

ANNUAL PROGRESS REPORT AND PROGRAM PLAN
INSTITUTE FOR MATHEMATICS AND ITS APPLICATIONS
JUNE 29, 2001

A. Annual Progress Report: A progress report shall be submitted to the cognizant Program Official by July 1 of each year. The annual report is subject to the review and approval by the cognizant NSF Program Official and the electronic report and hard copy supplementary material shall include the following:

- 1. A list of the programs and those who organized them; a list of the names and gender of participants who attended the annual programs for at least 10 weeks, their affiliation, their area of expertise, their designation (as senior participant, postdoctoral fellow, or student), the amount of stipend, travel and per diem paid them; the number of other participants in each of the activities and the number of members of underrepresented groups and women participating.*

2000 (July 19-28, 2000) Industrial Modeling Course for Graduate Students

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

For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see: <http://www.ima.umn.edu/modeling/>

IMA Career Workshop: Connecting Women in Mathematical Sciences to Industry, September 8-10, 2000. Cosponsored by the Association for Women in Mathematics (AWM), with partial support from the Department of Energy and Coastcom.

Organizers: Rosemary E. Chang (Computer Science, Coastcom), Suzanne Lenhart (Mathematics, University of Tennessee, Knoxville), Margaret H. Wright (Mathematics, Bell Laboratories, Lucent)

For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see:

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

A Career Workshop in Computational Science and Engineering: Minorities and Applied Mathematics - Connections to Industry and Government Laboratories,

May 4-6, 2001. Cosponsored by the Joint Alliance for Minorities in Mathematics (JAMM). With partial support from the Department of Energy.

Organizers: Raymond L. Johnson (Mathematics, University of Maryland), James Turner (Mathematics, Florida State University)

For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see:

<http://www.ima.umn.edu/multimedia/spring/minorities.html>

HOT TOPICS Workshops

Analysis and Modeling of Industrial Jetting Processes, January 10-13, 2001

Organizers: Michael Brenner (Mathematics) Massachusetts Institute of Technology, Avner Friedman (Center for Industrial Mathematics) University of Minnesota, Elbridge Gerry Puckett (Mathematics) University of California-Davis

For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see:

<http://www.ima.umn.edu/multimedia/winter/inkjet.html>

Mathematics of the Internet: E-Auction and Markets, December 3-5, 2000, with partial support by Ford , IBM , and the University of Minnesota Office of Information Technology.

Organizers: John Birge (School of Engineering and Applied Sciences, Northwestern University), Brenda Dietrich, (IBM T.J. Watson Research Center), Suzhou Huang (Ford Motor Company), Ennio Stacchetti (Department of Economics, University of Michigan), Rakesh Vohra (J.L. Kellogg Graduate School of Management, Northwestern University)

Public Lecture: The Other Side of the (e-Commerce) Fence by Robert Weber (Kellogg School of Management, Northwestern University)

For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see:

<http://www.ima.umn.edu/multimedia/fall/auction.html>

Modeling and Analysis of Noise in Integrated Circuits and Systems, August 29-30, 2000, sponsored in part by Motorola.

Organizers: Alper Demir (Bell Labs, Lucent Technologies), Kiran Gullapalli (Motorola Inc.), Boris Rozovskii (Center for Applied Mathematical Sciences, University of Southern California), Jacob White (Research Laboratory of Electronics, MIT). Advisory member: Len Borucki (Motorola)

For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see:

<http://www.ima.umn.edu/reactive/spring/circuit.html>

Mathematical Challenges in Global Positioning Systems (GPS), August 16 - 18, 2000, with partial support from Lockheed Martin.

Organizers: Kai Borre (Aalborg Universitet), Gerard Lachapelle (Geodesy, University of Calgary), Brian Leininger (Lockheed Martin), Fan Liu (Honeywell), Additional direction from: Craig Poling (Lockheed Martin), Suneel Sheikh (Honeywell)

For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see: <http://www.ima.umn.edu/gps/>

Special Workshop: Frontiers of Mathematics in Geosciences, March 5-7, 2001, Sponsored by the Divisions of Mathematical Sciences (DMS), Atmospheric Sciences (ATM), Earth Sciences (EAR) and Ocean Sciences (OCE), National Science Foundation

Organizers: Louise Kellogg (chair, Earth Sciences, University of California, Davis), Hal Caswell (Ocean Science/Math, Ecology, Woods Hole Oceanographics Institute), Kelvin Droegemeier (Atmospheric Science, University of Oklahoma), Darryl Holm (Mathematics, Los Alamos National Laboratories), Christopher K.R.T. Jones (Applied Mathematics, Brown University), Doug Nychka (Statistics, National Center for Atmospheric Research), Annick Pouquet (Atmospheric Science, CNRS, Observatory of the Cote d'Azur), Jim Rosenberger (Statistics, Penn State University) Dan Rothman (Earth Science, MIT), Roger Samelson (Ocean Science, Oregon State University), Don Turcotte (Earth Science, Cornell University), Bruce Turkington (Mathematics, University of Massachusetts)

For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see:

<http://www.ima.umn.edu/multimedia/winter/frontier.html>

IMA ANNUAL PROGRAM for 2000-2001: MATHEMATICS IN MULTIMEDIA September 2000 - June 2001

The year was divided into three components:

Fall Quarter, September-December, 2000: **Vision, Speech and Language**

Winter Quarter, January-March, 2001: **Digital Libraries**

Spring Quarter, April-June, 2001: **Geometric Design and Computer**

Graphics

Organizing Committee:

Michael Barnsley, Georgia Institute of Technology (Mathematics & CDSNS)

Rosemary Chang, Coastcom (Geometric design)

Tony Derose, Pixar (Computer graphics)

Stuart Geman, Brown University (Applied Mathematics)

Peter Olver, University of Minnesota (Mathematics)

Roni Rosenfeld, Carnegie-Mellon University (Computer Science)

Larry Schumaker, Vanderbilt University (Mathematics)

Ahmed Tewfik, University of Minnesota (Electrical Engineering)

Annual Program Workshops:

Short Course: Mathematical Methods in Speech and Image Analysis,
September 11-15, 2000

Speakers: Stu Geman (Applied Mathematics) Brown University, Basilis Gidas, (Applied Mathematics) Brown University, Peter J. Olver (Mathematics) University of Minnesota, Guillermo Sapiro (Electrical & Computer Engineering) University of Minnesota, Jackie Shen (Mathematics) University of Minnesota, Allen Tannenbaum (Electrical & Computer Engineering) Georgia Institute of Technology
For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see:
<http://www.ima.umn.edu/multimedia/fall/t1.html>

Workshop 1: Mathematical Foundations of Speech Processing and Recognition, September 18-22, 2000, with partial support by The Office of Naval Research

Organizers: Sanjeev Khudanpur (Center for Language and Speech Processing) Johns Hopkins University, Mari Ostendorf (Electrical Engineering) University of Washington, Roni Rosenfeld (Computer Science) Carnegie Mellon University
For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see:
<http://www.ima.umn.edu/multimedia/fall/m1.html>

Special Minisymposium: Brain Imaging, October 11-13, 2000, with partial support by The Office of Naval Research. 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)

Organizers: Guillermo Sapiro (Electrical and Computer Engineering), Daniel Kersten (Psychology), Gordon Legge (Psychology), Sheng He (Psychology), Xiaoping Hu (Department of Radiology-CMRR), Kamil Ugurbil (Department of Radiology-CMRR), all at the University of Minnesota

For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see:
<http://www.ima.umn.edu/multimedia/fall/ms1.html>

Workshop 2: Image Processing and Low Level Vision, October 16-20, 2000, with partial support by The Office of Naval Research.

Organizers: Allen Tannenbaum (Electrical & Computer Engineering) Georgia Institute of Technology, Peter Olver (Mathematics) University of Minnesota, Donald E. McClure (Applied Mathematics) Brown University, Pietro Perona (Electrical Engineering) Caltech

For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see:

<http://www.ima.umn.edu/multimedia/fall/m2.html>

Workshop 3: Mathematical Foundations of Natural Language

Modeling, October 30-November 3, 2000, with partial support by The Office of Naval Research.

Organizers: Roni Rosenfeld (Computer Science) Carnegie Mellon University, Sanjeev Khudanpur (Center for Language and Speech Processing) Johns Hopkins University, Mark Johnson (Cognitive and Linguistic Sciences) Brown University, Frederick Jelinek (Electrical and Computer Engineering) Johns Hopkins University

For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see:

<http://www.ima.umn.edu/multimedia/fall/m3.html>

Workshop 4: Image Analysis and High Level Vision, November 13-17,

2000, with partial support by The Office of Naval Research.

Organizers: Peter Olver (Mathematics) University of Minnesota, Allen Tannenbaum (Electrical & Computer Engineering) Georgia Institute of Technology, Donald Geman (Mathematics and Statistics) University of Massachusetts at Amherst, Yali Amit (Statistics) The University of Chicago, Steven Zucker (Computer Science and Electrical Engineering) Yale University

For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see:

<http://www.ima.umn.edu/multimedia/fall/m4.html>

Minisymposium: Fractals in Multimedia, January 17-19, 2001

Organizers: Michael F. Barnsley (Mathematics and Statistics) University of Melbourne, Edward Vrscay (Applied Mathematics) University of Waterloo, Dietmar Saupe (Institut für Informatik) Universität Leipzig

For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see:

<http://www.ima.umn.edu/multimedia/winter/ms.html>

Tutorial: Digital Libraries, January 25-26, 2001

Organizer: Ahmed Tewfik (Electrical Engineering) University of Minnesota

Speakers: James D. Johnston (AT&T Laboratories, Research), Shashi Shekhar (Computer Science, University of Minnesota), Sameh Sowelam (Cognicity Corp.)

For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see:

<http://www.ima.umn.edu/multimedia/winter/tut.html>

Workshop 5: Digital Libraries - Data Modeling and Representation,

January 29-February 2, 2001, with partial support by The Office of Naval Research.

Organizers: Robert Gray (Electrical Engineering) Stanford University, James Johnston (AT&T Labs Research), Michael T. Orchard (Electrical Engineering) Princeton University, Shashi Shekhar (Computer Science) University of Minnesota
For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see:
<http://www.ima.umn.edu/multimedia/winter/m5.html>

Workshop 6A: Digital Libraries - Digital Asset Management, February 12-16, 2001, with partial support by The Office of Naval Research.

Organizers: Michael Barnsley (Mathematics & Statistics) University of Melbourne, George Cybenko (Engineering) Dartmouth College, David Du (Computer Science) University of Minnesota
For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see:
<http://www.ima.umn.edu/multimedia/winter/m6.html>

IMA Public Lecture: Natural Laws of Digital Content: the Folly of Copy Protection on the Internet, Monday, February 12, 2001

Speaker: Bruce Schneier (CTO Counterpane Systems)
For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see:
<http://www.ima.umn.edu/multimedia/winter/m6.html>

Workshop 6B: Digital Libraries - Classification, Retrieval and Visualization, February 26-March 2, 2001, with partial support by The Office of Naval Research.

Organizers: David Forsyth (EECS) University of California-Berkeley, B.S. Manjunath (Electrical and Computer Engineering) University of California-Santa Barbara, Francois Pachet (SONY CSL-Paris)
For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see:
<http://www.ima.umn.edu/multimedia/winter/m7.html>

Joint IDR-IMA Workshop: Ideal Data Representation, April 9-13, 2001, cosponsored by the Army Research Office.

Organizers: Ronald DeVore (IDR Organizer, Industrial Mathematical Institute) University of South Carolina-Columbia, Amos Ron (IDR Organizer, Computer Sciences/Mathematics) University of Wisconsin — Madison, Patrick Van Fleet (Workshop Organizer, Mathematics) University of Saint Thomas
For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see:
<http://www.ima.umn.edu/multimedia/spring/idr.html>

Tutorial: Geometric Design, April 19-20, 2001

Speakers: Helmut Pottmann (Institut fuer Geometrie) Technische Universit t Wien, Stefan Leopoldseder (Institut fuer Geometrie) Technische Universit t Wien

For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see:

<http://www.ima.umn.edu/multimedia/spring/tut7.html>

Workshop 7: Geometric Design, April 23 - 27, 2001, with partial support by The Office of Naval Research.

Organizers: Larry Schumaker (Mathematics) Vanderbilt University, Rosemary Chang (Computer Science) Coastcom

For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see:

<http://www.ima.umn.edu/multimedia/spring/m7.html>

Tutorial: Computer Graphics, May 10 - 11, 2001

Speakers: Mathieu Desbrun (Computer Science) California Institute of Technology, Michael Gleicher (Computer Science) University of Wisconsin, Jessica Hodgins (Computer Science) Carnegie Mellon University, Peter Schröder (Computer Science) California Institute of Technology

For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see:

<http://www.ima.umn.edu/multimedia/spring/tut8.html>

Workshop 8: Computer Graphics, May 14 - 18, 2001, with partial support by The Office of Naval Research.

Organizers: Tony DeRose, Pixar Animation Studios, Peter Schröder (Computer Science) California Institute of Technology

For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see:

<http://www.ima.umn.edu/multimedia/spring/m8.html>

Workshop 9: Haptics, Virtual Reality, and Human Computer Interaction, June 14-15, 2001

Organizers: John Hollerbach (Computer Science) University of Utah, Tim Salcudean (Electrical and Computer Engineering) University of British Columbia

For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see:

<http://www.ima.umn.edu/multimedia/spring/m9.html>

Long Term Participants in the Multimedia Year

The names of female long term participants are marked in **Red italics**.

