

# INSTITUTE FOR MATHEMATICS AND ITS APPLICATIONS

University of Minnesota

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Newsletters, Updates and preprints are available via

anonymous ftp: [ftp.ima.umn.edu](ftp://ftp.ima.umn.edu), www: <http://www.ima.umn.edu/>

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

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## IMA NEWSLETTER # 280

December 1–31, 1999

1999–2000 Program

### REACTIVE FLOW and TRANSPORT PHENOMENA

See <http://www.ima.umn.edu/reactive/> for a full description of the 1999-2000 Annual Program on Reactive Flow and Transport Phenomena.

IMA schedules are subject to revision, particularly during workshops. See

<http://www.ima.umn.edu/~seminar/sched> and

<http://www.ima.umn.edu/newsletters/> for the latest scheduling information.

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| <b>News and Notes</b> |
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#### **Board of Governors Selects Program Topics: Geometric Methods in Inverse Problems and PDE Control for Summer 2001 and Optimization for the 2002-2003 Annual Program**

The Board of Governors approved a proposal to devote a Summer 2001 Program to the topic, **Geometric Methods in Inverse Problems and PDE Control**. The organizing committee consists of Chris Croke (University of Pennsylvania), Irena Lasiecka (University of Virginia), Gunter Uhlmann (University of Washington), and Michael Vogelius (Rutgers University). The proposal outlines a two week program to be held July 16 – 27, 2001.

This summer program's goals are to bring together geometers with researchers in inverse problems and control of PDE to facilitate exchange of ideas and encourage collaboration; to make tools of differential geometry known to those working in inverse problems and control, and to open new areas of research in geometry. The workshop will for instance explore the use of inverse problem and control methods to rigidity problems in geometry. This will be a two week program in which Week 1 will emphasize Geometric and PDE methods and Week 2 will focus on applications of these techniques to inverse and control problems. Both weeks will begin with overview talks designed to set the stage for the program. The presence of several talks of a survey nature will make this workshop an ideal venue for young researchers wanting to get involved in these fields.

For the most recently updated information, see <http://www.ima.umn.edu/GM/>

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

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

The Board of Governors also approved a proposal to devote the academic year September 2002 – June 2003 to the topic, **Optimization**. The organizing committee consists of Donald Goldfarb (Columbia), Bill Pulleyblank (IBM Research), Bill Cook (Rice), Tom Coleman (Cornell), John Birge (Northwestern), Brenda Dietrich (IBM Research), and Prabhakar Raghavan (IBM Research).

The year is divided into three quarters whose topics are “Supply Chain and Logistics Optimization” (Fall 2002), “New Optimization Paradigms and Approaches” (Winter 2003), and “Information Technology and Optimization” (Spring 2003).

The proposal outlines tentative plans for workshops on “Supply Chain Management”, “Computational Methods for Large Scale Integer Programs”, “Travel and Transportation”, “Nonconvex and Global Optimization”, “Optimization in Design and Inverse Problems”, “Semidefinite Programming and Robust Optimization”, “Communications Design”, and “Data Analysis and Optimization”.

As with all IMA programs, a primary goal of these workshops is to educate and interest mathematicians in the mathematical and scientific problems that arise in these dynamic and challenging areas of science and technology.

The most recently updated information, see <http://www.ima.umn.edu/optimization/>

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### **New Members Elected to the Board of Governors**

At its annual meeting in Minneapolis on 17 October 1999, the IMA Board of Governors elected four distinguished scientists as new members, who have agreed to serve on the board for three years beginning January 1, 2000. They are Joan Feigenbaum of AT&T, Bill Gear of NEC, Fan Chung Graham of UC San Diego and Jim Yorke of the University of Maryland.

Retiring members as of 31 December 1999 are Robert Calderbank (AT&T Bell Labs), Rosemary Chang (Silicon Graphics), John Polking (Rice University), and Ridgway Scott (University of Houston).

The IMA would like to express its deep gratitude to Drs. Calderbank, Chang, Polking, and Scott for their ideas and dedication in serving on the Board during the past three years. Continuing Board members are Douglas Arnold (Pennsylvania State University), Lynne Billard (University of Georgia), Jennifer Chayes (Microsoft), Richard Karp (University of Washington), James Paul Keener (University of Utah), Thomas Magnanti (Massachusetts Institute of Technology), and Juan Meza (Sandia National Laboratory), and Paul H. Rabinowitz (Univ. of Wisc.-Madison).

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### **Program Ideas**

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

Future programs are sought which could be carried out through:

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

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

E-mail: [miller@ima.umn.edu](mailto:miller@ima.umn.edu)  
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Please see <http://www.ima.umn.edu/ideas.html> for more detailed information.

