I. THEMATIC PROGRAMMES

Gang Tian (MIT), Clifford Taubes (Harvard), Rick Schoen (Stanford) and Jingyi Chen (UBC) the minicourse lecturers for the **Workshop on Geometric PDE**.

Jack Edmonds and Adrian Bondy discuss with participants in the **Workshop on Colourings and Homomorphisms**.

Theme 2000 (A): Graph Theory & Combinatorial Optimization

Mathematically, a **graph** consists only of a set of "vertices" and a set of pairs of vertices that are "joined" by "edges". Physical examples abound. For example, the vertices can be communication centres and the edges can represent direct connections between pairs, or the vertices can be the atoms of a molecule, and the edges can be chemical bonds. Although graphs are extremely basic objects, the subject of Graph Theory, which the studies the theoretical structure of graphs and the algorithmic exploitation of such structure, is a deep and active part of mathematics. There are also important applications and strong connections to other parts of mathematics and computer science.

Combinatorial Optimization is the mathematics of finding the best among some collection of discrete structures. An example would be to find the graph with some connectivity property and having the smallest number of edges, or to find the best route through a given graph. Again, this subject is both mathematically interesting and rich with applications.

Organizing Committee:

Brian Alspach (SFU)
Luis Goddyn (SFU)
Arvind Gupta (SFU)
Pavol Hell (SFU)
Valerie King (U. Victoria)
David Kirkpatrick (UBC)
Frank Ruskey (U. Victoria)

Programme

Computational Graph Theory and Combinatorics,
University of Victoria, May 6–8, 1999

Algorithms and Data Structures,
SFU Harbour Centre, August 11–14, 1999

11^{th} Canadian Conference on Computational Geometry,
UBC, August 15–18, 1999

Dynamic Graph Problems,
U. Victoria, June 5–9, 2000

Graph Decompositions,
PIMS-SFU, June 19–30, 2000

Flows, Cycles, and Orientations,
PIMS-SFU, July 3–14, 2000

Graph Colourings and Homomorphisms,
PIMS-SFU, July 17–28, 2000

This was a joint programme of the Fields Institute and the Pacific Institute for the Mathematical Sciences for a special year on graph theory and combinatorial optimization, taking place over the period June 1999 to August 2000. Lead-off workshops started at PIMS in the summer of 1999. September through May activities shifted to Fields, to eventually return to PIMS for the June through August, 2000 period. The fall term concentrated on combinatorial optimization, and the remaining period concentrated on graph theory and related topics.

Lead-off Events:

PIMS first sponsored a pre-thematic workshop on Computational Graph Theory and Combinatorics at the University of Victoria in May, 1999. The lead-off event for the joint thematic year was the Workshop on Algorithms and Data Structures (WADS), held at the SFU harbour Centre in August, 1999. Immediately following WADS was the Canadian Conference on Computational Geometry (CCCG), which took place at UBC in late August. Here are the events held in 2000.

Dynamic Graph Problems, Univ. of Victoria, June 5–9, 2000

Organizers: Monika Henzinger (Google Inc.) and Valerie King (Computer Science, University of Victoria)

For any graph problem, one may ask: If a graph instance undergoes an on-line sequence of updates, can one make use of previous computation to recompute the solution after each update more quickly? The study of dynamic graph problems has recently undergone some dramatic developments. The goal of this workshop is to bring together experts on various topics in the area with interested students and researchers, to discuss the current state of the field, identify promising directions for research, and do some problem-solving. Topics include: proving lower bounds, problems in computational geometry, new and old problems for undirected and for directed graphs, problems on trees, and applications to networks, data bases and programming languages.

Main lecturers:

Bob Tarjan (Princeton and Intertrust): *Parametric and Kinetic Heaps,*

Stephen Alstrup (IT University of Copenhagen): *Trees* and *Improved Algorithms for Finding Level Ancestors in Dynamic Trees,*

Faith Fich (University of Toronto): *Lower Bounds for Dynamic Graph Problems,*

David Eppstein (Univ. of California, Irvine): *Computational Geometry,*

Leo Guibas (Stanford University): *Kinetic Data Structures,*

Pino Italiano (Univ. degli Studi di Roma): *Fully Dynamic Transitive Closure: Breaking Through the $O(n^2)$ barrier,*

Roded Sharan (Tel Aviv University): *A Fully Dynamic Algorithm for Proper Interval Graph Recognition,*

Mikkel Thorup (AT & T Research): *2-Edge and Biconnectivity (Including Applications in Matching Theory), Tree Packing and General Dynamic Edge Connectivity* and *Applications to the Internet.*

Participants in the **PIMS Workshop on Dynamic Graph Problems** head to sea.

Graph Decompositions, PIMS-SFU, June 19–30, 2000

Organizing Committee: Brian Alspach, Chair, (U. Regina), Reinhard Diestel (U. Hamburg), Herbert Fleischner (Austrian Academy of Science), Ron Gould (Emory U.), Chris Rodger (Auburn U.)

