stop 229-3 (NASA Ames Research Center)	JUN 3 – 9
MILLER, WILLARD	400 Lind Hall (Mathematics and its Appli)	SEP 1 – AUG 31
MUCHA, PETER	Massachusetts Institute of Technology (Mathematics)	JUN 5 – 9
OSHER, STANLEY	UCLA (Mathematics)	JUN 3 – 9
RATSCH, CHRISTIAN	UCLA (Mathematics)	JUN 3 – 9
REITICH, FERNANDO	Univ. of Minnesota (Mathematics)	JUN 3 – 9
RINGHOFER, CHRISTIAN	Arizona State Univ. (Mathematics)	APR 4 – JUN 30
ROTHMAYER, ALRIC	Iowa State Univ. (Aerospace Engineering & Engineering Mec)	JUN 3 – 9
ROYTBURD, VICTOR	Rensselaer Polytechnic Institute (Mathematics)	JUN 3 – 9
SANTOSA, FADIL	IMA & Minnesota Center for Industrial M (MCIM)	SEP 1 – AUG 31
SETHIAN, JAMES	Univ. of California-Berkeley (Mathematics)	JUN 3 – 9
VLACHOS, DION G.	Univ. of Massachusetts (Chemical Engineering)	JUN 3 – 9
WALKER, ROBERT B.	Los Alamos National Laboratory (Theoretical Chemistry & Molec Physics)	JUN 3 – 9

CONFIRMED LONG-TERM SPRING 2000 PARTICIPANTS (as of 22 April 2000)

Four Weeks or More

Multiscale and Transition Regimes

GAMBA, IRENE	University of Texas at Austin	1-Apr – 31-May 2000
GOBBERT, MATTHIAS	University of Maryland	1-Jun – 30-Jun 2000
JIANG,LISHANG	Tongji University	1-May – 31-May 2000
LEVERMORE, DAVID	University of Arizona	1-Apr – 30-Jun 2000
NWABUEZE, KENNETH	University of Brunei, Darusalam	29-May – 29-Jun 2000
RINGHOFER, CHRISTIAN	Arizona State University	1-Apr – 30-Jun 2000

III. Summer 2000 Programs

July 19–28, 2000 Mathematical Modeling in Industry - A Workshop for Graduate Students

August 16–18, 2000 Mathematical Challenges in Global Positioning Systems (GPS)

August 28–29, 2000 Modeling and Analysis of Noise in Integrated Circuits and Systems

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Summer Program (July 19–28, 2000) Mathematical Modeling in Industry - A Workshop for Graduate Students

Organizers:
Rachel Kuske (University of Minnesota)
Fernando Reitich (University of Minnesota)

For current information see URL: http://www.ima.umn.edu/biology/winter/modeling/
This workshop is designed to provide graduate students and qualified advanced undergraduates with first hand experience in industrial research.

Format: Students will work in teams of up to 6 students under the guidance of a tutor from industry. The tutor will help guide the students in the modeling process, analysis and computational work associated with a real-world industrial problem. Each team will be expected to make a public oral presentation and submit a written report at the end of the 10-day period.

Projects and Industry Mentors: There will be 6 teams participating in the workshop. The following industry scientists have agreed to participate as mentors:

Participant	**Affiliation**	**Tentative Topic**
Dr. Robert Melville	Lucent Technologies	RF Communication Circuits
Dr. Joan Bachenko	Linguistic Technologies	Optimizing Language Models and Texts for Automatic Speech Recognition
Dr. Thomas Grandine	Boeing	Computer Aided Design: The Surface Intersection Problem
Dr. Sarah Patch	General Electric	Computer Tomography
Dr. Norm Curet	National Security Agency	Network Analysis
Dr. David Ross	Eastman Kodak	InkJet Printing

Application Procedure: Graduate students and advanced undergraduates are invited to apply. An application form must be submitted to the IMA. In addition, two letters of recommendation are required; one must be from the student's advisor, director of graduate studies, or department chair. Prerequisites vary and depend on the project, but computational skills are important.

The IMA will cover local living expenses but not travel (IMA Participating Institution may use their PI funds for this purpose). Selection criteria will be based on background and statement of interest, as well as geographic and institutional diversity. Women and minorities are especially encouraged to apply. **Applications must be completed by April 15, 2000** for full consideration. Early submissions are encouraged. Successful applicants will be notified by May 10, 2000.

A similar modeling course was held at the IMA during summer 1998. The industrial problems and student reports are available online. For further information contact `ima-staff@ima.umn.edu` or see on the web
URL: http://www.ima.umn.edu/modeling/

HOT TOPICS Workshop (August 16–18, 2000) Mathematical Challenges in Global Positioning Systems (GPS)

Organizers:
Kai Borre (Aalborg Universität)
Gerard Lachapelle (University of Calgary)
Brian Leininger (Lockheed Martin)
Fan Liu (Honeywell)

For current information see URL: http://www.ima.umn.edu/gps/

The Global Positioning System (GPS) utilizes triangulation and/or phase delays in continuous signals from a constellation of satellites in earth orbit to accurately locate a receiver antenna position relative to these satellites. GPS plays an important role in many navigation systems produced today, and is beginning to play an increasing role in providing accurate time signals for many industries. Applications include land surveying, autonomous vehicle control including the smart highway system, marine navigation, air traffic control, satellite navigation, and power signal time synchronization. With the addition of differential or relative signals, ultra-high precision GPS is capable of position accuracies on the order of a few centimeters.

There is a need for sophisticated algorithms for accurately and reliably processing the GPS signals for timing and navigation. Mathematics is of critical importance here. Areas of mathematics that are relevant include linear and non-linear algebra, signal processing and filtering, wave propagation, statistics, and scattering.