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### IMA Newsletter Distribution via the World Wide Web

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

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

We have a form available on our Newsletter Web page: <http://www.ima.umn.edu/newsletters/form.html> that we would like you to complete which will give the IMA enough information to keep you on our Newsletter mailing list.

If you cannot retrieve the newsletter from the Web, please call the IMA staff at 612-624-6066 or e-mail [staff@ima.umn.edu](mailto:staff@ima.umn.edu) if you would like to continue to receive a hard copy of the IMA Newsletter.

**Please respond by December 15** so you will be included in the next newsletter mailing. If we do not hear from you and we cannot obtain an e-mail address for you, you may be removed from the mailing list. We hope this will become a more efficient way of sharing the IMA Newsletter with you.

Thank you for taking the time to respond to this.

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| <b>Schedule for December 1–31, 1999</b> |
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| <b>Wednesday, December 1</b> |
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The 10:30 am IMA morning break will be at the IMA East in Lind Hall 400

|                   |                                  |               |
|-------------------|----------------------------------|---------------|
| 12:30–<br>1:30 pm | <b>Postdoc Brown Bag Seminar</b> | Lind Hall 401 |
|-------------------|----------------------------------|---------------|

An informal seminar run by and for IMA postdocs for the discussion of current research problems. Each week somebody will give a brief presentation of their work, which will then be discussed by the group.

|                             |
|-----------------------------|
| <b>Thursday, December 2</b> |
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The 10:30 am IMA morning break will be at the IMA East in Lind Hall 400

**School of Math Applied Mathematics and Numerical Analysis Seminar**  
**IMA West Seminar Room, Vincent Hall 570**

|          |                           |  |
|----------|---------------------------|--|
| 11:15 am | <b>Bruce Ayati</b><br>IMA | Galerkin Methods for PDE Models of Age and Space<br>Structured Populations |
|----------|---------------------------|--|

*Abstract:* We motivate and present Galerkin methods in age and space for a population model with nonlinear diffusion. We provide a stability analysis that gives the underlying logic for the convergence analysis. Examples illustrating the utility of the methods are shown.

See [http://www/math.umn.edu/~cockburn/seminar\\_99-00.html](http://www.math.umn.edu/~cockburn/seminar_99-00.html) for further information.

### IMA Industrial Postdoc Seminar

1:00–3:00 pm    **IMA Industrial Postdoc Seminar**  
IMA West Seminar Room  
Vincent Hall 570

Progress reports by industrial postdocs on their projects followed by discussion among participants.

The seminar is directed by Fadil Santosa. Those who wish to attend are asked to contact Professor Santosa.

**Friday, December 3**

The 9:30 am IMA morning break will be in the IMA West Lounge, Vincent Hall 502

### SEMINAR ON INDUSTRIAL PROBLEMS, 570 Vincent Hall

10:10 am    **Vladimir Druskin**    Gaussian Spectral Rules for Second Order Finite-  
Schlumberger-Doll Research    difference Schemes.

*Abstract:* The subject of this talk is targeted grid optimization for elliptic and time-domain problems arising in remote sensing (geophysics, computed topography, etc.), where the solution is needed only at few receiver points.

The optimization can be viewed as an extension of the conception of the Gaussian quadratures rules to the second order finite-difference schemes. A standard Gaussian  $k$ -point quadrature for numerical integration is chosen to be exact for  $2k$  polynomials, and an optimal grid with  $k$  nodes is chosen to match the impedance at the receiver points for some  $2k$  frequencies. To solve this problem we employ methods of rational approximation, linear algebra and inverse problem theory. The optimization yields exponential convergence of the impedance, i.e., the standard second order scheme with the three-point stencil exhibits spectral superconvergence.

The optimized scheme is applied to two- and three- dimensional problems in electromagnetic and acoustic well logging. Our numerical experiments exhibit exponential superconvergence at prescribed points (receivers), where the cost per grid node is close to that of the standard second order finite-difference scheme. We observe more than one order speedup for practically important problems.

Collaborators: Sergey Asvadurov (SLB), David Ingerman (Princeton-MIT), Shari Moskow (UFL) and Leonid Knizhnerman (CGE).

**Monday, December 6**

The 10:30 am IMA morning break will be at the IMA East in Lind Hall 400

**Tuesday, December 7**

The 10:30 am IMA morning break will be in the IMA West Lounge, Vincent Hall 502

### IMA Postdoc Seminar:

11:00 am    **Jay Gopalakrishnan**    On the Mortar Finite Element Method  
IMA

Organizers: Javier Armendariz & Henning Struchtrup

NOTE: The Postdoc Seminar is organized by the IMA postdoctoral members, but all interested IMA participants are encouraged to attend. The Seminar meets in Vincent Hall 570.