2000-01 MULTIMEDIA

NAME	Type of visitor	ARRIVE	DEPART	EXPERTISE	INSTITUTION
<i>ALLEN, BETH</i>	ECONOMICS FACULTY	1-Mar-01	31-May-01	ECONOMICS	University of Minnesota
ANDERSON, TONY		1-Jun-01	31-Aug-01	MATH	University of Minnesota
ARMENDARIZ, JAVIER	POSTDOC	1-Sep-00	31-Aug-01	MATH	IMA
BAXTER, JOHN	Math Faculty Released	1-Jan-01	30-Jun-01	MATH	University of Minnesota
BETELU, SANTIAGO	POSTDOC	7-Aug-00	31-Aug-01	MATH	IMA
<i>CARTER, JAMYLLÉ</i>	POSTDOC	1-Sep-00	31-Aug-01	MATH	IMA
<i>CHENG, CHRISTINE</i>	POSTDOC	1-Sep-00	31-Aug-01	MATH	Johns Hopkins University
CHENG, LI-TIEN	POSTDOC	1-Sep-00	15-Dec-00	MATH	IMA
CIPRA, BARRY		1-Sep-00	31-Aug-01	SCIENTIFIC WRITING	
COCKBURN, BERNARDO	Math Faculty Released	1-Sep-00	31-Aug-01	MATH	University of Minnesota
CRISTINI, VITTORIO	POSTDOC	1-Sep-00	31-Aug-01	MATH	University of Minnesota
DUCHAMP, TOM	VIV	1-Apr-01	30-Jun-01	MATH	University of Washington
DULLES, FRED		1-Sep-00	31-Aug-01		IMA
<i>DYN, NIRA</i>	VIV	1-Apr-01	30-Jun-01	MATH	Tel-Aviv University
EFENDIEV, YALCHIN	POSTDOC	1-Sep-00	31-Aug-01	MATH	IMA
ESEDOGLU, SELIM	POSTDOC	1-Sep-00	31-Aug-01	MATH	IMA
FADDA, GIUSEPPE		1-Mar-01	31-Aug-01		University of Padua
GARRETT, PAUL	Math Faculty Released	1-Sep-00	31-Aug-01	MATH	University of Minnesota
GOODMAN, GERALD	LONGTERM	1-Apr-01	30-Jun-01	MATH	University of Florence
GOPALAKRISHNAN, JAY	POSTDOC	1-Sep-00	31-Aug-01	MATH	IMA
GULLIVER, ROBERT	Math Faculty Released	1-Sep-00	31-Aug-01	MATH	University of Minnesota
HAN, BIN	POSTDOC	6-Jan-01	31-May-01	MATH	IMA
HAWA, TAKUMI	POSTDOC	1-Sep-00	31-Aug-01	MECHENG	IMA
HOFFMAN, JOHN		1-Sep-00	31-Aug-01		Lockheed Martin
HORSTMANN, DIRK	LONGTERM	21-Aug-00	31-Mar-01	MATH	Universitat zu Koeln
<i>INTERRANTE, VICTORIA</i>	COMPUTER SCIENCE	1-Sep-00	30-Jun-01	COMPUTER	University of Minnesota
KHUDANPUR, SANJEEV	VIV	9-Sep-00	9-Dec-00	COMPUTER	Johns Hopkins University
<i>KIM, HYEJOO</i>	LONGTERM-GRAD ST	17-Mar-01	31-Aug-01	STATISTICS	Seoul National University
KIM, JINSEOG	LONGTERM-GRAD ST	17-Mar-01	31-Aug-01	STATISTICS	Seoul National University
KIM, YONG JUNG	POSTDOC	1-Sep-00	31-Aug-01	MATH	IMA
KIRILL, DIMITRI	POSTDOC	1-Sep-00	31-Aug-01	MATH	IMA
LANG, CHRISTOPHER	LONGTERM	1-Sep-00	30-Nov-00	MATH	Indiana University Southeast
LOWENGRUB, JOHN	LONGTERM	1-Sep-00	31-Aug-01	MATH	University of Minnesota
LUTOBORSKI, ADAM	LONGTERM	26-Mar-01	31-May-01	MATH	Syracuse University
LI, SHUWANG	LONGTERM	1-Jun-01	31-Aug-01	MATH	University of Minnesota
LYUBEZNIK, GENNADY	Math Faculty Released	1-Sep-00	31-Aug-01	MATH	University of Minnesota
MACKLIN, PAUL		1-Jun-01	31-Aug-01		University of Minnesota
MELAMED, DAN		15-May-01	31-Aug-01	COMPUTER	Westgroup
MILLER, WILLARD		1-Sep-00	31-Aug-01	MATH	IMA
<i>NIGAM, NILIMA</i>	POSTDOC	1-Sep-00	31-Aug-01	MATH	IMA
NOVIKOV, ALEXEI	POSTDOC	1-Sep-00	31-Aug-01	MATH	IMAQ
OLVER, PETER	VIV	1-Sep-00	31-Aug-01	MATH	University of Minnesota
QIAN, JIANLIANG	POSTDOC	8-Aug-00	31-Aug-01	MATH	IMA
SANTOSA, FADIL		1-Sep-00	31-Aug-01	MATH	IMA and MCIM
SCHRODER, PETER	VIV	1-Apr-01	30-Jun-01	COMPUTER	California Institute of Technology
SHEN, JACKIE	Math Faculty Released	1-Sep-00	30-Jun-01	MATH	University of Minnesota
SVERAK, VLADIMIR	Math Faculty Released	1-Sep-00	31-Aug-01	MATH	University of Minnesota
TELLO, JOSE IGNACIO		18-Sep-00	22-Dec-00	MATH	Universidad Complutense de Madrid
THAYER, FRANCISCO JAV	LONGTERM	1-Sep-00	31-Aug-01	COMPUTER	MITRE Corporation

Demographics for IMA workshops for the 2000-2001 Program: Mathematics in Multimedia									
Workshop code	Title	Total	M	F	Af.				
					Cauc.	mer	Hisp.	Asian	merind
W6/18-7/13	IMA/PI Summer Program for Gradu	17	15	2	8	1	0	8	0
W7/19-28	Mathematical Modeling in Industry	44	33	11	28	2	3	11	0
W8/16-18	Mathematical Challenges in Global	39	36	3	31	0	1	7	0
W8/29-330	Modeling and Analysis of Noise in	26	25	1	17	0	0	9	0
W9/8-10	Connecting Women in Mathematic	77	7	70	58	1	3	15	0
W9/11-15	Short Course: Markov processes a	40	38	2	30	1	1	8	0
W9/18-22	Workshop 1: Mathematical Founda	50	44	6	29	1	0	20	0
W10/11-14	Brain Imaging	66	52	14	55	0	3	8	0
W10/16-20	Workshop 2: Image Processing an	73	68	5	58	0	5	10	0
W10/30-N3	Workshop 3: Mathematical Found	53	46	7	42	1	2	8	0
W11/13-17	Workshop 4: Image Analysis and H	65	59	6	48	1	5	10	1
w12/3-5	Mathematics and the Internet: E-A	71	63	8	49	1	2	19	0
W1/10-13	Analysis and Modeling of Industria	67	61	6	53	1	3	10	0
W1/17-19	Fractals in Mutimedia	32	28	4	25	1	1	5	0
W1/25-26	IMA Tutorial: Digital Libraries	16	13	3	10	1	0	5	0
W1/29-2/2	Workshop 5: Digital Libraries-Data	31	28	3	19	0	1	11	0
W2/12-16	Worshop 6A: Digital Libraries-Digi	34	31	3	23	1	1	9	0
W2/26-3/2	Workshop 6B: Digital Libraries-Cla	44	40	4	21	1	0	22	0
W3/5-7	Frontiers of Mathematics in the Ge	86	78	8	73	0	1	12	0
W4/9-13	Ideal Data Representation	86	72	14	66	2	1	17	0
W4/19-20	IMA Tutorial: Geometric Design	23	18	5	17	1	1	4	0
W4/23-27	Workshop 7: Geometric Design	50	43	7	35	0	1	14	0
W5/4-6	Minorities in Applied Mathematics	45	28	17	6	24	14	1	0
W5/10-11	IMA Tutorial: Computer Graphics	21	19	2	12	0	0	9	0
W5/14-18	Workshop 8: Computer Graphics	65	59	6	51	1	0	13	0
W6/14-15	Workshop 9: Haptics, Virtual Reali	41	35	6	28	0	2	11	0
sum		1262	1039	223	892	42	51	276	1
Longterm		50	45	5	35	1	3	11	0
Postdocs		15	12	3	6	1	2	6	0
TOTALS		1327	1092	231	933	44	56	293	1

2. A summary on the Institute's postdoctoral program. This should include participant reports as above along with sketches of the postdoctoral fellows activities, including placement information.

The IMA is very proud of the quality, training and the subsequent performance of our postdocs. We keep track of them and follow their progress. See www.ima.umn.edu/people/all-reg-postdocs.html for a list of all of our past and present

theme year postdocs and www.ima.umn.edu/people/all-ind-postdocs.html for all of our industrial postdocs, with present locations and hyperlinks to email and home pages. Our postdoc program is a comprehensive career development program. A strong component of this new program is to provide a nurturing environment for research. A second equally important component is to complete the postdoc s preparation for a career in academia or industry. **Two-year postdoc positions** are now the norm, except for postdocs on leave from other schools. This required extra funding (which has been provided by the University of Minnesota), the cooperation of the School of Mathematics and other departments, to provide teaching development opportunities. The first year of the postdoc experience involves participation in the IMA theme program. At the beginning of each program year there is a special Meet the IMA Postdocs event in which each postdoc has 5 minutes to describe his/her research interests to an audience of other postdocs, IMA long term participants and University faculty. This aids in match the postdocs with senior mentors. Also there is a special weekly research seminar that is run by and for the postdocs. In the second year (when the IMA theme program may be inappropriate for the second year postdocs) there is a special seminar for these second year postdocs (and possibly some small special workshops) with faculty involvement to continue the mentoring experience. Also there is a special _ time teaching development program for some of the postdocs. This includes participation in the University of Minnesota Bush Foundation teaching development project that involves one-on-one mentoring of junior faculty by master teachers. For other postdocs who are interested, there are opportunities for industrial interaction as well as teaching mentoring.

The IMA places considerable emphasis on the mentoring of postdocs. The University has provided additional funds for the support of the IMA that can be used to strengthen the faculty in areas of applied and industrial mathematics that will directly impact the mentoring. (Professor M. Carme Calderer, a former IMA postdoc herself, has been hired under this program and will help with the postdoc mentoring program.) Also we strongly encourage long-term senior visitors to work actively with postdocs and make some of the release time provided to School of Mathematics faculty to participate in IMA programs contingent on interaction with the postdocs. Every postdoc is assigned a faculty mentor for the full two years.

With the advice of the organizers of the 2000--2001 year on Mathematics in Multimedia, the IMA chose seven new postdoctoral members for the period September 1, 2000 to August 31, 2002. These postdocs were 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	Research Specialty	2001-2002 Position
Santiago Ignacio Betelu	Univ. Nacional del Centro de la Provincia de Buenos Aires	Roberto Gratton	Fluid Dynamics, Numerical Methods, Image Processing	IMA Industrial Postdoc

Jamylle Carter	UCLA	Tony Chan	Level Set Methods, Image Processing	IMA Postdoc
Li-Tien Cheng	UCLA	Stanley Osher	Level Set Methods, Image Processing	Assistant Professor, UC San Diego
Selim Esedoglu	Courant Institute of Mathematical Sciences	Robert Kohn	Image Segmentation, PDEs	IMA Postdoc
Bin Han	Princeton University	Rong-Qing Jia	Wavelets, Harmonic Analysis, Computer Aided design	Assistant Professor, University of Alberta
Jianliang Qian	Rice University	William Symes	Image Analysis, Multigrid Methods, Multiscale Phenomena	IMA Postdoc

Reports on the work of these postdocs can be found in the online document: www.ima.umn.edu/multimedia/AR/PD.html

Second Year Postdocs (Hired for the 1999-2000 Reactive Flow and Transport Phenomena Program)

Name	PH.D. Institution	Advisor	Research Specialty	2001-2002 Position
Javier Armendariz	Northwestern University	Moshe Matalon	Combustion, Free boundary problems	Senior Profession Staff, Applied Physics Laboratory, Johns Hopkins University
Yalchin Efendiev	California Institute of Technology	Thomas Hou	Fluid Dynamics, Finite Element Methods, Multiscale Phenomena	Assistant Professor, Mathematics, Texas A&M University
Takumi Hawa	Rensselaer Polytechnic Inst.	Zvi Rusak	Combustion, Fluid Dynamics	Postdoc, Combustion Research, Mechanical Engineering, University of

				Minnesota
Yong Jong Kim	University of Wisconsin	Anthanasios E. Tzavaras	Nonlinear PDEs, Numerical Analysis	Postdoc, Mathematics, University of Minnesota
Alexei Novikov	Stanford University	George Papanicolaou	PDEs, Fluid Dynamics	von Karman Instructor, Applied Mathematics, CalTech

Reports on the work of these postdocs can be found in the online document:
www.ima.umn.edu/multimedia/AR/PD.html

Industrial Postdocs

Name	PH.D. Institution	Advisor	Research Project	Sponsoring Company	2001-2002 Position
Christine Cheng	Johns Hopkins University	Lenore Cowen	routing protocol for ad-hoc networks, multicasting, and declustering strategies for data queries	Telcordia Technologies	IMA Industrial Postdoc
Jay Gopalakrishnan	Texas A&M University	J.H. Bramble & J.E. Pasciak	ablation therapy	Medtronic	Assistant Professor, Mathematics, University of Florida
Dimitri J. Kirill	Northwestern University	Michael Miksis	modeling of chemical mechanical planarization (CMP) process	Motorola	
Nilima Nigam	University of Delaware	George Hsiao	modeling of read heads for magnetic disks.	Seagate	Assistant Professor, Mathematics, McGill University

Reports on the work of these postdocs can be found in the online document:
www.ima.umn.edu/multimedia/AR/PD.html

Christine Cheng started her industrial postdoctoral appointment on October 1, 2000. Her assignment was to work with scientists at Telcordia Technologies in Morristown, NJ. She spent a total of 6 months in residence at Telcordia and is now at the IMA. While there, she started several projects including routing protocol for ad-hoc networks, multicasting, and declustering strategies for data queries. She will continue this work as well as pursuing other research interests during the next year.