This workshop will focus on mathematical issues that arise in increasing the processing speed, accuracy and reliability of GPS. It will be an opportunity for the mathematical community to become more aware of these issues. Invited participants will be mathematicians, engineers and scientists from industry and from academia.

Among the principal topics considered will be:

- Problems with reflected signals (Multipath) with respect to pseudo-range data and integrated carrier data, their mathematical characterization and methods of addressing these problems
- Integrity of solutions of positioning algorithms
- Resolution of the phase ambiguity in position determination
- Global tomography, estimation of water content in the troposphere and the ionosphere

Additional topics: Antennas (beam pattern characterization and utilization, antenna shaping), Mathematical modeling of the GPS receiver, Avoidance of frequency jamming and/or interference, Use of dual and triple frequencies from GPS, GLONASS.

HOT TOPICS Workshop (August 29-30, 2000) Modeling and Analysis of Noise in Integrated Circuits and Systems

Organizers:
Alper Demir (Bell Labs)
Kiran Gullapalli (Motorola)
Boris Rozovskii (USC)
Jacob White (MIT)
Advisory member: Len Borucki (Motorola)

For current information see URL: http://www.ima.umn.edu/reactive/spring/circuit.html

This workshop is driven by the need to extract information from noisy, weak signals in electronic devices, such as those used in communications. In order to be able to deal with noise, it is essential that it is modeled in the appropriate context, and that it is carefully analyzed. Noise in circuits come from a number of sources and can take several forms – shot noise,

flicker, thermal noise, etc. Understanding how noise is generated at various sources, and how it is propagated in a system, is critical to the design and operation of integrated circuits and systems.

The focus of the workshop is the modeling and analysis of noise/interference in integrated circuits and systems. The goal is to bring together scientists working in device noise modeling, circuit design, circuit simulation, stochastic processes, dynamical systems, and numerical analysis to discuss the underlying physical principles, design considerations, the mathematical formalisms, and numerical methods used in dealing with the problem. The 2-day workshop will consist of invited lectures and discussions sessions. The intention is to forge synergy through a multidisciplinary effort.

IMA Career Workshop (September 8–10, 2000) Connecting Women in Mathematical Sciences to Industry

Organizers:Rosemary E. Chang
Suzanne Lenhart
Margaret H. Wright

Cosponsored by the Association for Women in Mathematics (AWM)
See URL: http://www.ima.umn.edu/women_in_industry.html

Mathematical problems arising in industrial applications typically involve complicated, interdisciplinary issues of formulation, analysis and solution. Many women in mathematical sciences today are contributing to this important work in industrial applications, but more women should be informed of the opportunities provided by real world problems for high quality research, contributions to practical solutions and rewarding careers. This weekend workshop is intended to increase and enhance the awareness of women mathematicians about industrial applications.

The diverse nature of industrial applications will be conveyed through technical talks by selected participants, chosen based on their successful experiences with real world problems. A panel of women established in successful industrial careers will give their viewpoints to encourage women to become involved with industrial problems. Focused small group discussions will be included to exchange ideas on strategies to enhance the participation of women in industrial applications.

CONFIRMED WORKSHOP PARTICIPANTS: (as of 20 April 2000

ROSEMARY CHANG		ALESSANDRA CHIARELI	3M
CAROLYN CHO	SmithKline Beecham R&D	SHARON FILIPOWSKI	Boeing Company
ANNA GILBERT	AT&T Labs	SONIA GLAVASKI	Honeywell
KATHLEEN HOFFMAN	U. of Maryland, Baltimore County	SARAH HOLTE	FHCRC
TAMMY KOLDA	Sandia National Laboratories	LYNNE PARKER	Oak Ridge National Laboratory
MARGARET WRIGHT	AT&T Labs	BIN YU	Bell Labs and U.C. Berkeley

2000–2001 Annual Program:

III. MATHEMATICS IN MULTIMEDIA

September 1, 2000 – August 31 2001
Organizers: Michael Barnsley (Georgia Institute of Technology)
Rosemary Chang (SGI)
Tony Derose (Pixar)
Stu Geman (Brown University)
Peter Olver (University of Minnesota)
Roni Rosenfeld (Carnegie-Mellon University)
Larry Schumaker (Vanderbilt University)
Ahmed Tewfik (University of Minnesota)

See also http://ww.ima.umn.edu/multimedia/

Introduction:

The past few years have seen an explosion in the use of digital media. Industry is making significant investments to deliver digital audio, image and video information to consumers and customers. A new infrastructure of digital audio, image and video recorders and players, on-line services and electronic commerce is rapidly being deployed. At the same time, major corporations are converting their audio, image and video archives to an electronic form. Individual consumers may also soon be able to convert their image and video archives to digital form.

This burgeoning of digital information coupled with advances in computing, interface and communication technologies has paved the way for multimedia. The most distinctive characteristic of a multimedia product is that it carries and delivers digital information in mixed modes on a single platform. What makes multimedia different from traditional information products is a much richer variety of underlying works. A multimedia product may contain graphics, film, video, music, photographs, paintings, animation, text, data, maps, games, and multimedia software.

Current and future challenges in multimedia technologies include (i) better understanding of the interaction between different media, (ii) two-way man-machine interaction in speech recognition and computer vision, (iii) improved quality of computer generated media, (iv) developing communication protocols that protect data privacy, and (v) restructuring existing data bases to respond to real-time performance demands.