**McKnight Seminar in the Mathematical Biosciences  
Meets in the IMA Lecture Hall EE/CS 3-180**

12:00 pm      **Hans Othmer**      Signal Transduction and Motor Control in Bacteria: Microscopic Models and Macroscopic Behavior  
University of Minnesota

*Abstract:* Bacterial chemotaxis is widely-studied because of its accessibility and because it incorporates processes that are important in a number of sensory systems: signal transduction, excitation, adaptation, and a change in behavior, all in response to stimuli. Quantitative data on the change in behavior is available for this system, and the major biochemical steps in the signal transduction/processing pathway have been identified. We will discuss a mathematical model that can reproduce many of the major features of the intracellular response, including the change in the level of chemotactic proteins to step and ramp stimuli such as those used in experimental protocols. We will also describe a mechanism for the interaction of the chemotactic proteins with the motor switch, and will discuss how the microscopic model can be incorporated in macroscopic equations that describe the behavior of bacterial populations.

The McKnight Seminar is a joint project of the Graduate School, the Departments of Chemical Engineering & Materials Science, Mathematics, and Neuroscience, the Biological Process Technology Institute (BPTI), and the Institute for Mathematics and its Applications (IMA).

**Wednesday, December 8**

The 10:30 am IMA morning break will be at the IMA East in Lind Hall 400

12:30–      **Postdoc Brown Bag Seminar**      Lind Hall 401  
1:30 pm

An informal seminar run by and for IMA postdocs for the discussion of current research problems. Each week somebody will give a brief presentation of their work, which will then be discussed by the group.

3:00 pm      **IMA Holiday Party**  
IMA East, Lind Hall 400

We will gather to celebrate the holidays with a potluck meal and party. IMA participants, postdocs, staff, math faculty and IT Dean's staff are invited to bring their families and a dish to share!

**Thursday, December 9**

The 10:30 am IMA morning break will be at the IMA East in Lind Hall 400

**School of Math Applied Mathematics and Numerical Analysis Seminar  
IMA West Seminar Room, Vincent Hall 570**

11:15 am      **William Symes**      Adaptively Gridded Finite Difference Schemes for the  
Rice University      Eikonal Equation

*Abstract:* The geodesic distance from a "source" point is a viscosity solution of an eikonal equation, and has an upwind singularity at the source. This upwind singularity limits the global convergence of difference schemes to first order,



Organizers: Javier Armendariz & Henning Struchtrup

NOTE: The Postdoc Seminar is organized by the IMA postdoctoral members, but all interested IMA participants are encouraged to attend. The Seminar meets in Vincent Hall 570.

**Wednesday, December 15**

The 10:30 am IMA morning break will be at the IMA East in Lind Hall 400

12:30–  
1:30 pm            **Postdoc Brown Bag Seminar**            Lind Hall 401

An informal seminar run by and for IMA postdocs for the discussion of current research problems. Each week somebody will give a brief presentation of their work, which will then be discussed by the group.

**Thursday, December 16**

The 10:30 am IMA morning break will be at the IMA East in Lind Hall 400

**School of Math Applied Mathematics and Numerical Analysis Seminar**  
**IMA West Seminar Room, Vincent Hall 570**

11:15 am            **Guido Kanschat**            Residual Based A Posteriori Error Estimates with Appli-  
University of Heidelberg            cation to Parameter Identification

*Abstract:* Residual based error estimates will be introduced. The difference between the Eriksson-Johnson and the weighted residual approach will be explained and examples are given. Then, a simple problem of parameter identification in a physical model will be presented. It will be solved by Lagrangian multipliers and the weighted residual a posteriori error estimate will be applied to it. First results are shown to obtain further input from the discussion.

See <http://www.math.umn.edu/~cockburn/seminar.99-00.html> for further information.

**Friday, December 17**

The 10:30 am IMA morning break will be in the IMA West Lounge, Vincent Hall 502

**Monday, December 20**

The 10:30 am IMA morning break will be at the IMA East in Lind Hall 400

**Tuesday, December 21**

The 10:30 am IMA morning break will be in the IMA West Lounge, Vincent Hall 502

**Wednesday, December 22**

The 10:30 am IMA morning break will be at the IMA East in Lind Hall 400

12:30–  
1:30 pm            **Postdoc Brown Bag Seminar**            Lind Hall 401

An informal seminar run by and for IMA postdocs for the discussion of current research problems. Each week somebody will give a brief presentation of their work, which will then be discussed by the group.