Jayadeep Gopalakrishnan continued his work with Medtronic in modeling of a surgical procedure called Ablation Therapy. His work has provided valuable insight into the performance of ablation catheters, and in particular, helped understand how to create better designs. He is joining the faculty of the University of Florida in August, and plans to continue collaboration with Medtronic.

Dimitri Kirill continued his work with Motorola on modeling of Chemical Mechanical Planarization (CMP) process. He also pursued research in material science independent of the Motorola work. He is presently looking for industrial positions, having had several interviews.

Nilima Nigam completed her work with Seagate in modeling of read heads for magnetic disks. Using multipole methods, she was able to create simulation tools of unprecedented capabilities. Her work has allowed Seagate engineers to evaluate complicated designs for next generation read heads. She is planning to join the faculty of McGill University in Montreal in August.

3. A description of graduate student participation in activities of the Institute, including events sponsored by the IMA at affiliated institutions, IMA Tutorials, and special programs for graduate students. This should include reports as above on individual participants.

IMA Participating Institutions Graduate Student Summer Program

The IMA pioneered the Graduate Student Summer Program in 1990 and manages it for the IMA Participating Institutions. Each year this program brings together for four weeks in the summer, a select group of mathematics students from the IMA Participating Institutions. Students are nominated by their PI department heads and must commit to participation for the full four weeks. The students live in a dormitory on one of the PI campuses; the location of the campus changes from year to year. During the four weeks, there is a series of (related) lectures given by four senior mathematicians. (Funding for

the lecturers and student living expenses, for at most two students from each Participating Institution, are assumed by the IMA.) The goals of this program are:

- To expose graduate students to a selected set of exciting topics.
- To create interaction among students from different institutions.

The program is addressed to good students who have completed a full year of genuine graduate courses, who have indicated a preference for the general area of the summer program, but who probably have not yet narrowed down to a specific research topic.

Kent State University, Department of Mathematics and Computer Science
2000 Summer Program for Graduate Students on "**Number Theory**" June 26-July 21,
2000

Organizer: Morley Davidson (Kent State University)

This program assumed as background only the core mathematics typically taught during a first year graduate course sequence, e.g., core techniques from real variables (power series) and complex variables (contour integrals), and covered any further techniques as the necessity arose. Recommended background reading was contained in the descriptions provided by the speakers.

Week One: June 26-30, Morley Davidson, Kent State University
Additive Number Theory

Week Two: July 3-7, Harold Diamond, University of Illinois at Urbana-Champaign
Analytic Number Theory

Week Three: July 10-14, Peter D.T.A. Elliott, University of Colorado at Boulder
Probabilistic Number Theory

Week Four: July 17-July 21, Kannan Soundararajan, Institute for Advanced Study
L-Functions

List of Participants

Name	Institution
APEL, GEOFFREY	Northern Illinois University
AVILEZ, ADAM	Ohio State University
CHAN, TSZ-HO	University of Michigan
DANCS, MICHAEL	Pennsylvania State University
GAGOLA, STEPHEN	Michigan State University

GAO, PENG	University of Michigan
GHAIM, BERHANE	Kent State University
GIBSON, D. JASON	University of Illinois at Urbana-Champaign
GORODNIK, ALEXANDER	Ohio State University
HARTWIG, BRIAN	University of Wisconsin-Madison
HUBER, TIM	Northern Illinois University
KARUNATHILAKE, UPALI	University of Minnesota
KEEN, JEFFREY	Kent State University
SILLS, ANDREW	University of Kentucky
TRIGG, SCOTT	University of Wisconsin-Madison
WHITE, DIANA	University of Illinois at Urbana-Champaign
YI, EUNJEONG	University of Houston
ZEIBIG, GERD	Kent State University

Assessment of the program: Sixteen of the students filled out the online evaluation form. Here is a summary of their ratings:

Accommodations: excellent

Excellent 10 xxxxx xxxxx

Very Good 1 x

Good 1 x

Adequate 4 xxxx

Poor

Other/No comment:

Financial information: excellent

Excellent 11 xxxxx xxxxx x

Very good 3 xxx

Good 1 x

Adequate

Poor 1 x

Other/No comment:

Information on housing_travel_financial_maps_etc: good

Excellent 8 xxxxx xxx

Very Good 3 xxx
Good 5 xxxxx
Adequate
Poor
Other/Nocomment:

Quality of morning lectures: excellent
Excellent 10 xxxxx xxxxx
Very Good 5 xxxxx
Good 1 x
Adequate
Poor
Other/Nocomment:

How useful were the afternoon session?: excellent
Excellent: 7 xxxxx xx
Very Good 7 xxxxx xx
Good 2 xx
Adequate
Poor
Other/Nocomment:

Mathematical benefits: excellent
Excellent: 9 xxxxx xxxx
Very Good 4 xxxx
Good 2 xx
Adequate 1 x
Poor
Other/Nocomment:

Developing contact with other students was: excellent
Excellent: 13 xxxxx xxxxx xxx
Very Good 1 x
Good 2 xx
Adequate
Poor
Other/Nocomment:

Overview of comments: The comments were generally quite favorable, with only a few criticisms and very few ratings as low as adequate. There was a trend towards praising the lectures, organization and overall utility of the program. There was no apparent pattern for negative comments. There were some requests for adjustments in the facilities (e.g. gyms, cafeterias) and a few requests for more advance information. One comment mentioned the discrepancies in student prior background as a problem.

Selected comments

I would have liked to see more information about how the lectures/problem sessions were going to be run. I didn't know if the program would be closer to a standard class (i.e., written homework, etc) or more like a lecture series with some group problems.

The speakers' presentations are all very clear and the materials covered are not too heavy nor too light.

The afternoon informal sessions went on well and I also learned a lot of things by doing the exercises.

We developed friendship with the classmates, and I could learn different approaches from each speaker. In general, it was very good experience and I enjoyed the program.

This was one of the most enriching mathematical experiences I've had in graduate school. Thank you.

I would have liked to see more specific coverage on the web site of that which was to be discussed during the program.

IMA Summer Program: Mathematical Modeling in Industry - A Workshop for Graduate Students, July 19 to July 28, 2000

Organizers: Rachel Kuske and Fernando Reitich, University of Minnesota

The workshop is designed to provide graduate students and qualified advanced undergraduates with first hand experience in industrial research.

Format : Students work in teams of up to 6 students under the guidance of a tutor from industry. The tutor helps guide the students in the modeling process, analysis and computational work associated with a real-world industrial problem. Each team is 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 were 6 teams participating in the workshop. The following industry scientists agreed to participate as mentors:

1. Dr. Robert Melville, Lucent Technologies, **RF Communication Circuits**
2. Dr. Joan Bachenko, Linguistic Technologies, **Optimizing Language Models and Texts for Automatic Speech Recognition**
3. Dr. Thomas Grandine, Boeing, **Computer Aided Design: The Surface Intersection Problem**
4. Dr. Sarah Patch, General Electric, **Computed Tomography**

5. Dr. Norm Curet, National Security Agency, **Network Analysis**

6. Dr. David Ross, Eastman Kodak, **Microactuator Design**

Application Procedure: Graduate students and advanced undergraduates were invited to apply. Two letters of recommendation were required; one from the student's advisor, director of graduate studies, or department chair. Prerequisites varied and depended on the project, but computational skills were important.

The IMA covered local living expenses but not travel (IMA Participating Institution could use their PI funds for this purpose). Selection criteria were based on background and statement of interest, as well as geographic and institutional diversity. Women and minorities were especially encouraged to apply.

Participants:

BACHENKO, JOAN	Lernout&Hauspie/Linguistic Technologies, Inc.
CHUNG, YEOJIN	University of California, Irvine
CINTRON-ARIAS, ARIEL	Cornell University
CRACIUN, BOGDAN	California Institute of Technolgy
CURET, NORM	National Security Agency
DENOGEAN, LISA	Cornell University
DUNLAVY, DANNY	Western Michigan University
ELLIS, ROBERT	University of California San Diego
GONZALEZ, COREY	University of Maryland, College Park
GRANDINE, THOMAS	The Boeing Company
HEITMANN, NOEL	University of Pittsburgh
HRUSKA, SUZANNE	Cornell University
HU, JICUN	Marquette University
INGALLS, BRIAN	Rutgers University
INGRASSIA, CHRIS	New York University
JOO, SOOKYUNG	Purdue University
KISKOWSKI, MARIA	University of Notre Dame
LAVICZA, ZSOLT	University of Cincinnati
LEFEAUX, JENNIFER	North Carolina State University
LEGIA, QUOC THONG	Texas A&M University
LIM, HYEONA	Michigan State University
LIN, RUNCHANG	Wayne State University
LITTMAN, WALTER	University of Minnesota
LOWITZSCH, SVENJA	Texas A&M University
MALONZA, DAVID	Iowa State University
MARCIA, ROUMMEL	University of California, San Diego
MCCLEARY, KEVIN	Kent State University
MELVILLE, ROBERT	Lucent Technologies
MINUT, AURELIA	Michigan State University
NGOUYASSA, DANY	Indiana University
ORUGANTI, SHOBHA	Mississippi State University
OU, MIAO-JUNG YVONNE	University of Delaware
PARK, JANG	Northwestern University
PATCH, SARAH	General Electric Company

PINEDA, ANGEL	University of Arizona
QUILLEN, PATRICK	University of Kentucky
REYNOLDS, DANIEL	Rice University
ROSS, DAVID	Eastman Kodak Company
SMITH, BRYAN	Tufts University
SONG, MINSU	University of Illinois at Urbana-Champaign
SUN, JIANZHONG	Purdue University
TARFULEA, NICOLAE	Pennsylvania State University
TSAI, RICHARD	University of California Los Angeles
VALDIVIA, NICOLAS	Wichita State University

Summary of Most Important Results:

See <http://www.ima.umn.edu/modeling/> for the program schedule and abstracts of the problems. The problem presentations and oral reports (except for the NSA problem and report) are available in streaming Video on the IMA web site, see <http://www.ima.umn.edu/recordings/2000-07.MathModeling/> . The students wrote reports on their work. The papers were bound into IMA Preprint 1752: Mathematical Modeling in Industry (Six papers are included in this preprint): 1752-1. Numerical Steady-State Solutions of Non-Linear DAE's Arising in RF Communication Circuit Design, [Danny Dunlavy, Sookhyung Joo, Runchang Lin, Roummel Marcia, Aurelia Minut, and Jianzhong Sun (Robert Melville, mentor)], 1752-2. Optimizing Language Models for Speech Recognition, [Lynch Hruska, Maria Kiskowski, Jennifer Lefeaux, Kevin McCleary, Dany Ngouyassa, Bryan Smith (Joan Bachenko, mentor)], 1752-3. The Bivariate Contouring Problem, [Thomas Grandine, Bogdan Craciun, Noel Heitmann, Brian Ingalls, Quoc Thong Le Gia, Miao-jung Ou, and Yen-hsi Richard Tsai (Thomas Grandine, mentor)], 1752-4. Second Order Solution of Fritz John's Ultrahyperbolic PDE for Volumetric Computed Tomography, [Jicun Hu, Chris Ingrassia, Svenja Lowitzsch, Jang Park, Angel Pineda, Daniel Reynolds, and Nicholas Valdivia (S.K. Patch, mentor)], 1752-5. Not available yet (Norm Curet, mentor), and 1752-6. The Design of a Microactuator, [Y. Chung, Z. Lavicza, H. Lim, D. Malonza, M. Song, and N. Tarfulea (David Ross, mentor)]. The reports are also available on the IMA Website, see <http://www.ima.umn.edu/talks/workshops/7-19-28.2000math-modeling/index.html> .

The purpose of the workshop was to expose students to the types of mathematical problems that arise in industry, thus providing an educational experience complementary to the usual academic program. The student groups were able to make progress on issues that are concerned in real industry problems.

Some results were: 1) computational algorithm for the envelope in a swept surface, necessary for three-dimensional optimal design. 2) Volumetric computed tomography based on data from the helical geometry of the scan, necessary for the next generation of machines. 3) Targeting of unexpected correlations in different speech classifications, suggesting a new direction of study for practical speech recognition algorithms presently in use.

The groups used mathematical techniques from a wide range of areas, including numerical linear algebra, optimization, combinatorics, probability, statistics, differential equations, Fourier analysis, and geometry.