Mathematics, with its reliance on exposing and exploiting the hidden patterns and structures in physical phenomena, will play a key role in uniting and synthesizing the different modalities inherent in the ongoing multimedia revolution. The mathematical disciplines that are required cover a broad spectrum, ranging from pure algebra and group theory, through geometry and topology, and, naturally, analysis - both analytical and numerical - with probabilistic and stochastic methods playing a particularly important role. The interface between mathematics and multimedia applications forms a two-way street - not only do existing mathematical theories acquire new and unexpected applications, but the multimedia applications themselves point to new problems requiring solutions, which in turn will stimulate new developments in mathematics itself. Thus, we can view multimedia in the role of a twenty-first century reincarnation of the old mathematical paradigm that inseparably synergizes research in pure mathematics and its applications.

One of the hallmarks of the subject is the incredible variety of mathematical tools and theories that arise. Although perhaps daunting to the novice, this diversity enhances the range of possible interactions and cross fertilizations among the different mathematical disciplines, as each is called into play in quantifying, analyzing and developing practical algorithms. A key goal of the multimedia year at the IMA is to foster the interaction between researchers using similar tools in different multimedia modalities, and, on the other hand, providing researchers utilizing different mathematical techniques to study the same modality to compare results and combine promising methods. The year will play an important role in exposing the mathematical community to a new range of challenging and timely mathematical problems and applications. Particular attention will be paid to the training of postdoctoral researchers to be familiar with a wide variety of mathematical tools and techniques that will hopefully lay the foundations for a genuinely mathematical discipline that will become known as ”multimedia.”

The underlying mathematical theories can be broadly divided into several important, overlapping categories. First, since vision, language, music, video and other sensory processes are much less deterministic than ordinary physical phenomena, a large class of methods rely on probabilistic and stochastic paradigms. For example, Markov random fields form the basis of much current research in speech and feature recognition, in visual tracking, in segmentation, and in signal processing and storage. Statistical estimation and Bayesian methods feature in pattern recognition, in language modeling, in optical character recognition, as well as signal image reconstruction. Monte Carlo methods have been successfully used in the numerical analysis of some processes, as well as in computer design and graphics.

Wavelets and other transform methods appear in a wide variety of contexts, including image and signal compression and enhancement, computer graphics, texture analysis, and the recovery of degraded audio signals. A particularly striking example is the FBI’s adoption of a wavelet-based system for compression of fingerprint images. (On the other hand, image enhancement techniques based on nonlinear differential equations have also been dramatically successfully in forensics and video enhancement.) Wavelet methods are particularly useful in the as yet poorly understood theory of image textures, but successfully incorporating them into the variational and partial differential equation approaches to segmentation has yet to be completed.

Since digital imagery is a fundamentally discrete data system, a particular surprise is the relevance of both nonlinear partial differential equations and variational methods in low level image and video processing. The mathematical techniques include the various recent approaches to curve shortening and mean curvature flows (originally studied by differential geometers) and the variational approaches of the type used in minimal surfaces. These methods are used in denoising images and in edge detecion of features, and have seen success in visual tracking and recognition of objects, medical imaging,

video enhancement, and collision avoidance. Implementation of the relevant nonlinear diffusion equations has led to the development of fast, sophisticated numerical algorithms that have broad applicability. The passage from discrete pixel-based image to continuous partial differential equation and back to discrete finite difference numerical implementation sounds paradoxical, until one realizes that the fundamental processes in continuum mechanics and fluid dynamics work in precisely the same paradigm - the discrete molecular system is modeled by a continuous system, e.g. the Navier-Stokes equations, which are themselves integrated numerically via a discrete approximation.

The nonlinear partial differential equation approach to image processing relies on classical differential geometry. Modern fractal geometry, which arose in the study of natural phenomena, also has immediate applications in computer graphics, animation and the construction of artificial scenes. Fractal-based algorithms has had dramatic results in practical image compression, while very recent wavelet-fractal hybrids indicate the potentialities for cross disciplinary approaches to multimedia processes.

Algebraic theories arise in cryptography and information theoretic approaches to signal processing. Secure computing, copyright protection, and language grammars also rely on fundamental algebraic methods for implementation.

In computer graphics and geometric design, the digital representation of fully three-dimensional objects has been the subject of intense research activity in the past decade, leading to powerful new algorithms. Algebraic geometry, splines, wavelets, optics and solid geometry are but a few of the mathematical tools brought to bear on this vital area. Applications include computer graphics, surface and solid rendering, animation, flight simulation, virtual reality, and scientific and medical imagery. But real-time display of fully three-dimensional images remains problematic, necessitating further research in the fundamental mathematical issues. Inevitable technological advances in graphics performance will continuously change the requirements for real-time rendering and the complexity of models to be visualized.

Group theory is recognized to play an increasingly important role in media analysis; for instance, both human and camera visual systems naturally incorporate certain symmetries, including translations, rotations, scalings, and then progressing on to the less familiar groups of affine and projective transformations. Galilean invariance plays an important role in movie restoration and recognition of moving objects. In general, the reliable recognition of objects must form an integral part of any functional multimedia system. These include recognition of visual objects, target recognition, satellite images, speech and language recognition, optical character recognition, and language. Most of these are still in their infancy, with the underlying mathematical theory still in need of development. Applying symmetry groups to recognition problems in a natural fashion requires the adaptation of classical geometric theories of differential invariants and algebraic invariants, subjects that formed the core of pure mathematical research in the last century. Recent work on symmetry-incorporating numerical approximations hold significant promise for computation of invariants and object recognition in physical images.