**Thursday, December 23**

The 10:30 am IMA morning break will be at the IMA East in Lind Hall 400

**Friday, December 24**

**A University of Minnesota holiday. IMA offices will be closed.**

**Monday, December 27**

**A University of Minnesota holiday. IMA offices will be closed.**

**Tuesday, December 28**

The 10:30 am IMA morning break will be in the IMA West Lounge, Vincent Hall 502

**Wednesday, December 29**

The 10:30 am IMA morning break will be at the IMA East in Lind Hall 400

12:30–  
1:30 pm

**Postdoc Brown Bag Seminar**

Lind Hall 401

An informal seminar run by and for IMA postdocs for the discussion of current research problems. Each week somebody will give a brief presentation of their work, which will then be discussed by the group.

**Thursday, December 30**

The 10:30 am IMA morning break will be at the IMA East in Lind Hall 400

**Friday, December 31**

**New Year’s Eve, a University of Minnesota holiday. IMA offices will be closed.**

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**CURRENT IMA PARTICIPANTS**

**POSTDOCTORAL MEMBERS FOR 1999–2000 PROGRAM YEAR**

| <u>NAME</u>        | <u>PREVIOUS INSTITUTION</u>        |
|--------------------|------------------------------------|
| ANDERSON, KEVIN    | University of Arizona              |
| ARMENDARIZ, JAVIER | Northwestern University            |
| AYATI, BRUCE       | University of Chicago              |
| EFENDIEV, YALCHIN  | California Institute of Technology |
| HAWA, TAKUMI       | Rensselaer Polytechnic Inst.       |
| KIM, YONG          | University of Wisconsin            |
| NOVIKOV, ALEXEI    | Stanford University                |

**POSTDOCTORAL MEMBERSHIPS IN INDUSTRIAL MATHEMATICS**

| <u>NAME</u>          | <u>PREVIOUS INSTITUTION</u> | <u>INDUSTRIAL AFFILIATION</u> |
|----------------------|-----------------------------|-------------------------------|
| COULT, NICHOLAS      | University of Colorado      | FMA&H                         |
| GOPALAKRISHNAN, JAY  | Texas A& M University       | Endocardial Solutions         |
| KIRILL, DIMITRI      | Northwestern University     | Motorola                      |
| NIGAM, NILIMA        | University of Delaware      | Seagate                       |
| VARGHESE, ANTHONY    | University of Oxford        | Endocardial Solutions         |
| ZATEZALO, ALEKSANDAR | Univ. of Minnesota          | Lockheed Martin               |

### Other Postdoctoral Appointments

| NAME                | PH. D. INSTITUTION         |
|---------------------|----------------------------|
| STRUCHTRUP, HENNING | Universität of Berlin      |
| MYONG, RHO SHIN     | The University of Michigan |

#### VISITORS IN RESIDENCE (as of 14 October 1999)

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|                     |                                       |                 |
|---------------------|---------------------------------------|-----------------|
| BOOTY, MICHAEL      | New Jersey Institute of Technology    | SEP 21 - DEC 31 |
| BUCKMASTER, JOHN    | Univ. of Illinois at Urbana Champaign | SEP 1 - DEC 31  |
| CARPENTER, TAMI     | Telcordia Technologies                | DEC 9 - 10      |
| COCKBURN, BERNARDO  | University of Minnesota               | SEP 1 - AUG 31  |
| DOLD, JOHN          | UMIST                                 | SEP 2 - DEC 6   |
| DRUSKIN, VLADIMIR   | Schlumberger-Doll Research            | DEC 2 - 3       |
| DULLES, FRED        | IMA                                   | SEP 1 - AUG 31  |
| FRIEDMAN, AVNER     | University of Minnesota               | SEP 1 - AUG 31  |
| KALNINS, ERNIE      | University of Waikato                 | NOV 19 - DEC 13 |
| LITTMAN, WALTER     | University of Minnesota               | SEP 1 - AUG 31  |
| LUSKIN, MITCH       | University of Minnesota               | SEP 1 - AUG 31  |
| MILLER, WILLARD     | IMA                                   | SEP 1 - AUG 31  |
| MYONG, RHO SHIN     | Gyeongsang National University        | DEC 16 - MAR 15 |
| NI, WEI-MING        | University of Minnesota               | SEP 1 - AUG 31  |
| OLVER, PETER        | University of Minnesota               | SEP 1 - AUG 31  |
| SANTOSA, FADIL      | IMA & MCIM                            | SEP 1 - AUG 31  |
| SELL, GEORGE        | University of Minnesota               | SEP 1 - AUG 31  |
| SMITH, HAL          | Arizona State University              | SEP 1 - MAY 15  |
| SVERAK, VLADIMIR    | University of Minnesota               | SEP 1 - AUG 31  |
| TELLO, JOSE IGNACIO | Universidad Complutense de Madrid     | SEP 26 - DEC 19 |
| ZAJIC, TIM          | Lockheed Martin                       | SEP 1 - AUG 31  |

See also URL: <http://www.ima.umn.edu/people/>