Twenty-one of the students filled out the online evaluation form. Here is a summary of their ratings:

Accommodations:

excellent (4), very good (5), good (9), adequate (3)

Financial information: *excellent (10), very good (8), good (3)*

Information on housing_travel_financial_maps_etc: *excellent (7), very good (13), good (1)*

Problem group:

RF Communication Circuits (5), Network Analysis (3), Language Models (3),

CAD: Surface Intersection (4), Computed Tomography (5), Microactuator Design (1)

Quality of problem:

RF Communication Circuits: excellent (3), very good (2)

Network Analysis: excellent (2), very good (1)

Language Models: excellent (1), very good (1), poor(1)

CAD: Surface Intersection: excellent (4)

Computed Tomography: excellent (2), very good (3)

Microactuator Design: excellent (1)

Mathematical benefits:

RF Communication Circuits: excellent (4), very good (2)

Network Analysis: excellent (2), very good (1)

Language Models: excellent (1), adequate (1), good (1)

CAD: Surface Intersection: excellent (1), very good (2)

Computed Tomograph: excellent (2), very good (2), good (1)

Microactuator Design: excellent (1)

Developing contact with other students was: *excellent (13), very good (4), good (4)*

Short Courses and Tutorials:

Four short courses and tutorials were held during the year and they attracted many graduate students, both to the tutorials and the following workshops.

Short Course: Mathematical Methods in Speech and Image Analysis,

September 11-15, 2000

Speakers: Stu Geman (Applied Mathematics) Brown University, Basilis Gidas, (Applied Mathematics) Brown University, Peter J. Olver (Mathematics) University of Minnesota, Guillermo Sapiro (Electrical & Computer Engineering) University of Minnesota, Jackie Shen (Mathematics) University of Minnesota, Allen Tannenbaum (Electrical & Computer Engineering) Georgia Institute of Technology

For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see:

<http://www.ima.umn.edu/multimedia/fall/t1.html>

Tutorial: Digital Libraries, January 25-26, 2001

Organizer: Ahmed Tewfik (Electrical Engineering) University of Minnesota

Speakers: James D. Johnston (AT&T Laboratories, Research), Shashi Shekhar

(Computer Science, University of Minnesota), Sameh Sowelam (Cognicity Corp.)

For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see:

<http://www.ima.umn.edu/multimedia/winter/tut.html>

Tutorial: Geometric Design, April 19-20, 2001

Speakers: Helmut Pottmann (Institut fuer Geometrie) Technische Universit t Wien,

Stefan Leopoldseder (Institut fuer Geometrie) Technische Universit t Wien

For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see:

<http://www.ima.umn.edu/multimedia/spring/tut7.html>

Tutorial: Computer Graphics, May 10 - 11, 2001

Speakers: Mathieu Desbrun (Computer Science) California Institute of

Technology, Michael Gleicher (Computer Science) University of Wisconsin, Jessica

Hodgins (Computer Science) Carnegie Mellon University, Peter Schr der (Computer

Science) California Institute of Technology

For details about this program, including description, schedule, titles and abstracts, online copies of presentations, and participant lists, see:

<http://www.ima.umn.edu/multimedia/spring/tut8.html>

4. A list of the individuals consulted on the selection of topics for the programs just completed, including their disciplinary specialties and employers.

The IMA directors consulted hundreds of people to select the topics for the 2000-2001 Programs. Most of the consultation was done with the organizers of the annual program and the organizers of each of the workshops (their names, affiliations and disciplines are listed above), and the members of the IMA governance and advisory committees:

IMA Board of Governors

Marsha Berger	Courant Institute, NYU	PDEs
Fan Chung Graham	UC San Diego	Combinatorics
Joan Feigenbaum	Yale University	Computer Science
Bill Gear	NEC Research Institute	Scientific Computation
Richard Karp (chair)	University of Washington	Computer Science
Jon Kettenring	Telcordia Technologies	Networks
Tom Kurtz	University of Wisconsin, Madison	Probability and Statistics
Thomas Magnanti	Massachusetts Institute of Technology	Operations Research
Juan Meza	Sandia National Laboratory	Scientific Computation
De Witt Summers	Florida State University	Math Biology
William Symes	Rice University	Inverse Problems
James Yorke	University of Maryland	Dynamical Systems

Industrial Advisory Committee

Gerard van Oortmerssen	Centrum voor Wiskunde en Informatica (CWI)	Computer Science
David Garrett	Lockheed Martin	Industrial Modeling
David Ross	Eastman Kodak Company	Industrial Modeling
T. Craig Poling	Lockheed Martin	Radar, Scattering
David Chock	Ford Motor Company	Air Quality Modeling
Lawrence Cowsar	Bell Labs, Lucent Technologies	Nonlinear Optics,
Samuel P. Marin	General Motors Corporation	Industrial Modeling
David Sharp	Los Alamos National Laboratories	Complex Systems
Rahul Mehra	Medtronic Inc	Heart Modeling
Allen Cox	Honeywell, Inc.	Diffraction, Maxwell

		Equations
Leonard Borucki	Motorola Inc.	Semiconductor Modeling
William Pulleyblank	IBM Corporation	Optimization
Charles Geisler	Minnesota Technology Incorp.	Industrial Modeling
Lalitha Venkataramanan	Schlumberger-Doll Research	Inverse problems
Albert Gilg	Siemens	Semiconductor modeling
Jon Kettenring	Telcordia Technologies (Bellcore)	Network Modeling
David Misemer	3M Center	Industrial Modeling

Scientific Program Advisory Committee

Avner Friedman	Minnesota Center for Industrial Mathematics	PDEs, Industrial Modeling, Free Boundary problems
Mac Hyman	Los Alamos National Laboratory	Scientific Computation
George Papanicolaou	Stanford University	Probability, PDEs
Emanuel Parzen	Texas A&M University	Statistics
William Pulleyblank (Chair)	IBM Corporation	Optimization

Computational Programs and Resources Advisory Committee

Mitchell Luskin (Chair)	University of Minnesota	Scientific Computation
Douglas Arnold	Penn State	Scientific Computation
George Cybenko	Dartmouth College	Digital Libraries, Networks
Leslie Greengard	Courant Institute	Scientific Computation
Jorge Mor	Argonne National Laboratory	Scientific Computation, Optimization

IMA Participating Institutions Department Heads (in Mathematics departments, unless otherwise noted)

Richard Duke	Georgia Institute of Technology
Dan Maki	Indiana University
Max D. Gunzburger	Iowa State University
Michiel Bertsch	Istituto per le Applicazioni del Calcolo "Mauro Picone" del CNR
Andrew Tonge	Kent State University
Peter Lappan	Michigan State University
Ratnasingham Shivaji	Mississippi State University
William Blair	Northern Illinois University
Peter March	Ohio State University
Gary Mullen	Pennsylvania State University
Carl Cowen	Purdue University
Hyuk Kim	Brain Korea 21 Mathematical Sciences Division
Jongwoo Jeon	Statistical Research Center for Complex Systems (SRCCS), at Seoul National University
William Rundell	Texas A&M University
Robert Fefferman	University of Chicago
Joanna Mitro	University of Cincinnati
Bill Fitzgibbon	University of Houston-University Park
Joseph Rosenblatt	University of Illinois
Paul S. Muhly	University of Iowa
Peter Anton Perry	University of Kentucky
P.M. Fitzpatrick	University of Maryland at College Park
Al Taylor	University of Michigan
Naresh Jain	University of Minnesota
Steven A. Buechler	University of Notre Dame
John Chadam	University of Pittsburgh
Alejandro Adem,	University of Wisconsin at Madison
Lowell Hansen	Wayne State University

Association for Women in Mathematics Advisory Committee

Suzanne Lenhart (chair)	Mathematics, University of Tennessee
Joan Feigenbaum	Computer Science, Yale
Pam Cook	Mathematics, U of Delaware
Denise Kirschner	U of Michigan Medical School

Joint Association for Minorities in Mathematics Advisory Committee

Ray Johnson	Mathematics, University of Maryland
James Turner	Computational Science, Florida State University

5. A brief description of the science in each of the Institute's programs, the collaborations started as a result of the program, and the scientific achievements, including short descriptions of the most significant ones written in laymen's terms.

(Note: At the time that this section is being prepared, the Mathematics in Multimedia programs is not yet over. We are still in the process of collecting research reports and evidence of new collaborations and will post them on our web site at:

www.ima.umn.edu/multimedia/AR/LT.html and www.ima.umn.edu/multimedia/AR/PD.html

as they are received.)

Mission and Theme programs:

The mission of the Institute is to close the gap between theory and applications. This task is two-fold:

- To identify areas of mathematical research related to problems in other sciences and industry.
- To encourage the participation of mathematicians in these areas of application by providing settings conducive to the solution of such problems, and by demonstrating that research mathematics can make a real impact in the sciences.

Implicit in this mission statement is the belief that basic mathematics research is enriched by the challenge of new problems from science and industry. The IMA scientific programs allow mathematicians and other scientists to share a stimulating research environment. Yearly programs are chosen in important areas of emerging opportunities for mathematicians and are designed to encourage interaction between mathematicians and scientists from academia, industry and government laboratories. They feature several periods of concentration and are highlighted by 8-12 workshops. Postdoctoral members, for both annual and industrial programs, are a key component of the IMA programs. They are selected by open competition. Participation by these postdoctoral members is critical to the mission of the IMA, since it is expected that they will use their experience to become leaders in the mathematical-scientific community.

The Mathematics in Multimedia and related workshop program:

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 stimulate new developments in mathematics itself.

A key goal of the multimedia year at the IMA was 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 played an important role in exposing the mathematical community to a new range of challenging and timely mathematical problems and applications. Particular attention was paid to the training of postdoctoral researchers to be familiar with a wide variety of mathematical tools and techniques that should lay the foundations for a genuinely mathematical discipline that will become known as "multimedia." This IMA year provided a unique and unprecedented opportunity to bring together researchers in a wide variety of mathematical disciplines and applications to focus on multimedia. 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.

It is much too early to judge the ultimate success of this effort, but the following reports and vignettes show that a great deal of progress was made, both in the Multimedia and in the IMA Industrial program:

DTED Seminar (Ron DeVore, Nira Dyn, Peter Schroeder, Vladimir Temlyakov)

Digital Terrain Elevation Data (DTED) are topographical maps giving the altitude at various sampling sites (posts). While they are a tremendous resource, their usefulness is limited by the size and volume of such maps.

There is a great need for processing tools which will enable their storage and fast rendering. This working seminar investigated mathematical tools based on approximation and computer graphics for compression and fast rendering. The participants identified several related mathematical issues based on Kolmogorov entropy in the Hausdorff metric as well as graphics issues based on strategies for efficient triangulation. The seminar met approximately 10 times and should result in both efficient algorithms and interesting mathematical results on entropy.

Fractal Imaging: Michael F. Barnsley, Edward Vrscay and Dietmar Saupe

organized a unique and highly successful IMA Minisymposium: Fractals in Multimedia, January 17-19, 2001. The original goals of the minisymposium were to demonstrate that

fractal mathematics leads to a broad collection of useful mathematical tools, common themes, new ways of looking at and thinking about existing algorithms, and applications in multimedia; and

to consider future developments. However, taking into account that with the development of the Internet, requirements for image compression changed, the organizers extended the original goals to include a particular focus on the following questions.

(i) Where is fractal imaging now, and what has been achieved over the last decade?

(ii) What are the goals of fractal imaging over the next decade, and how might they be achieved?

The meeting itself provided a very good picture of the present areas of fractal imaging and fractal image compression. The meeting provided a unique opportunity for the fractal imaging community to get together and lay plans for future work.

Furthermore, at the meeting on the Saturday morning following the formal meeting it was decided to go forward with an IMA proceedings volume, focused particularly on Where we are now and The future. Future researchers will be able to dovetail their efforts and join in with the program.

Futhermore the group decided to produce a Twenty-First Century Volume on Second Generation Fractal Imaging. Work on this volume will begin in 2002. The goal of the volume will be to set the ball rolling in the direction of applications of the (yet to be discovered) solution to the fractal inverse problem. The group hopes to have an IMA conference or workshop in the summer of 2002 to start work on this volume. They intend to establish an informal group of interested researchers, initially centered on the participants at the minisymposium, to communicate by e-mail list and a selected Web Site, focused on progress towards fractal imaging. This will be done through the IMA Research Communities Web Site.

Best Basis Selection (Ron DeVore, Guergana Petrova, and Vladimir Temlyakov)

This group met informally several times at the IMA and were able to prove interesting theorems on how

to choose a best basis from a library of bases for approximation. In a nutshell, their results extend David Donoho's theory for L_2 to approximation in L_p , $p \neq 2$. These results are important for understanding the role of best basis selection in image processing.

PDE and Wavelet Based Image processing (Ron DeVore and Guillermo Shapiro)

DeVore and Shapiro met several times to discuss the advantages of each approach. They have identified

several problems to help clarify the roles of each method and the possible fusing of techniques from each area.

Initiated by **Helmuth Pottman**'s Tutorial talk on Classical Geometry and Geometric Computing, **Tom Duchamp** got interested in the problem of approximating or interpolating closed curves with developable surfaces. He came up with a very promising approach to this topic, whose practical relevance is for example in blankholder surface design for sheet metal forming tools.

Helmuth Pottman and **Nira Dyn** worked on nonlinear subdivision schemes for dual planar curves, spherical curves, developable surfaces and ruled surfaces. They developed algorithms and could numerically verify the expected results of the algorithms. They hope that this will lead to a nice geometric analysis of a class of nonlinear nonstationary subdivision schemes.

Vladimir Temlyakov and **Adam Lutoborski** examined greedy type algorithms with regard to redundant systems (dictionaries). They studied theoretical greedy type algorithms: a Vector Weak Greedy Algorithm, a Vector Weak Orthogonal Greedy Algorithm. These algorithms are defined by weaker assumptions than their analogs the Pure Greedy Algorithm, and Orthogonal Greedy Algorithm. The weaker assumptions make these new algorithms more ready for practical implementation. The "vector" type greedy algorithms allow them to approximate simultaneously a given finite set (vector) of elements. They have proved the convergence theorems and also have given estimates for the rate of approximation by means of these algorithms. The convergence and the estimates apply to approximation from an arbitrary dictionary in a Hilbert space. They are working on a paper.