Use of multimedia in manufacturing holds great potential for industrial applications. Visual control of the robots used in industrial processes, such as semiconductor manufacturing and etching, requires efficient, real-time processing of images, incorporating the denoising, enhancement, segmentation, and object recognition techniques from a computer vision system into a broader control-theoretic loop. Some striking experiments, including an image-based vehicular navigational system, show significant promise. Fast and efficient numerical implementation of the analytical algorithms provides the key to real-time applications and automatic control. Both finite difference and finite element methods have been successfully employed. For example, the use of level set methods for front tracking and interface evolution in phase transitions requires fast marching algorithms and efficient numerical implementations. However, to date the marriage of computer vision and control theory has yet to be properly consummated, requiring a new synthesis of the underlying mathematical theories.

In summary, while much progress can be seen on individual aspects, their synthesis into a mathematical theory of multimedia is as yet unexplored. This year at the I.M.A. will provide a unique and unprecedented opportunity to bring together researchers in a wide variety of mathematical disciplines and applications. Forging these disparate subjects into a new and vital subject will have long range effects, both within mathematics, and in the practical applications to multimedia science.

FALL QUARTER (September 1–December 31, 2000): **Vision, Speech and Language**
WINTER QUARTER (January 1–March 31, 2001): **Digital Libraries**
SPRING QUARTER (April 1–June 30, 2001): **Geometric Design and Computer Graphics**

1 Short Course (September 11–15, 2000) Mathematical Methods in Speech and Image Analysis

Organizer: Stu Geman (Brown University)

For current information see URL: http://www.ima.umn.edu/multimedia/fall/t1.html

The purpose of the short course is to introduce basic mathematical methods used in speech and/or image analysis. There will be a brief introduction to the state of the art in speech and image analysis and to some of the related mathematical issues of current interest. Following the introduction there will be three tutorials, one on partial differential equations, one on signal processing, and one on probability and statistics. These will cover some of the core mathematical technologies of modern speech and image analysis, including: nonlinear PDE's for image denoising and deblurring, and for shape analysis; spectral (Fourier) and multiscale (wavelet) based signal transformations; random fields, graphical models, and dynamic programming in image and language analysis.

Topic	**Speaker**
Introduction & Overview	Stu Geman
PDE Methods	Guillermo Sapiro
Spectral and Multiscale (Wavelet) Methods	Jackie Shen
Probabilistic and Statistical Methods	To be announced

2 Workshop (September 18-22, 2000) Mathematical Foundations of Speech Processing and Recognition

Organizers: S. Khudanpur (Johns Hopkins University)
Mari Ostendorf (University of Washington)
Roni Rosenfeld (Carnegie Mellon University)

See URL: http://www.ima.umn.edu/multimedia/fall/m1.html

Speech recognition technology has seen a significant breakthrough with the introduction of Hidden Markov Models and related data-driven statistical techniques in the 70's and 80's. But current technology is still very fragile, breaking down with small changes in speaker characteristics, channel characteristics or discourse domain. This points to fundamental weaknesses in signal representation, and existing limitations of the HMM approach. The proposed workshop will bring together researchers actively working on novel solutions to the problems of speech signal representation, acoustic modeling, and model adaptation, together with mathematicians working in the areas of statistical estimation, stochastic processes and clustering. The first two days will consist of overviews of the acoustics, production, perception and automatic recognition of speech and related speech applications, followed by talks about ongoing research in these areas. The goal is to create a synergy between mathematicians and practitioners to pursue the next generation of solutions to speech processing and recognition problems. To this end, we will aim to:

- Familiarize mathematicians with speech processing and recognition technology, outline underlying fundamental problems and currently popular/successful solutions.
- Present novel models, ideas or approaches currently being pursued in the speech community.
- Present recent advances in mathematics which may be relevant to the speech community.

We hope that this will in turn encourage informal discussions, exchanging of ideas, fostering collaborations and formulating specific mathematical problems whose solutions will advance the state of the art.

CONFIRMED WORKSHOP PARTICIPANTS: September 18-22, 2000 (as of 20 April 2000

ALWAN, ABEER	BOURLARD, HERVE	COHEN, JORDAN	DENG, LI
GISH, HERB	GLASS, JAMES	HERMANSKY, HYNEK	HOLMES, WENDY

JUANG, FRED	KHUDANPUR, SANJEEV	LEE, CHIN-HUI	MACON, MICHAEL
OSTENDORF, MARI	RISSANEN, JORMA	ROSENFELD, RONI	ROWE, ERROL
SAGISAKA, YOSHINORI	YOUNG, STEVE		

3 Minisymposium (October 11-14, 2000) Brain Imaging

Organizers:Guillermo Sapiro (ECE), Dan Kersten (CCS), Gordon Legge (CCS), Sheng He (CCS), Xiaoping Hu (CMRR), Kamil Ugurbil (CMRR)

Co-sponsors:

Cognitive Neuroscience and Brain Imaging Program, Center for Cognitive Sciences (CCS), Center for Magnetic Resonance Research (CMRR), Department of Neuroscience, Department of Electrical and Computer Engineering (ECE), (all at the University of Minnesota.)

See URL: http://www.ima.umn.edu/multimedia/fall/ms1.html

The study of the human brain and its perceptual, cognitive, and motor functions is without any doubt one of the most challenging and fascinating topics of contemporary science. Recent years have seen significant advances in the application of sophisticated mathematical theories and visualization techniques to the problems arising in brain imaging modalities such as PET, EEG, MEG, optical imaging, and functional MRI. Fundamental problems like image registration, signal detection, surface warping, surface visualization, inter-subject registration, and inverse problems have to be addressed in order to fully utilize these techniques. All this research is carried out by interdisciplinary teams including radiologists, engineers, mathematicians, physicists, neuroscientists, and cognitive scientists. It is the goal of this workshop to bring together these teams. The Minisymposium will fundamentally include two types of lectures. One part will cover the techniques used to solve some of the mathematical/engineering problems raised by brain imaging research. The second component will include lectures on the use of brain imaging to advance our knowledge about the cognitive processes in the human brain. Introductory lectures about brain imaging modalities will be presented as well.