Nyra Dyn, Tom Duchamp, and Gunter Griener held a working seminar on 3D subdivision. The first issue was the subdivision of 3D to regular tetrahedra, and the corresponding refinement step. They made considerable progress in defining the subdivision scheme, in understanding the underlying subdivision of space to tetrahedra and in adapting the scheme to non-regular tetrahedrizations.

Nyra Dyn and Postdoc Bin Han started a collaboration on the construction of factorizable interpolatory subdivision schemes, which are simpler to implement and which have good smoothness properties. They also started a project on Geometry-based interpolatory subdivision schemes, which use in addition to location information also normal information. A univariate geometry-based algorithm was implemented by Bin Han, giving good performance, and they expect to construct an analogous one for surfaces, analyze and implement it.

Tom Duchamp reports:

When I first agreed to participate for a full three months (April--June) in the Multimedia program at the IMA, I expected to spend most of that time engaged in my own research; beginning new research projects and developing profitable collaborations with other researchers was an unexpected bonus. I attribute that to two things:

- the mix of long term visitors combined with a series of stimulating workshops on various aspects of multimedia sponsored by the IMA
- the unique mix of mathematicians, statisticians, engineers, and computer scientists that the IMA fosters.

A brief description of some of my activities at the IMA during my stay follows.

B. Collaborative Projects.

1. During the Workshop in Geometric Design April 23-27, I had several discussions with **Helmut Pottmann** and **Miriam Lucian** about a special family of ruled surfaces called **developable surfaces**. They are of interest in the aerospace industry because they model physical surfaces that can be made from a single flat metal sheet without stretching. Most surfaces are not developable, but an object composed of a small number of approximately developable surfaces could be fabricated from flat metal sheets with only a small amount of stretching. For this reason, developable surfaces are of great interest to the aerospace industry.

This leads to the following mathematical problem: given a smooth simple closed curve, find a ruled surface that is bounded by the curve and is as close to a developable surface as possible. Although we have not yet solved the problem, our conversations have led to at least one promising approach based on techniques from the calculus of variations, one that I plan to investigate over the next few months.

2. In April, **Nira Dyn**, **Gunter Griener** and I conducted a daily working seminar devoted to 3D subdivision methods. These methods have important applications to geometric modeling; they also have potential applications to the solution of partial differential equations, especially to nonlinear elasto-dynamics. Our first goal was to study the regular case where space is tessellated by congruent tetrahedra. The seminar continued after Gunter left, during May and June. We succeeded in constructing a C^2 -subdivision rule in the regular case, and we have made some progress toward extending it to an arbitrary triangulation of a compact 3D-manifold.

3. Part of my research in April, May, and June involved continuing a project with my colleague **Werner Stuetzle** of the University of Washington on the application of subdivision surfaces to function estimation on Riemannian surfaces of arbitrary topology and geometry. Such function estimation is a fundamental problem in statistics. We are now writing a research paper containing this work. The IMA funded a two-week long visit by Stuetzle in April, during which time we made substantial progress toward the completion of the paper. We plan to submit our work for publication by the end of August.

In addition to the collaborative projects already mentioned in which he participated, **Peter Schroder** reports;

During my 3 month research stay at the IMA I have continued a number of active research projects and started several new ones. The latter in particular were of an entirely serendipitous nature and greatly facilitated through interactions of myself and other visitors of the IMA .

Differential Geometric Interpretation of Thin-Shell Theories: In a very fresh interaction between **Tom Duchamp** and myself we have begun work on a purely differential geometry (i.e., geometric invariant) based interpretation of Kirchhoff-Love type theories describing the mechanical behavior of thin-shells. Typical finite element approaches based on standard mechanics tensor analysis yield very complex, unwieldy and error prone expressions of the energies and their variational derivatives as needed by standard non-linear root finders which need to be employed to eventually solve the time discretized PDE. In particular the resulting expressions provide no insight as to which terms are most important and which other terms may be eliminated while staying within the approximations already implied by the application of the FEM method. Since the mechanics of such shells are based on invariant measures a different approach attempts to express the material model entirely in terms of invariant differential geometric quantities providing more insights into the relative importance of different terms. It is hoped that this will eventually lead to a formulation of the governing equations in terms of appropriate discrete operators which are well defined for irregular meshes. Such a formulation would promise great performance improvements.

Other Work: I continue to work in a collaboration with Peter Oswald on novel $\sqrt{3}$ -subdivision schemes. This work has benefited from discussions with **Denis Zorin** during his visit to the IMA. With a student at Caltech I am working on variational subdivision. This work has been enhanced by discussions with **Gnter Greiner** during his visit to the IMA. Interactions with **Michael Gleicher** during his visit have informed my work with a postdoc and student back at Caltech on animation of subdivision surfaces and have inspired a visit of myself to the University of Wisconsin. There are numerous other smaller examples of interactions. My main takeaway from this visit is just how valuable it is to visit with other people and spend meaningful time (not just a few hours at a conference) together. I plan on continuing short working visits to other researchers around the world after my return to Caltech.

Michael Brenner, one of the organizers of the workshop **Analysis and Modeling of Industrial Jetting Processes**, January 10 - 13, 2001 describes what a great success it was:

The meeting was a success beyond my expectation. Not only were the large majority of the talks of extremely high quality, but they complemented themselves very well, and in ways we did not anticipate when putting the program together. As an example, at least four speakers dealt with the phenomenon of a spherical drop of fluid splashing on a solid surface: **David Wallace** from MicroFab, our first speaker, described how the details of this question are crucial for depositing solder drops onto Flip-Chip semiconductor devices; Our third speaker, **Ely Sachs** from MIT, showed another beautiful example of this in the

context of his three dimensional printing processes: drops depositing on a powder layer create craters, which limits the precision of their engineering. Then we had two, more scientific speakers, who touched on this subject: **D. Poulikas** from ETH showed his numerical simulations which clearly established the phenomenon as due to capillary waves. And then **David Quere**, from College de France, showed his beautiful experiments of drops bouncing on hydrophobic surfaces, which exposed the various regimes of bouncing drops. One of David's drops lifted off the solid surface in a shape close to a "baseball bat", which then oscillated through a complex series of shapes. Rather remarkably, another of our speakers, **Osman Basaran** from Purdue, had just presented a numerical simulation of fluid started in a baseball bat shape, and found a sequence of shapes which were very similar to those of Quere. Basaran's "baseball bat shapes" was motivated by a different experiment, the breaking of a pendant drop near a nozzle, a problem discussed in detail by some of the other speakers.

This is just an example of the types of interactions that occurred at the meeting. In a wide range of technologies, the same issues kept coming up again and again, even though the background and motivation of the speakers was very different. The combination of mathematics, engineering and technology at the same meeting allowed everyone to leave with a different perspective on the problems they have been thinking about previously.

Peter J. Olver, one of the organizers made this personal report and assessment of the program:

My research activities this past year concentrated on further development of the applications and theory of my new equivariant theory of moving frames. The moving frame method leads to new algorithms for object recognition and symmetry detection, which were developed in collaboration with colleagues **A. Tannenbaum** and **G. Sapiro** in electrical engineering. Fruitful discussions of the applications of these methods were held with several of the visitors during the fall program.

I recently developed new geometrical foundation for numerical approximations of differential invariants and differential equations, named "multi-space". Applications of the moving frame method in this context leads to a new method for generating symmetry-preserving numerical approximations, of interest in geometric integration, computer vision, and a wide variety of other applications. Extending the initial constructions to functions of several variables has required revisiting the basic theory of multivariate interpolation theory, and several new ideas of interest are under development. Input from several visitors in the spring, particularly **Carl de Boor** and **Nira Dyn**, has been particularly helpful to this project.

The moving frame method gives a solution to a basic problem in the calculus of variations. In collaboration with my former student, **Irina Kogan** we have developed a general method for going directly from the differential invariant formula for an invariant variational problem to its differential invariant Euler-Lagrange equations. Applications in geometry, physics and engineering are under development.

In collaboration with **J. Sanders**, Amsterdam, a remarkable connection between polynomials in classical invariant theory and modular forms via the representation theory of the Heisenberg algebra was established. These results have connections with the algebraic approach to integrable systems. Extensions to the multivariable version is being pursued with **Petitot & Sole** in Universite de Lille, France.

As a result of discussions in the fall, I initiated a collaboration with **Dan Kersten**, Psychology, Minnesota, on statistical analysis of boundaries of natural objects, including statistics of the moving frame signature curve. We co-supervised an undergraduate honors student, **Kristi Walter**, and will be continuing the project this summer.

In collaboration with **J. Sanders and J.P. Wang**, a new theory of “ghost symmetries” for nonlocal partial differential equations was established. The ghosts completely resolve a number of troubling paradoxes that plague the nonlocal theory of symmetries of differential equations.

My Ph.D. student **Mireille Boutin** finished her degree this year. Her thesis applies moving frame methods to equivalence and symmetry detection of polygons including applications in image processing. She was an enthusiastic participant during the program, and will be going to Brown University to work with **David Mumford's** group in computer vision.

As one of the principal organizers, including both computer vision workshops, I was heavily involved in arrangements during the year. I spent a significant amount of time organizing a regular multimedia seminar throughout the year that featured both local and visiting researchers from a broad range of areas. This continued the introductory seminar that was organized at the IMA during the preceding academic year.

My assessment of the program is that, on balance, it was quite successful. The fall, and particularly the spring programs were particularly good, and initiated a number of significant new collaborations among participants. The fall vision program suffered from the cancellation of some long term visitors and the move by Allen Tannenbaum to Georgia Tech, but the two

conferences and the brain imaging workshop were very productive. The speech workshops were outstanding, and it was a great benefit for the postdocs and other visitors to have **Sanjeev Khudanpur** to help explain the basics of Markov models in speech processing. Except in the spring, when quite a few long term visitors were in residence, getting longer term visitors proved to be a problem, and the continuity of the program between workshops and mentoring of postdocs suffered to some extent. In part, this is due to the area, where the top researchers typically run labs and supervise many students and postdocs, and so moving for an extended period is not a viable option.

On balance, the program was very wide ranging and innovative, and helped introduce mathematicians to the extremely broad range of activity in multimedia. Perhaps it may have been better to have more focus, concentrating more on the fall and spring programs; the winter workshops were good, but tended to have less mathematical content. Another suggestion is that the year was divided up among non-overlapping organizing committees, and the interactions between areas, even vision and speech which ran on an interleaved basis, did not connect and interact nearly as much as could have been possible. My recommendation for future programs would be to have at least one or two people involved in the entire year for continuity, and to have more overlap among the committees.

Multimedia Postdoc Jianliang Qian describes well the opportunities for young researchers provided by the IMA program:

As a first year IMA postdoctoral member for the thematic year “Mathematics in Multimedia”, I have actively participated in various activities, including workshops, seminars and tutorials. This provided me with an excellent opportunity to broaden my views of how the mathematics plays a role in the modern multimedia age. During the course of the year, I have also become aware of some new application areas, such as level-set evolution theory for image processing, viscosity solution for image analysis related PDEs, inverse problems for EEG and MEG based on Maxwell equations, just to name a few that come to my mind right away. Of course, I also liked listening to the other applications of various techniques and methods in Multimedia, such as geometrical design and computer graphics.

Aparting from the IMA workshops and seminars, I also took part in IMA Postdoc Seminar and the Applied Mathematics Seminar of School of Mathematics. During the Spring quarter, I was in charge of organizing the Postdoc seminar; I invited several well-known professors in the field to give talks at the Postdoc Seminar: Prof. **Wolfgang Dahmen** at RTH, Aachen who spoke on “Adaptive wavelet methods”, Prof **Adam Lutoborski** from Syracuse University who told us about

“Numerical methods for the procrastus problem”, Prof. Paul Garret from School of Mathematics who spoke on “ Overview of Rijndael, the new Advanced Encryption Standard”. Besides those senior visitors, I also invited other junior visitors to speak on their researches. Of course, I also gave a talk at Postdoc Seminar during the fall quarter. In addition, I was invited to give a talk at the Applied Mathematics Seminar at the School of Mathematics and at the Applied Mathematics Seminar at Michigan State University.

As for my research accomplishments for this year, it is pretty fruitful. I have finished three papers and one in preparation; in addition, I have three papers accepted to publish in Geophysics and Wave Motion and one under review for Journal of Computational Physics:

Qian and Symes, “Paraxial geometrical optics for anisotropic quasi-P waves: theories and numerical methods,” accepted by Wave Motions, 2001.

Qian and Symes, “Paraxial eikonal solvers for anisotropic quasi-P traveltimes,” submitted to Journal of Computational Physics, 2001.

Qian and Symes, “An adaptive finite-difference method for traveltimes and amplitudes in isotropic media,” to appear in Geophysics, 2001.

Qian and Symes, “Finite-difference quasi-P traveltimes for anisotropic media,” to appear in Geophysics}, 2001.

Specifically I have been collaborating other researchers on several different projects. The first project is continuation of my thesis work. I developed a full aperture eikonal solver for quasi-P waves in anisotropic media. There are already two papers out of this project:

Qian, J., Symes, W. W. and Dellinger, J., “A full aperture eikonal solver for quasi-P traveltimes,” submitted to SEG at San Antonio, TX, 2001.

Qian, J. and Symes, W. W., “A paraxial formulation for the viscosity solution of quasi-P eikonal equations,” to be submitted.