CONFIRMED WORKSHOP PARTICIPANTS: October 11-14, 2000 (as of 20 April 2000)

ALBER, MARK	BAJCSY, RUZENA	BOOKSTEIN, FRED L.	BUECHEL, CHRISTIAN
EDDY, WILLIAM	FAUGERAS, OLIVIER	GAUTHIER, ISABEL	HE, SHENG
HU, XIAOPING	KERSTEN, DAN	LANGE, NICK	LEGGE, GORDON
LOGOTHETIS, NIKOS	MCINTOSH, RANDY	MENON, RAVI	MILLER, MICHAEL
MITRA, PARTHA	NELSON, CHARLES	OSHER, STANLEY	SAPIRO, GUILLERMO
STROTHER, STEPHEN	TARR, MICHAEL	VAN DEN BROEK, PAUL	WORSLEY, KEITH

4 Workshop (October 16-20, 2000) Image Processing and Low Level Vision

Organizers:Allen Tannenbaum University of Minnesota
Peter Olver University of Minnesota
D.E. McClure Brown University
P. Perona Caltech

See URL: http://www.ima.umn.edu/multimedia/fall/m2.html

Recent years have seen significant advances in the application of sophisticated mathematical theories to the problems arising in image processing. As yet, even very low level visual processing by computers remains a challenging problem. Both planar and three-dimensional images are of importance, and these arise in a wide variety of applications, including medical imagery—ultrasound, nuclear magnetic resonance, X-ray computed topography, etc.— military and industrial imaging, and film restoration and animation. Basic issues include image smoothing and denoising, image enhancement, morphology, image compression, segmentation (determining boundaries of objects— including problems of camera distortion and partial occlusion). Several mathematical approaches have emerged, including methods based on nonlinear partial

differential equations, stochastic and statistical methods, and signal processing techniques, including wavelets and other transform theories. Partial differential equations are used to describe the evolution of shapes under curvature-controlled diffusions, providing a multi-scale representation that is based upon curvature flows of fundamental importance in differential geometry. These methods have proven successful in noise reduction while maintaining edge retention. Applications to segmentation are based on a variational formulation of the method of "snakes" or moving contours, in which an initial contour converges to the object boundary via a gradient descent flow based on a conformally Riemannian metric. Wavelets have applications to practical image compression methods, and texture characterization. Statistical methods such as the EM algorithm have been successfully applied to a variety of low level vision problems. A primary goal of this workshop is to educate and interest mathematicians in the mathematical and scientific problems that arise in basic image processing.

CONFIRMED WORKSHOP PARTICIPANTS: October 16-20, 2000 (as of 20 April 2000)

ALBER, MARK	CASELLES, VINCENT	CHAN, TONY F.C.	CIPOLLA, ROBERTO
DAUBECHIES, INGRID C.	DONOHO, DAVID	FARIDANI, ADEL	JACOBS, DAVID
KIMIA, BENJAMIN B.	MALLAT, STEPHANE	MCCLURE, DONALD E.	MILLER, WILLARD
MUMFORD, DAVID	OLVER, PETER	OSHER, STANLEY	OSTROV, DANIEL N.
PAUWELS, ERIC	PERONA, PIETRO	SANTOSA, FADIL	SOATTO, STEFANO
TANNENBAUM, ALLEN	TER HAAR ROMENY, BART M.	VAN GOOL, LUC	VOGEL, CURTIS
WILLSKY, ALAN S.	YEZZI, ANTHONY	ZEEVI, Y.Y.	

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5 Workshop (October 30-November 3, 2000) Mathematical Foundations of Natural Language Modeling

Organizers:Roni Rosenfeld (Carnegie Mellon University)
Sanjeev Khudanpur (Johns Hopkins University
Mark Johnson (Brown University
Frederick Jelinek (Johns Hopkins University

See URL: http://www.ima.umn.edu/multimedia/fall/m3.html

Language modeling is crucial to all applications that process human language with less than complete knowledge. This includes speech recognition, machine translation, optical character recognition, handwriting recognition, spelling and grammar correction, and others. Formal theories of grammar have so far failed to account adequately for actual natural usage of language. Stochastic versions of formal grammars are still less successful (as measured by cross entropy of their predictions) than simple Markovian models (ngrams) which are estimated from larger amounts of data. With the advent of huge textual corpora, a breakthrough in language modeling will come when we successfully integrate linguistic knowledge with statistical estimation techniques.

This workshop will bring together researchers who are working on various aspects of language modeling (stochastic grammars, clustering, maximum entropy models) with mathematicians with interest in these and related problems (Bayesian methods, clustering, information theory). The first 2 days will consist of an overview of the field and existing techniques, followed by presentations of ongoing research. The overall objective is to encourage interaction and collaborations between mathematicians and practitioners to pursue the next generation of solutions to language modeling problems. The specific goals are:

- Familiarize the mathematicians with the language technology, outline underlying fundamental problems and currently popular/successful solutions.
- Present novel models, ideas or approaches currently being pursued in the language modeling community.
- Present recent advances in mathematics which may be relevant to the language modeling community.