The second project is a priori error estimates for monotone schemes for Hamilton-Jacobi (HJ) equations. This is a collaboration with my mentor, Prof. **Bernardo Cockburn**, School of Mathematics. We analysed monotone schemes for HJ equations by using a technique, so-called paraboloid test. We plan to use these techniques to tackle second-order nonlinear PDEs also. Products of this research are:

Cockburn, B., “A priori error estimates for monotone schemes for Hamilton-Jacobi equations”, to be submitted.

The third project is on optical waveguide and near-field optics with Professor **Fadil Santosa** of IMA and Professor **Gang Bao** at Michigan State University. This is a ongoing project.

Reactive Flow Postdoc Yong Jung Kim describes the advantages of the IMA program for the second year of a postdoctoral appointment, in terms of contact with distinguished IMA visitors and the **mentoring** provided by University of Minnesota faculty..

My second year as a postdoctoral member of the IMA was a productive one so far. The project on the metastability in reaction-diffusion equations had the first result, a joint work with **A. E. Tzavaras** (U of WI) accepted by SIAM. The project has been continued as a joint work with Wei-Ming Ni (U of MN) which is about to be submitted. The work with **Shi Jin** (U of WI) regarding the instability of roll waves and a numerical scheme for it has been published recently. I also found a new collaborator, **Bernardo Cockburn** (U of MN). He invited me to his project for error estimation for nonlinear hyperbolic conservation. In the project we consider a posteriori error estimates for discontinuous solutions for the scalar equations with general diffusion and reaction terms in multi-dimensional space.

The most exciting part in my research during my second year in IMA is the development in the theory of the piecewise self-similarity solutions to conservation laws. The potential of such a solution has been found during my first year. The discussions with other IMA postdoctoral members and visitors like **R. DeVore** and **B. Lucier** were very helpful in the development. In the first article the basic idea and properties are introduced together with numerical examples. In the scheme the exact solution is achieved through the self-similarity summations among base functions without time discretization and, hence, we can possibly construct a scheme of complexity order $O(N)$, not $O(N^2)$. This method also has the strength as a analytical tool in the study of long time behavior. In another paper we establish an optimal L^1 convergence rate to N -waves. This project should be an continuing one for a while.

There are several prospects and mysteries. Here I want to remark one of them. The front tracking method for scalar problems can be completely rewritten in this point of view, which is simpler and stronger. But for the systems it is hard to answer. It seems like extensive efforts needed to explore this possibility as it has been required in the development for the front tracking method.

Industrial Postdoc Jayadeep Gopalakrishnan worked with Medtronic in modeling of a surgical procedure called Ablation Therapy. His work has provided valuable insight into the performance of ablation catheters, and in particular, helped understand how to create better designs. He is joining the faculty of the University of Florida in August, and plans to continue collaboration with Medtronic.

Industrial Postdoc Nilima Nigam completed her work with Seagate in modeling of read heads for magnetic disks. Using multipole methods, she was able to create simulation tools of unprecedented capabilities. Her work has allowed Seagate engineers to evaluate

complicated designs for next generation read heads. She is planning to join the faculty of McGill University in Montreal in August.

More detailed research reports from IMA participants are available online at:

www.ima.umn.edu/multimedia/AR/LT.html and
www.ima.umn.edu/multimedia/AR/PD.html

Workshop Feedback: One way in which the IMA assesses the quality of our workshops is through an **online feedback form** that we urge every participant to fill in. A summary of these responses for each of our 2000-2001 workshops is online at:

www.ima.umn.edu/multimedia/AR/FB.html

6. A brief discussion of industrial participation in IMA activities, including research projects, problem seminars, postdoctoral programs, and program planning.

Participation and outreach -- Industrial participation in IMA workshops has been relatively high over the reporting period due to the importance of the Annual Program topic "Multimedia" in industry. The workshops on Vision and Speech, Digital Libraries, and Computer Graphics were particularly well attended by industry participants. Many companies were visited by IMA over the reporting period. The purpose of these visits is to engage industry scientists in IMA programs and to generate new ideas for Hot Topics workshops. The workshops on Noise Modeling (August 2000), E-Auction (December 2000), and Jetting Processes (January 2001) were results of these interactions. These visits also serve to engage companies in our Industrial Postdoctoral program.

Industrial Problems Seminar -- The IMA continued its Industrial Problems Seminar in which we feature industry speakers. We had a total of 14 talks during 2000-2001. The topics were quite varied and provided a good introduction to IMA members about mathematical challenges arising in industrial research. Slides of the talk are available for most of the presentation through the IMA webpage. Some of the speakers took the opportunity to recruit IMA postdocs during their visit.

Program Planning -- The annual Industrial Advisory Board meeting provides corporate participants at the IMA a chance to advise programs that are in the planning stages. IMA also solicits ideas for future programs at this meeting.

Research -- Industry sponsored 4 postdocs during the reporting period. The projects are:

"Research in the telecommunications and information technology", sponsored by Telcordia Technologies; Christine Cheng, postdoc.

"Modeling of Ablation Therapy", sponsored by Medtronic Inc.; Jayadeep Gopalakrishnan, postdoc.

"Modeling of Chemical Mechanical Planarization", sponsored by Motorola; Dimitri Kirill, postdoc.

"Modeling of Read Heads in Magnetic Disc Drives", sponsored by Seagate; Nilima Nigam, postdoc.

7. List of publications arising from the year just completed.

IMA PREPRINTS FROM JUNE 1, 2000 TO PRESENT

JUNE 2000

1708 Henning Struchtrup and John Dold, Surface tension in a reactive binary mixture of incompressible fluids

1709 Henning Struchtrup, Positivity of entropy production and phase density in approximate solutions of the Boltzmann equation

1710 Marcelo Bertalmio, Li-Tien Cheng, Stanley Osher, and Guillermo Sapiro, Variational problems and partial differential equations on implicit surfaces: The framework and examples in image processing and pattern formation

1711 Jayadeep Gopalakrishnan and Joseph E. Pasciak, Overlapping Schwarz preconditioners for indefinite time harmonic Maxwell equations

1712 Cheng-Shang Chang, David D. Yao, and Tim Zajic, Large deviations for processes with long-range dependence, with queueing applications

1713 A.A. Shah, R.W. Thatcher, and J.W. Dold, Stability of a spherical flame ball in a porous medium

1714 Andres Fco. Sol, Shing-Chung Ngan, Guillermo Sapiro, Xiaoping Hu, and Antonio Lopez, Anisotropic 2D and 3D averaging of fMRI signals

1715 Alberto Bartesaghi, Guillermo Sapiro, and Gregory Randall, A system for the generation of curves on 3D brain images

- 1716 Tuncay Aktosun, Martin Klaus, and Cornelis van der Mee, Small-energy asymptotics of the scattering matrix for the matrix Schrödinger equation on the line
- 1717 Tuncay Aktosun and Paul E. Sacks, Potential splitting and numerical solution of the inverse scattering problem on the line
- 1718 H. Struchtrup, M. Luskin, and M.R. Zachariah, A model for kinetically controlled internal phase segregation during aerosol coagulation
- 1719 Nilima Nigam, A variational method for acoustic scattering from a thin penetrable shell
- 1720 Shantanu D. Rane and Guillermo Sapiro, Evaluation of JPEG-LS, the new lossless and near-lossless still image compression standard, for compression of high-resolution elevation data
- 1721 D. Lewis and N. Nigam, A geometric integration algorithm with applications to micromagnetics
- 1722 Tuncay Aktosun and Martin Klaus, Small-energy asymptotics for the Schrödinger equation on the line
- 1723 Yalchin Efendiev, Numerical modeling of formation invasion
- 1724 Yalchin Efendiev, Exact upscaling of transport in porous media and its applications
- 1725 Ilaria Perugia and Dominik Schötzau, The coupling of local discontinuous Galerkin and conforming finite element methods
- 1726 Hongjun Gao and Jinqiao Duan, Averaging Principle for Quasi-Geostrophic Motions under Rapidly Oscillating Forcing
- 1727 J.I. Díaz and J.I. Tello, A mathematical analysis of a model of the growth of necrotic tumors in presence of inhibitors
- 1728 Bernardo Cockburn, Guido Kanschat, Dominik Schötzau, and Christoph Schwab, Local discontinuous Galerkin methods for the Stokes system
- 1729 Jinqiao Duan and Björn Schmalfuß, The 3D quasigeostrophic equation under random perturbation
- 1730 Henri Schurz, On moment-dissipative stochastic dynamical systems
- 1731 Bernardo Cockburn and Chi-Wang Shu, Runge-Kutta discontinuous Galerkin methods for convection-dominated problems

- 1732 J.W. Dold, R.W. Thatcher, and A.A. Shah, Reaction-sheet jump conditions in premixed flames
- 1733 K.R. Schneider and H. Schurz, Waveform relaxation methods for stochastic differential equations
- 1734 Xin-Chu Fu, Weiping Lu, Peter Ashwin, and Jinqiao Duan, Symbolic Representations of Iterated Maps
- 1735 J. Gopalakrishnan and G. Kanschat, A multilevel discontinuous Galerkin method
- 1736 J.I. Diaz and J.I. Tello, On the controllability in a mathematical model of growth of tumors
- 1737 István Gyöngy and Nicolai Krylov, On splitting up method and stochastic partial differential equations
- 1738 F. Andreu, V. Caselles, J.I. Diaz, and J.M. Mazón, Some qualitative properties for the total variational flow
- 1739 E.G. Kalnins, J.M. Kress, G. Pogosyan, and W. Miller, Jr., Completeness of superintegrability in two dimensional constant curvature spaces
- 1740 Irina A. Kogan and Peter J. Olver, Invariant Euler-Lagrange equations and the invariant variational bicomplex
- 1741 Henri Schurz, Moment attractivity, stability and contractivity exponents of stochastic dynamical systems
- 1742 S. Huang, Y. Yang, and K. Anderson, A theory of finitely durable goods monopoly with used-goods market and transaction costs
- 1743 Tony F. Chan and Jianhong Shen, Non-texture inpainting by curvature-driven diffusions (CDD)
- 1744 Bin Han, Symmetric real-valued orthonormal scaling functions with compact support in $L^2(\mathbb{R}^s)$
- 1745 John Oliensis and Yacup Genç, Fast and accurate algorithms for projective multi-image structure from motion
- 1746 John Oliensis and Yacup Genç, Three algorithms for 2-image and 2-image structure from motion
- 1747 Douglas N. Arnold, Franco Brezzi, Bernardo Cockburn, and L. Donatella Marini, Unified analysis of discontinuous Galerkin methods for elliptic problems

- 1748 Gabriele Gorla, Victoria Interrante, and Guillermo Sapiro, Growing fitted textures
- 1749 Tuncay Aktosun and Ricardo Weder, Inverse scattering with partial information on the potential
- 1750 Robert Gulliver and Walter Littman, Chord uniqueness and controllability: The view from the boundary, I
- 1751 Luca Rondi, Uniqueness for the determination of sound-soft defects in an inhomogeneous planar medium by acoustic boundary measurements
- 1752-1 Danny Dunlavy, Sookhyung Joo, Runchang Lin, Roummel Marcia, Aurelia Minut, and Jianzhong Sun (Robert Melville, mentor) Numerical Steady-State Solutions of Non-Linear DAE's Arising in RF Communication Circuit Design
- 1752-2 Suzanne Lynch Hruska, Maria Kiskowski, Jennifer Lefeaux, Kevin McCleary, Dany Ngouyassa, Bryan Smith (Joan Bachenko, mentor), Optimizing Language Models for Speech Recognition
- 1752-3 Thomas Grandine, Bogdan Craciun, Noel Heitmann, Brian Ingalls, Quoc Thong Le Gia, Miao-jung Ou, and Yen-his Richard Tsai (Thomas Grandine, mentor), The Bivariate Contouring Problem
- 1752-4 Jicun Hu, Chris Ingrassia, Svenja Lowitzsch, Jang Park, Angel Pineda, Daniel Reynolds, and Nicholas Valdivia (S.K. Patch, mentor), Second Order Solution of Fritz John's Ultrahyperbolic PDE for Volumetric Computed Tomography
- 1752-5 Ariel Cintron-Arias, Norman Curet, Lisa Denogean, Robert Ellis, Corey Gonzalez, Shobha Oruganti, and Patrick Quillen (Norm Curet, mentor), A network diversion vulnerability problem
- 1752-6 Y. Chung, Z. Lavicza, H. Lim, D. Malonza, M. Song, and N. Tarfulea (David Ross, mentor), The Design of a Microactuator
- 1753 Alvaro Pardo and Guillermo Sapiro, Visualization of high dynamic range images
- 1754 Facundo M moli and Guillermo Sapiro, Fast computation of weighted distance functions and geodesics on implicit hyper-surfaces
- 1755 Bin Han, Symmetry Property and Construction of Wavelets With a General Dilation Matrix
- 1756 Bin Han, Projectable Multivariate Wavelets