CONFIRMED WORKSHOP PARTICIPANTS: October 30-November 3, 2000 (as of 20 april 2000)

ABNEY, STEVEN	BAKER, JAMES	BELLEGARDA, JEROME	BICKEL, PETER
CATONI, OLIVIER	CHARNIAK, EUGENE	CHI, ZHIYI	GEMAN, STU

GILLICK, LARRY	JELINEK, FREDERICK	JI, CHUANSHU	JOHNSON, MARK
KHUDANPUR, SANJEEV	MOHRI, MEHRYAR	MUMFORD, DAVID	MURUA, ALEJANDRO
PEREIRA, FERNANDO	ROSENFELD, RONI	VERT, JEAN-PHILIPPE	

6 Workshop (November 13-17, 2000) Image Analysis and High Level Vision Modeling

Organizers:Peter Olver (University of Minnesota)
Allen Tannenbaum (University of Minnesota)
Donald Geman (University of Massachusetts at Amherst)
Y. Amit
Steven Zucker (Yale University)

See URL: http://www.ima.umn.edu/multimedia/fall/m4.html

This workshop will concentrate on mathematical and practical issues arising in the higher level processes in image analysis. These include object recognition, optical character and handwriting recognizers, printed-circuit board inspection systems, and quality control devices, motion detection, robotic control by visual feedback, theory of shape, reconstruction of objects from stereoscopic view and/or motion, and many others.

Shape theory is of fundamental importance since it is the bottleneck between high and low level vision. The recent geometric partial differential equation methods have been essential in throwing new light on this very difficult problem area. There are two classical approaches to approximating the shape of objects. The first is based on diffusion and often leads to the (Gaussian) smoothing of contour information. The second approach is based on morphological morphology operations that represent the interior of shapes as sets, e.g., a collection of disks. The geometric PDE approach based on abstract conservation principles, Hamilton-Jacobi theory, and curvature driven flows leads to a computational theory of shape that naturally characterizes its computational elements including protrusions, parts, bends, and seeds (which show where to place the components of a shape). Stochastic processes, including Markov random fields, have been used in a Bayesian framework to incorporate prior constraints on a smoothness and the regularities of discontinuities into algorithms for image restoration and reconstruction. Sequential decision theory has been used to develop algorithms for efficient identification of objects in a scene, including handwritten characters, roads in satellite imagery, and faces. Deformable templates have been used to automate the identification of structures, both normal and pathological, in medical imagery.

Since human vision relies on a variety of symmetry transformations, including Euclidean, affine and projective invariance, the incorporation of group theory and invariants into the image processing equations has been of great importance in the design of algorithms, both continuous and numerical. Stochastic processes, including Markov random fields, have been used in a Bayesian framework to incorporate prior constraints on a smoothness and the regularities of discontinuities into algorithms for image restoration and reconstruction.

A primary goal of this workshop is to educate and interest mathematicians in the mathematical and scientific problems that arise in the study of computer and natural vision. There will be a mix of tutorials in natural and artificial vision and mathematical talks on the theoretical foundations of existing and proposed vision systems. An additional goal is to bring together researchers working in these areas to compare results and to collaborate on ways to integrate these approaches into a powerful overall mathematical approach to vision. Unlike numerical analysis, the computer vision community has yet to establish ”benchmark” tests for comparison of the various visual processing systems that are available, making direct and rigorous comparisons difficult. In this workshop we propose to initiate the development of a set of benchmark visual images that can be used for overall comparison purposes.

CONFIRMED WORKSHOP PARTICIPANTS: November 13-17, 2000 (as of 20 april 2000)

AMIT, YALI	BELHUMEUR, PETER	BIEDERMAN, IRVING	BLAKE, ANDREW
CHELLAPPA, RAMA	COHEN, LAURENT D.	COOPER, DAVID	DICKMANNS, ERNST
DONOHO, DAVID	DRYDEN, IAN	FAUGERAS, OLIVIER	FLEURET, FRANCOIS
GEIGER, DAVI	GEMAN, DONALD	GEMAN, STU	GIDAS, BASILIS
HINTON, GEOFFREY	MASCARO, MASSIMO	MCCLURE, DONALD E.	MILLER, MICHAEL
MUMFORD, DAVID	OLIENSIS, JOHN	OLVER, PETER	PENNEC, XAVIER

PERONA, PIETRO	POGGIO, TOMASO	RANGARAJAN, ANAND	RAPHAEL, CHRISTOPHER S.
SHAH, JAYANT M.	SHAPLEY, ROBERT	TANNENBAUM, ALLEN	TER HAAR ROMENY, BART M.
ULLMAN, SHIMON	YOUNES, LAURENT	YUILLE, ALAN	ZHU, SONG CHUN
ZISSERMAN, ANDREW	ZUCKER, STEVEN		

CONFIRMED LONG-TERM Fall 2000 PARTICIPANTS (as of 22 April 2000)