- 1757 Tony F. Chan, Sung-Ha Kang, and Jianhong Shen, Euler's elastica and curvature based inpaintings
- 1758 Dongho Chae and Oleg Yu. Imanuvilov, Non-topological multivortex solutions to the self-dual Maxwell-Chern-Simons-Higgs systems
- 1759 Jinqiao Duan and Benjamin Goldys, Ergodicity of Stochastically Forced Large Scale Geophysical Flows
- 1760 Igor Chueshov, Jinqiao Duan, and Björn Schmalfuss, Probabilistic Dynamics of Two-Layer Geophysical Flows
- 1761 Gerhard O. Michler, Report on the retrodigitization project "archiv der mathematik"
- 1762 Anand Singh and H.S. Dhimi, Procreation of inner product space for generalized B-function
- 1763 S.I. Betelu and M.A. Fontelos, Capillarity driven spreading of power-law fluids
- 1764 Paul Castillo, Performance of discontinuous Galerkin methods for elliptic PDE's
- 1765 H.S. Dhimi, Words standarization by non-parametric statistical methods
- 1766 Shantanu D. Rane, Guillermo Sapiro, and Marcelo Bertalmio, Structure and texture filling-in of missing image blocks in wireless transmission and compression applications
- 1767 Avner Friedman and J. Ignacio Tello, Stability of solutions of chemotaxis equations in reinforced random walks
- 1768 S. Betelu, A. Tannenbaum, and G. Sapiro, A method for denoising textured surfaces
- 1769 Michael Galbraith, A geometric-optics proof of a theorem on boundary control given a convex function
- 1770 Tony F. Chan and Jianhong Shen, Morphologically invariant PDE inpaintings
- 1771 N.V. Krylov, A simple proof of a result of A. Novikov
- 1772 M. Bertalmio, A.L. Bertozzi, and G. Sapiro, Navier-Stokes, Fluid Dynamics, and Image and Video Inpainting
- 1773 Igor Chueshov, Jinqiao Duan, and Björn Schmalzfuß, Navier-Stokes, Fluid Dynamics, and Image and Video Inpainting
- 1774 Ilaria Perugia and Dominik Schtzau, The hp-local discontinuous Galerkin method for low-frequency time-harmonic Maxwell's equations

- 1775 George Avalos and Irena Lasiecka, Exact controllability of structural acoustic interactions
- 1776 Nira Dyn and Elza Farkhi, Spline subdivision schemes for compact sets with metric averages
- 1777 Vittorio Cristini, John Lowengrub, and Qing Nie, Nonnecrotic tumor growth and the effect of vascularization. I. Linear analysis and self-similar evolution
- 1778 V. Cristini and J. Lowengrub, Three-dimensional crystal growth. I. Linear analysis and self-similar evolution
- 1779 V. Cristini, M. Simeone, S. Guido, R. Hooper, and C.W. Macosko, Lamellar microstructure of emulsions
- 1780 Russell Hooper, Vittorio Cristini, Sundeep Shakya, John S. Lowengrub, Jeffrey J. Derby, and Christopher W. Macosko, Modeling multiphase flows using a novel 3D adaptive remeshing algorithm
- 1781 Vittorio Cristini, Jerzy Blawdziewicz, and Michael Loewenberg, An adaptive mesh algorithm for evolving surfaces: Simulations of drop breakup and coalescence
- 1782 Jerzy Blawdziewicz, Vittorio Cristini, and Michael Loewenberg, Critical behavior of drops in linear flows: I. Phenomenological theory for drop dynamics near critical stationary states
- 1783 Yuriko Y. Renardy and Vittorio Cristini, Effect of inertia on drop breakup under shear
- 1784 Yuriko Y. Renardy and Vittorio Cristini, Scalings for fragments produced from drop breakup in shear flow with inertia
- 1785 Y. Renardy, V. Cristini, and J. Li, Drop fragment distributions under shear with inertia
- 1786 Yuriko Y. Renardy and Michael Renardy, A new volume-of-fluid formulation for surfactants and simulations of drop deformation under shear at a low viscosity ratio

All of these preprints are available on the IMA web site at:
<http://www.ima.umn.edu/2000-2001research.html>

**MANUSCRIPTS RECEIVED TO DATE FOR THE IMA PROCEEDINGS
FOR 2000-2001 PROGRAM ON MATHEMATICS IN MULTIMEDIA**

MATHEMATICAL FOUNDATIONS OF SPEECH PROCESSING AND RECOGNITION, (September 18-22, 2000) AND
MATHEMATICAL FOUNDATIONS OF NATURAL LANGUAGE MODELING (October 30-November 3, 2000)

Editors: Roni Rosenfeld, Sanjeev Khudanpur, Mari Ostendorf, and Mark Johnson

Switching dynamic system models for speech articulation and acoustics by Li Deng

Semiparametric filtering in speech processing by Benjamin Kedem and Konstantinos Fokianos

An introduction to locally linear embedding by Lawrence K. Saul and Sam T. Roweis

SHORT COURSE: MATHEMATICAL METHODS IN SPEECH AND IMAGE ANALYSIS, SEPTEMBER 11-15, 2000

IMAGE PROCESSING AND LOW LEVEL VISION, October 16-20, 2000

IMAGE ANALYSIS AND HIGH LEVEL VISION, November 13-17, 2000

Editors of the combined volume: Peter Olver and Allen Tannenbaum

A large deviation theory analysis of Bayesian tree search by James M. Coughlan and A.L. Yuille

Expectation-based, multi-focal, saccadic vision (Understanding dynamic scenes observed from a moving platform) by Ernst D. Dickmanns

Monge-Kantorovich problem and image warping by Steven Haker and Allen Tannenbaum

Analysis and synthesis of visual images in the brain: Evidence for pattern theory by Tai Sing Lee

IMA "HOT TOPICS" WORKSHOP: MATHEMATICS OF THE INTERNET: E-AUCTION AND MARKETS, December 3-5, 2000

Editors: Brenda Dietrich and Rakesh Vohra

Auctioning telecommunications bandwidth with guaranteed quality of service by G. Anandalingam and Neil J. Keon

Linear Programming and Vickrey Auctions by Sushil Bikhchandani, Sven de Vries, James Schummer, and Rakesh V. Vohra

An integer programming formulation of the bid evaluation problem for coordinated tasks by John Collins and Maria Gini

A column generation approach for combinatorial auctions by Brenda Dietrich and John J. Forrest

Price negotiations for procurement of direct inputs by Andrew J. Davenport and Jayant R. Kalagnanam

An iterative online auction for airline seats by Marta Eso

Pricebot dynamics by Suzhou Huang, Kevin Anderson, and Yong Yang

Threshold pricing for selling network capacity through forward contracts by Steve G. Lanning, W.A. Massey, and Qiong Wang

Modeling Opportunities in Auctions by Michael H. Rothkopf

IMA MINISYMPOSIUM: FRACTALS IN MULTIMEDIA, January 17-19, 2001
Editors: Michael F. Barnsley, Dietmar Saupe, and Edward Vrscay

Iterated function systems for lossless data compression by Michael F. Barnsley

On the statistics of dimension: Fractional dynamics and fractal modulation
by J.M. Blackledge, S. Mikhailov and M.J. Turner

A web-based fractal geometry course for non-science students by Michael Frame

Fractal image compression with fast local search by Raouf Hamzaoui and Dietmar Saupe

Using the Picard contraction mapping to solve inverse problems in ordinary differential equations by H.E. Kunze and E.R. Vrscay

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Iterated data mining techniques on embedded vector modeling by Ning Lu

Self-affine vector measures and vector calculus on fractals by F. Mendivil and E.R. Vrscay

On engineering the appearance of cyberspace by F. Kenton Musgrave

Uniqueness of invariant measures for place-dependent random iterations by Orjan Stenflo

From fractal image compression to fractal-based methods in mathematics by Edward R. Vrscay.

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Editors: Carlos Castillo-Chavez with Sally Blower, Pauline van den Driessche, Denise Kirschner, and Abdul-Aziz Yakubu

PARTIAL LIST OF PAPERS WRITTEN/PUBLISHED BY IMA PARTICIPANTS

J. Amendariz, Evaporation and Combustion of Thin Films of Liquid Fuels, *J. Fluid Mech.*, 435 (2001) pp.351-376.

J. Armendariz, Effects of nonsoluble surfactants at a liquid-vapor interface of a burning thin film, To be submitted.

Superintegrability in two dimensional complex Euclidean space}, E.G. Kalnins, W. Miller and G.S. Pogosyan, in ``Algebraic Methods in Physics, A Symposium for the 60th Birthdays of Jiri Patera and Pavel Winternitz'', Yvan Saint-Aubin and Luc Vinet, eds., CRM Series in Mathematical Physics, Springer , New York, 2001

Coulomb-oscillator duality in spaces of constant curvature, E. G. Kalnins, W. Miller and G. S. Pogosyan, J. Math. Phys. 41, 2629-2657, (2000)

Completeness of multiseparable superintegrability in $E(2,C)$, E.G. Kalnins, W. Miller and G.S. Pogosyan, J.Phys.A: Math Gen. 33,4105, (2000)

Completeness of multiseparable superintegrability on the complex 2-sphere, E.G. Kalnins, W. Miller and G.S. Pogosyan, J. Physics A: Math. Gen. 33, 6791-6806, (2000)

Completeness of superintegrability in two-dimensional constant curvature spaces, E.G. Kalnins, J. Kress, W. Miller and G.S. Pogosyan, J. Phys. A: Math Gen. 34. 4705--4720, (2001)

Y. Efendiev and L. Durlofsky, ``Numerical Modeling of Subgrid Heterogeneity in Two Phase Flow Simulations'', submitted to Water Resour. Res, 2001

Y. Efendiev, M. Luskin, H. Struchtrup and M. R. Zachariah, ``Hybrid sectional model for coagulation and phase segregation in binary liquid nanodroplets'', submitted to Nanoparticle Res., 2001

Y. Efendiev and M. R. Zachariah, ``A model for two-component aerosol coagulation and phase separation: A method for changing the growth rate of nanoparticles'', Chem. Eng. Sci, in press, 2001

Y. Efendiev and M. R. Zachariah, ``Hybrid Monte-Carlo method for Simulation of Two-Component Aerosol Coagulation and Phase Segregation'', J. Colloid Inter. Sci., submitted, 2001

Affine Invariant Erosion of 3D Shapes, S. Betelu, G. Sapiro, A. Tannenbaum, accepted at the ICCV'2001 conference in computer vision \label{erosion}.

Focusing of non-circular self-similar shock waves, S. Betelu and D. Aronson, submitted to Physical Review Letters \label{gasdynamics}.

Capillarity driven spreading of power-law fluids, S. Betelu and M. Fontelos,
submitted to Applied Mathematics Letters and IMA preprints
\label{nonnewtonian}.

A method for denoising surfaces with shape texture, S. Betelu, G. Sapiro, A. Tannenbaum, for the SIAM Conference on Imaging Science 2001
\label{smoothing}.

Noise Resistant area-based medial axis of planar curves, S. Betelu, G. Sapiro and A. Tannenbaum, submitted to Pattern Recognition \label{skeleton}.

Y. Efendiev and L. Durlofsky, ``Numerical Modeling of Subgrid Heterogeneity in Two Phase Flow Simulations'', submitted to Water Resour. Res, 2001

Y. Efendiev, M. Luskin, H. Struchtrup and M. R. Zachariah, ``Hybrid sectional model for coagulation and phase segregation in binary liquid nanodroplets'', submitted to Nanoparticle Res., 2001

Y. Efendiev and M. R. Zachariah, ``A model for two-component aerosol coagulation and phase separation: A method for changing the growth rate of nanoparticles'', Chem. Eng. Sci, in press, 2001

Y. Efendiev and M. R. Zachariah, ``Hybrid Monte-Carlo method for Simulation of Two-Component Aerosol Coagulation and Phase Segregation'', J. Colloid Inter. Sci., submitted, 2001

J. Gopalakrishnan (with J. E. Pasciak) ``Overlapping Schwarz preconditioners for indefinite time harmonic Maxwell equations'' Math.~Comp.(accepted)

J. Gopalakrishnan (with J. E. Pasciak) ``A multigrid algorithm for time harmonic Maxwell equations'' (with J. E. Pasciak and L. Demkowicz) in preparation.

B. Han, Symmetry property and construction of wavelets with a general dilation matrix, submitted to Linear Alg. Appl., IMA preprint 1755

B. Han, Projectable multivariate wavelets, submitted to Appl. Comput. Harmon. Anal., IMA preprint 1756

B. Han, The initial functions in a subdivision scheme, submitted to Approximation Theorem X (Conference proceeding edited by C. A. Chui, L. L. Schumaker and J. Stoeckler).

B. Han, Computing the Smoothness Exponent of a Symmetric Multivariate Refinable Function, submitted to SIAM J. Matrix Anal. Appl.

B. Han, Examples of bivariate Hermite spline refinable functions, ready to be submitted.

"The dynamics of a viscous flow in a channel with a sudden expansion,"
Hawa, T. and Rusak, Z., Journal of Fluid Mechanics, 436, pp.283-320,
2001.

"Viscous flow in a slightly asymmetric channel with a sudden
expansion," Hawa, T. and Rusak, Z., Physics of Fluids, 12, 9, pp.2257-
2267, September 2000.

"Detonation evolution due to an initial temperature gradient," Kapila,
A., Schwendeman
D., Quirk, D., and Hawa, T., IMA Proceedings, (submitted).

"Numerical-asymptotic expansion matching for computing a viscous flow
around a sharp corner," Hawa, T. and Rusak, Z., Theoretical and
Computational Fluid Dynamics, (submitted in August 2000).

"The dynamics of detonation due to an initial temperature gradient,"
Hawa, T., Schwendeman D., and Kapila A., Bulletin of American Physical
Society, 45, (9), 148, November 2000.

Y.-J. Kim and A.-E. Tzavaras, Diffusive N-waves and Metastability in
Burgers equation},
SIAM J. Math. Anal., to appear.

Y.-J. Kim and W.-M. Ni Convergence rate of the Burgers equation to N-
waves, preprint.

S. Jin and Y.-J. Kim, On the computation of roll waves. Math. Model.
Num. Anal. 35 (2001), 463--480.

B. Cockburn, A simple introduction to error estimation for nonlinear
hyperbolic conservation laws. preprint,
<ftp://ftp.math.umn.edu/pub/misc/cockburn/ee.ps.gz>

Y.-J. Kim, Piecewise Self-similar Solutions and a Numerical Scheme for
Scalar
Conservation Laws. (Siam J. Numer. Anal., submitted)

Y.-J. Kim, Piecewise Self-similar Solutions and Asymptotic Behavior in
Scalar Conservation Laws. preprint.