Four Weeks or More

Vision, Speech and Language

BAKER, JAMES	Dragon Systems Inc.	21-Oct–17-Nov-00
BELHUMEUR, PETER	Yale University	1-Nov–30-Nov-00
BRUCKSTEIN, ALFRED	Technion	1-Sep–31-Dec-00
CASELLES, VINCENT	Universität Illes Baltears	1-Sep–31-Dec-00
CIPOLLA, ROBERTO	University of Cambridge	1-Sep–31-Dec-00
COCKBURN, BERNARDO	University of Minnesota	1-Sep-00–31-Aug-01
DICKMANNS, ERNST	Universitt der Bundeswehr Mnchen	1-Nov–30-Nov-00
FAUGERAS, OLIVIER	INRIA	10-Oct–17-Nov-00
GARRETT, PAUL	University of Minnesota	1-Sep-00–31-Aug-01
GEIGER, DAVI	Courant Institute, NYU	1-Nov–30-Nov-00
GEMAN, DONALD	University of Massachusetts at Amherst	1-Nov–30-Nov-00
GIDAS, BASILIS	Brown University	1-Nov–30-Nov-00
GULLIVER, ROBERT	University of Minnesota	1-Sep-00–31-Aug-01
HOLMES, WENDY	20/20 Speech Ltd.	1-Sep-00–30-Sep-00
KHUDANPUR, SANJEEV	Johns Hopkins University	1-Sep-00–31-Dec-00
LANG, CHRISTOPHER	Indiana University Southeast	1-Sep-00–31-Dec-00
LOGOTHETIS, NIKOS	Max Planck Inst. for Biological Cybernetics	10-Oct-00–17-Nov-00
LYUBEZNIK, GENNADY	University of Minnesota	1-Sep-00–31-Aug-01
MCCLURE, DONALD E.	Brown University	15-Oct–17-Nov-00
MCGEHEE, RICHARD	University of Minnesota	1-Sep-00–31-Aug-01
MUMFORD, DAVID	Brown University	10-Oct–17-Nov-00
MURUA, ALEJANDRO	University of Washington	3-Oct–3-Nov-00
OLIENSIS, JOHN	NEC Research Institute Inc.	1-Nov–30-Nov-00
OLVER, PETER	University of Minnesota	1-Sep–31-Aug-01
PATERA, JIRI	Universite de Montreal	1-Sep–31-Dec-00
PEREIRA, FERNANDO	AT&T Labs	1-Sep–31-Dec-00
PERONA, PIETRO	Caltech	15-Oct–17-Nov-00
SHEN, JACKIE	University of Minnesota	1-Sep–30-Jun-01
STOLCKE, ANDREAS	SRI International	3-Oct–3-Nov-00
SVERAK, VLADIMIR	University of Minnesota	1-Sep–31-Aug-01
TER HAAR ROMENY, B. M.	University Medical Center	15-Oct–17-Nov-00
VERT, JEAN-PHILIPPE	Ecole Normale Superieure	3-Oct–3-Nov-00
ZUCKER, STEVEN	Yale University	1-Nov–30-Nov-00

IV. THE IMA VOLUMES IN MATHEMATICS AND ITS APPLICATIONS

The IMA Volumes listed here have all been published. To check for the status of future volumes, check the ima website at http://www.ima.umn.edu/volumes.html

http://www.ima.umn.edu/volumes.html

You can also place an order for available volumes by calling the toll-free # 1–800–SPRINGER or by writing:

attn: Book Fulfillment Department
Springer-Verlag
44 Hartz Way
Secaucus, NJ 07094

Volume 115: Pattern Formation in Continuous and Coupled Systems: A Survey Volume
Editors: Martin Golubitsky, Dan Luss, and Steven H. Strogatz

This volume contains a number of mini-review articles authored by speakers and attendees at the IMA workshop on *Pattern Formation in Continuous and Coupled Systems.* Pattern formation has been studied intensively for most of this century by both experimentalists and theoreticians. This workshop focused on new directions in the patterns literature. Systems that generate new types of pattern such as discrete coupled systems, systems with global coupling, and combustion experiments were stressed, as were new types of pattern.

The mini-reviews in this volume are intended to be pointers to the current literature for researchers at all levels and to have extensive bibliographies. They are also intended to discuss why certain subjects are currently exciting and worthy of additional research.

Volume 116: Statistical Models in Epidemiology, the Environment and Clinical Trials
Editors: M. Elizabeth Halloran and Donald Berry

This volume contains refereed papers by participants in the two weeks on Clinical Trials and one week on Epidemiology and the Environment held as part of the six weeks workshop on Statistics in the Health Sciences at the Institute for Mathematics and its Application (IMA) in the summer 1997. Donald Berry was in charge of the weeks on clinical trials, and Elizabeth Halloran organized the week on epidemiology and the environment. The collection includes a major contribution from Jamie Robins, Andrea Rotnitzky, and Daniel Scharfstein on sensitivity analysis for selection bias and unmeasured confounding in missing data and causal inference models. In another paper, Jamie Robins presents a new class of causal models called marginal structural models. Alan Hubbard, Mark van der Laan, and Jamie Robins present a methodology for consistent and efficient estimation of treatment-specific survival functions in observational settings. Brian Leroux, Xingye Lei, and Norman Breslow present a new mixed model for spatial dependence for estimating disease rates in small areas. Andrew Lawson and Allan Clark demonstrate Markov Chain Monte Carlo methods for clustering in spatial epidemiology. Colin Chen, David Chock, and Sandra Winkler present a simulation study examining confounding in estimation of the epidemiologic effect of air pollution. Dalene Stangl discusses issues in the use of reference priors and Bayes factors in analyzing clinical trials. Stephen George reviews the role of surrogate endpoints in cancer clinical trials.

Volume 117: Structured Adaptive Mesh Refinement (SAMR) Grid Methods
Editors: Scott B. Baden, Nikos P. Chrisochoides, Dennis B. Gannon, and Michael L. Norman

This volume contains papers from a workshop on Structured Adaptive Mesh Refinement (SAMR) held by the Institute of Mathematics and its Applications in the Spring of 1997.

Structured adaptive mesh refinement (SAMR) methods have matured over the past 20 years and are now the method of choice for certain difficult problems, such as compressible flow. SAMR presents difficult technical challenges, both in terms of the numerical techniques involved and the complexity of the programming effort, especially on parallel computers. In order to gain insight into managing these difficulties, much research effort has been directed at mesh generation, parallel computation, and improvements in accuracy, aimed primarily at refinement interfaces. A major stumbling block in this endeavor is that many of these techniques entail substantial amounts of problem specific detail. Standardization is highly unlikely, except within narrowly defined problem domains.

The papers presented in this collection are based on talks given at the Workshop on Structured Adaptive Mesh Refinement Grid Methods, held at the Institute for Mathematics and Its Applications, University of Minnesota, on March 12-13, 1997. They describe research to improve the general understanding of the application of SAMR to practical problems; identify issues critical to efficient and effective implementation on high performance computers; stimulate the development of a community code repository for software including benchmarks to assist in the evaluation of software and compiler

technologies. The ten Chapters of this volume have been divided into two parts reflecting two major issues in the topic: (I) programming complexity of SAMR algorithms and (II) applicability and numerical challenges of SAMR methods. Part I presents three programming environments and two libraries that address the concerns of efficient execution and reduced software development times of SAMR applications. Part II describes an overview of applications that can benefit from SAMR methods, ranging from crack propagation and industrial boilers to the evolution of a cluster of galaxies.

Volume 118: Dynamics of Algorithms
Editors: Rafael de la Llave, Linda R. Petzold, and Jens Lorenz

The articles collected in this volume represent the contributions presented at the IMA workshop on "Dynamics of Algorithms" which took place in November 1997. The workshop was an integral part of the 1997–98 IMA program on "Emerging Applications of Dynamical Systems."

The interaction between algorithms and dynamical systems is mutually beneficial since dynamical methods can be used to study algorithms that are applied repeatedly. Convergence, asymptotic rates are indeed dynamical properties. On the other hand, the study of dynamical systems benefits enormously from having efficient algorithms to compute dynamical objects.

Volume 119: Numerical Methods for Bifurcation Problems and Large-Scale Dynamical Systems
Editors: Eusebius Doedel and Laurette S. Tuckerman

The Institute for Mathematics and its Applications (IMA) devoted its 1997–1998 program to Emerging Applications of Dynamical Systems. Dynamical systems theory and related numerical algorithms provide powerful tools for studying the solution behavior of differential equations and mappings. In the past 25 years computational methods have been developed for calculating fixed points, limit cycles, and bifurcation points. A remaining challenge is to develop robust methods for calculating more complicated objects, such as higher-codimension bifurcations of fixed points, periodic orbits, and connecting orbits, as well as the calculation of invariant manifolds. Another challenge is to extend the applicability of algorithms to the very large systems that result from discretizing partial differential equations. Even the calculation of steady states and their linear stability can be prohibitively expensive for large systems (e.g. $10^3 - -10^6$ equations) if attempted by simple direct methods.

Several of the papers in this volume treat computational methods for low and high dimensional systems and, in some cases, their incorporation into software packages. A few papers treat fundamental theoretical problems, including smooth factorization of matrices, self–organized criticality, and unfolding of singular heteroclinic cycles. Other papers treat applications of dynamical systems computations in various scientific fields, such as biology, chemical engineering, fluid mechanics, and mechanical engineering.

Volume 120: Parallel Solution of Partial Differential Equations
Editors: Petter Bjørstad and Mitchell Luskin

The papers in this volume are based on lectures given at the IMA workshop on the Parallel Solution of PDE during June 9–13, 1997. The numerical solution of partial differential equations has been of major importance to the development of many technologies and has been the target of much of the development of parallel computer hardware and software. Parallel computer offers the promise of greatly increased performance and the routine calculation of previously intractable problems.

This volume contains papers on the development and assessment of new approximation and solution techniques that can take advantage of parallel computers. It will be of interest to applied mathematicians, computer scientists, and engineers concerned with investigating the state-of-the-art and future directions in numerical computing. Topics include domain decomposition methods, parallel multi-grid methods, front tracking methods, sparse matrix techniques, adaptive methods, fictitious domain methods, and novel time and space discretizations. Applications discussed include fluid dynamics, radiative transfer, solid mechanics, and semiconductor simulation.

Volume 121: Mathematical Models for Biological Pattern Formation
Editors: Philip K. Maini and Hans G. Othmer

The formation of patterns in developing biological systems involves the spatio-temporal coordination of growth, cell-cell signalling, tissue movement, gene expression and cell differentiation. The interactions of these complex processes are

generally nonlinear, and thus mathematical modelling and analysis are needed provide the framework in which to compute the outcome of different hypothesis on modes of interaction and to make experimentally testable predictions.

This collection contains papers exploring several aspects of the hierarchy of processes occurring during pattern fromation. A number of papers address the modelling of cell movement and deformation, with application to pattern formation within a collection of cells in response to external signalling cues. The results are considered in the context of pattern generation in *Dictyostelium discoideum* and bacterial colonies.

A number of models at the macroscopic level explore the possible mechanisms underlying spatio-temporal pattern generation in early development, focussing on primitive streak, somitogenesis, vertebrate limb development and pigmentation patterning. The latter two applications consider in detail the effects of growth on patterning.

The potential of models to generate more complex patterns are considered and models involving different modes of cell-cell signalling are investigated. Pattern selection is analysed in the context of chemical Turing patterns, which serve as a paradigm for morphogenesis and a model for vegetation patterns is presented.

Forthcoming Volumes:

1997–1998: *Emerging Applications of Dynamical Systems* Multiple-Time-Scale Dynamical Systems

Endocrinology: Mechanism of Hormone Secretion and Control

Membrane Transport and Renal Physiology

Mathematical Approaches for Emerging and Reemerging Infectious Diseases

1999 Summer Program: Codes, Systems, and Graphical Models

1999–2000: Reactive Flow and Transport Phenomena
Fire