A. Novikov, G. Papanicolaou, "Eddy viscosity of cellular flows"
Journal of Fluid Mechanics (to appear)

Hsiao, G.C. and Nigam, N., "A transmission problem in the exterior of a
thin domain",
Quaderni di Matematica, 2000, "Proceedings in memory of G. Fichera"

Hsiao, G.C. and Nigam, N., "A problem in fluid-structure interactions",
submitted, 2000

Hsiao, G.C. and Nigam, N., "An interesting result regarding propagation
of elastic waves in thin shells", in preparation , 2001

Wang, Lei X. and Nigam, N., "A fast algorithm for 3-D micromagnetics
computations",

in preparation for submission to the IEEE , 2001

Nigam,N., A variational method in acoustics related to an impenetrable scatterer coated by a thin penetrable shell, SIAM Waves Conference Proceedings, 2000,

Lewis, D. and Nigam, N., A geometric integration algorithm with applications to micromagnetics, IMA preprint series, 2000

Nigam,N., A variational method for acoustic scattering from a thin penetrable shell,
IMA preprint series, 2000, no. 1719

Lewis, D. and Nigam,N., A higher-order Lie group integrator for micromagnetics, in preparation, 2001,

George Hsiao and Peter Monk and Nilima Nigam, Error analysis of a finite element-integral equation scheme for approximating the time-harmonic Maxwell system, SIAM J. Numer. Anal.,
2000, submitted

Monk,P. and Nigam,N., A combined finite element-fast multipole method for approximating the time-harmonic Maxwell system, in preparation, 2000

Qian and Symes, ``Paraxial geometrical optics for anisotropic quasi-P waves: theories and numerical methods,`` accepted by Wave Motions}, 2001.

Qian and Symes, ``Paraxial eikonal solvers for anisotropic quasi-P traveltimes,`` submitted to Journal of Computational Physics, 2001.

Qian and Symes, ``An adaptive finite-difference method for traveltimes and amplitudes in isotropic media,`` to appear in Geophysics}, 2001.

Qian and Symes, ``Finite-difference quasi-P traveltimes for anisotropic media,`` to appear in Geophysics}, 2001.

Cockburn, B., ``A priori error estimates for monotone schemes for Hamilton-Jacobi equations``, to be submitted.

Dirk Horstmann `` Localization in Lattice and Continuum Models of Reinforced Random Walks``, joint work with H.G. Othmer and K.J. Painter (in preparation)

Dirk Horstmann `` Aggregation under Local Reinforcement: From Lattice to Continuum``, joint work with H.G. Othmer and K.J. Painter (in preparation)

Paul Tupper ``Adaptive model reduction for chemical kinetics." BIT (submitted)

Paul Tupper ``Constructing SDEs from ODEs with random data" Journal of Statistical Physics (submitted)

John Lowengrub, Almost Optimal Convergence of the Point Vortex Method for Vortex Sheets using Numerical Filtering, with R.C. Caflish and T.Y. Hou, *Math. Comp.*, 68, pp. 1465-1496, 1999.

John Lowengrub, Topological Transitions in Liquid/Liquid Interfaces, with J. Goodman, H. Lee, E. Longmire, M.J. Shelley and L. Truskinovsky, *Chapman & Hall/CRC Res. Notes Math*, 409 (Free Boundary Problems: Theory and Applications, Crete 1997), pp. 221-236, 1999.

John Lowengrub, Microstructural Evolution in Orthotropic Elastic Media}, with P.H. Leo and Q. Nie, *J. Comp. Phys.*, 157, pp. 44-88, 2000.

John Lowengrub, Focusing of an elongated hole in porous medium flow, with S.B. Angenent, D.G. Aronson and S.I. Betelu, *Physica D* 151 (2001), 228-252.

John Lowengrub, A Comparison of Experiments and Simulations on Pinch-Off in Round Jets, with E.K. Longmire and D.L. Gefroh, to appear in *Proceedings of the 1999 ASME/JSME Meeting*, San Francisco.

John Lowengrub, Boundary Integral Methods for Multicomponent Fluids and Multicomponent Materials}, with T.Y. Hou and M.J. Shelley, to appear *J. Comp. Phys.*, 2001.

John Lowengrub, Measurement and modeling of latent heat release during freezing in a small container, with R. V. Devireddy, J.C. Bischof, P.H. Leo, to appear in *Proceedings of the International Mechanical Engineering Exposition (IMECE-2000)*.

John Lowengrub, Modelling Pinchoff and Reconnection in a Hele-Shaw Cell Part I: The Models and their Calibration}, with H. Lee and J. Goodman, *Phys. Fluids*, to appear.

John Lowengrub, Modelling Pinchoff and Reconnection in a Hele-Shaw Cell Part II: The Analysis and Simulation in the Nonlinear Regime}, with H. Lee and J. Goodman, *Phys. Fluids*, to appear.

John Lowengrub, Modeling multiphase flows using a novel 3D adaptive remeshing algorithm, with R. Hooper, V. Cristini, S. Shakya, J. Derby and C. Macosko, to appear, *Proceedings of the First International Conference on Computational Methods in Multiphase Flow*

John Lowengrub, On an Elastically Induced Splitting Instability, with P.H. Leo and Q. Nie, to appear *Acta Metall.*

John Lowengrub, Measurement and numerical analysis of freezing in solutions enclosed in a small container, with R. Devireddy, P. Leo and J. Bischof, to appear *Int. J. Heat Mass Transfer*.

John Lowengrub, Three-dimensional crystal growth. I. Linear analysis and self-similar evolution}, submitted to *J. Crys. Growth*, with V. Cristini.

John Lowengrub, Nonnecrotic tumor growth and the effect of vascularization, submitted to *J. Math. Biol.*, with V. Cristini and Q. Nie.

- Olver, P.J., Sanders, J., Transvectants, modular forms, and the Heisenberg algebra, *Adv. Appl. Math.*, 25 (2000) 252--283
- Olver, P.J., Joint invariant signatures, *Found. Comput. Math.*, 1 (2001) 3--67
- Olver, P.J., Geometric foundations of numerical algorithms and symmetry, *Appl. Alg. Engin. Commun. Comput.*, 11 (2001) 417--436
- Olver, P.J., Moving frames --- in geometry, algebra, computer vision, and numerical analysis, *Foundations of Computational Mathematics*, R. DeVore, A. Iserles and E. Suli, eds., London Math. Soc. Lecture Note Series, vol. 284, Cambridge preprint, University Press, Cambridge, 2001, pp. 267--297
- Foursov, M.V., Olver, P.J., Reyes, E.G., On formal integrability of evolution equations and local geometry of surfaces, *Diff. Geom. Appl.*, to appear.
- Olver, P.J., Lie groups and differential equations, *Handbook on the Heart of Algebra*, A.V. Mikhalev and G.F. Pilz, eds., Kluwer Acad. Publ., Dordrecht, Netherlands, to appear
- Olver, P.J., The canonical contact form, submitted.
- Kogan, I.A., Olver, P.J., Invariant Euler-Lagrange equations and the invariant variational bicomplex, submitted.
- Kogan, I.A., Olver, P.J., The invariant variational bicomplex, *CBMS Workshop Proceedings*, Howard University, to appear.
- Olver, P.J., Sanders, J., Wang, J.P., Ghost symmetries, submitted.
- Olver, P.J., Moving frames: a brief survey, *SPT2001 proceedings*, Sardinia, to appear.
- Lewis, D., Olver, P.J., Geometric integration algorithms on homogeneous manifolds, in preparation.
- Olver, P.J., Multivariate interpolation and quasideterminantal factorization, in preparation.
- Olver, P.J., Multi--space, in preparation.

8. A report on specific efforts to include women and members of underrepresented groups in the programs and workshops at IMA.

The inclusion of members of members underrepresented groups is of great importance to the IMA. It is worth noting that in the context of Mathematics, women constitute an underrepresented

group, and therefore maximizing the participation of women mathematicians is a priority. We solicit guidance from a number of sources in order to assist us in doing the best possible job of inclusion. We ask the organizers of individual workshops to suggest names and in many cases directly contact potential participants in advance of formal invitations to encourage their attendance. This technique is particularly effective as a method of ensuring broad participation from women and underrepresented groups. Also, consistent with the IMA's general goal of bridging gaps between mathematics and other disciplines, we strive to maintain a balance between the numbers of mathematicians and other scientists at these workshops.

In January 2000 the IMA and the Association for Women in Mathematics (AWM) reached a formal agreement under which an AWM committee has been formed to consult with the IMA Director and to suggest appropriate female organizers and participants for forthcoming IMA programs. Committee Chair - Suzanne Lenhart (Mathematics, University of Tennessee). Committee members - Joan Feigenbaum (Computer Science, Yale), Pam Cook (Mathematics, U of Delaware), Denise Kirschner, (U of Michigan Medical School). On September 8-10, 2000 the IMA held a Career Workshop: Connecting Women in Mathematical Sciences to Industry, cosponsored by the AWM, see:

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

As part of the ongoing IMA effort in this area, the IMA and JAMM (the Joint Alliance for Minorities in Mathematics) and its member schools have entered into a long-term relationship with the aims 1) of increasing involvement of minority mathematicians, graduate students and other scientists from under-represented groups in the annual and summer research programs of the IMA, improving access to the latest research initiatives and results, and developing and increasing personal contacts with leaders in these fields; and 2) increasing the involvement of mathematicians and graduate students from under-represented groups in industrial mathematics, developing industrial mathematics courses and research projects with industry, and providing information about industrial employment.

The following agreement has been reached:

In order to enhance the participation of underrepresented minorities in mathematics, a Consortium called the Joint Alliance for Minorities in Mathematics (JAMM) has been organized. This alliance is composed of research universities and historically black colleges and universities (HBCUs). At the present time, JAMM is composed of the following institutions; Arizona State University, Howard University, Iowa State University Morehouse College, North Carolina A&T University, Spelman College, University of Colorado, University of Maryland at College Park, and the University of Massachusetts at Amherst. The primary goal of JAMM is substantially to increase the participation of minorities in research and education related activities throughout the mathematical community, with special emphasis on those activities that provide real-world problems arising from settings such as industrial and government laboratories. The ideas implemented in the Consortium have antecedents in a number of national reports, but grew out of suggestions compiled at the first Minorities and Applied Mathematics-Connections to Industry Conference held at IMA in October, 1996.

A linkage between JAMM and the IMA is one natural mechanism for accomplishing the above-mentioned goal. The IMA has a commitment from specific members of the JAMM alliance who suggest participants for IMA workshops that will further broaden the pool of participants: Ray Johnson (Mathematics, University of Maryland), James Turner (Mathematics, Florida State University). On May 4-6, 2001, the IMA held a Career Workshop: Minorities and Applied

Mathematics - Connections to Industry and Government Laboratories, cosponsored by JAMM, see: <http://www.ima.umn.edu/multimedia/spring/minorities.html>

9. Report on the state of the various program Web pages and their use by the scientific community.

The IMA Web site is an integral part of our programming. IMA Preprints are available <http://www.ima.umn.edu/preprints/new.preprintlist.html> , as well as the Newsletters that contain our complete program (titles and abstracts of all talks, announcements of informal research seminars, participants in residence, special announcements) <http://www.ima.umn.edu/newsltrs/index.html> .. Researchers can register for workshops online, apply for postdoctoral and long term participant positions, and fill in workshop evaluation forms. We continue to put our workshops on the web. This includes abstracts of talks, hyperlinks to speaker s Web page and original source material, copies of transparencies, hyperlinks to preprints, and in some cases, film and audio clips of the talks and discussion sessions. We no longer make large numbers of paper copies of transparencies and notes, but rely on the web-based materials. For some special talks, such as industrial problem seminars, we offer streaming video on an experimental basis. However, to date we have not found streaming video in general to be a very effective or cost efficient method of delivering scientific content.

Web site usage is increasing dramatically, up a factor of 3 in most categories over the past year. The following table gives the usage by month. The June 2001 figures are not complete; they cover the period June 1-27.

Summary by Month										
Month	Daily Avg				Monthly Totals					
	Hits	Files	Pages	Visits	Sites	KBytes	Visits	Pages	Files	Hits
Jun 2001	31076	26224	13013	2014	30815	16051591	56407	364377	734295	870149
May 2001	33242	27869	13955	1814	33499	16649706	56244	432629	863958	1030507
Apr 2001	23249	19182	11557	1284	20421	13674324	38524	346725	575473	697482
Mar 2001	21038	17280	10326	1228	20433	16112795	38076	320127	535710	652202
Feb 2001	23497	18102	12462	1213	20371	10413423	33966	348950	506878	657923
Jan 2001	20495	16732	10419	1131	19145	9339202	35068	323006	518715	635374
Dec 2000	17673	14780	9415	1008	15211	7549622	31278	291880	458186	547869
Nov 2000	21329	18082	10683	1293	17966	9187652	38816	320511	542460	639877
Oct 2000	19640	16575	10093	1217	17692	6538542	37754	312883	513826	608850
Sep 2000	18583	15654	9649	1126	17084	6952548	33800	289499	469649	557501

Aug 2000	11662	9789	4959	975	15077	4775243	30234	153741	303469	361546
Jul 2000	8680	7420	3238	927	13612	4381385	28749	100400	230027	269109
Totals						121626033	458916	3604728	6252646	7528389

10. Membership in the Board of Governors and the Scientific Advisory Committee.

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