The workshop consisted of a series of invited instructional lectures whose purpose was to survey the current status of a variety of important graph decomposition problems. Graph decompositions is a topic at the heart of graph theory. Decomposition problems have a long history, have spawned large areas of research, and continue to be studied by many people inside and outside of graph theory. Steiner triple systems were introduced early in the nineteenth century. When viewed as decompositions of complete graphs into complete graphs of order 3, their generalization leads to the well studied field of design theory. When viewed as decompositions of complete graphs into 3-cycles, their generalization leads to a wide range of problems dealing with decomposition of complete graphs into cycles.

Vertex coloring is a topic that was introduced in the middle of the nineteenth century, has generated considerable research over the years and has important scheduling applications. It corresponds to a particular kind of vertex decomposition of a graph. Edge coloring problems also have scheduling applications and have been studied extensively. They correspond to decompositions of graphs into 1-factors.

The preceding topics are still actively studied along with many new areas of investigation. G. Ringel's conjecture that K_{2n+1} can be decomposed into any fixed tree of size n directly led to the notion of a graceful labelling of a tree. That in turn spawned the very active area of graph labellings. The cycle double cover conjecture has attracted a lot of attention over the last twenty years. Isomorphic factorizations, orthogonal factorizations and ascending subgraph decompositions are other areas in which there are many unsolved problems and considerable research activity.

The format of the workshop was informal with invited talks dovetailed with working sessions. The purpose was to provide the opportunity for a group of approximately 40 researchers and graduate students from around the world to work together to gain a better understanding of widely accepted problems in the area. The workshop consisted of problem-solving sessions, tutorials designed for the non-expert, and a series of invited instructional lectures, the purpose of which was to survey the current status of a variety of important graph decomposition problems, and more specifically, edge decomposition problems.

Main lecturers:

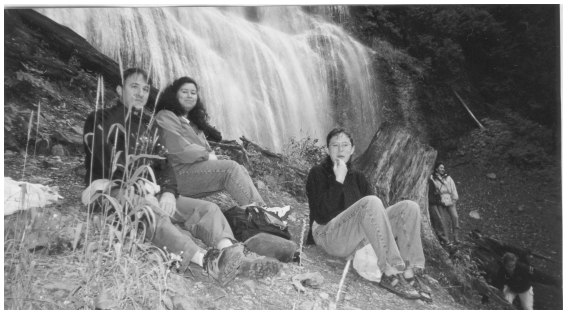
Darryn Bryant (Univ. Queensland)
Edward Dobson (Mississippi State)
Mark Ellingham (Vanderbilt)
Herbert Fleischner (Austrian Academy of Science)
Ron Gould (Emory U.)
Hans-Dietrich Gronau (U. Rostock)
Jiuqiang Liu (Eastern Michigan U.)
Chris Rodger (Auburn U.)
Mateja Sajna (Capilano College)

Flows, Cycles, and Orientations, PIMS-SFU, July 3–14, 2000

Organizer: Luis Goddyn (SFU)

This workshop presented an opportunity for participants to identify and work collaboratively on current problems in graph/matroid theory which broadly fall into the above three categories. Topics were concerned with algorithmic, polyhedral, algebraic, probabilistic, or extremal aspects, and involved embeddings, flow/colouring theory, circuit/bond covers, matroids and connectivity.

The format of the workshop consisted of two formal talks per day, interspersed with periods during which the participants engaged in informal discussions.



Enrique Garcia (U. of Ohio), Laura Chavez (SFU), and Cindy Loten (SFU), graduate student participants in the **Workshop on Flows Cycles and Orientations,** relax on an outing to Bridal Veil Falls.

Main lecturers:

Matt DeVos (Princeton): *I. Antiflows* and *II. Flow Choosability,*

Bertrand Guenin (Univ. of Waterloo): *Even Cycle Matroids,*

Petr Hlineny (Fields Institute): *Crossing Numbers,*

Kathie Cameron (Wilfred Laurier): *Parity of Nodes,*

Winfred Hochstäettler (Köln): *Dirac condition for Matroids,*

Mohamed Kobeissi (Univ. J. Fourier): *Cycles in Hypercubes,*

Sean McGuinness (Univ. of Umeå): *CDC for oddness four,*

Deryk Osthus (Humboldt Univ.): *Thomassen's conjecture,*

Riste Skrekovski (Univ. of Ljubljana): *Nowhere Zero Flows,*

Miki Tarsi (Tel-Aviv University): *Cycles and Flows,*

Dirk Vertigan (Lousisiana State Univ.): *Matroids,*

Doug West (Univ. of Illinois): *Alon-Tarsi on Hypergraphs,*

C.-Q. Zhang (W. Virginia Univ.): *Flows and Covers,*

Xuding Zhu (Nat. Sun Yat-sen Univ.): *Range of Flow Numbers.*

Graph Colourings and Homomorphisms, PIMS-SFU, July 17–28, 2000

Organizing Committee: Pavol Hell (Chair, SFU), Jing Huang (UVic), Rick Brewster (Capilano College), Gena Hahn (Montreal)

Graph colourings are at the core of graph theory. Starting from the famous four colour conjecture, now theorem, all the way to applications in scheduling, graph theory developed along with the study of colourings. From both theoretical and algorithmic perspective, colourings have always played a central role.

Nowhere-zero flows were introduced by Tutte as an extension of chromatic number. Indeed a flow is the matroidal dual of a graph colouring. Many well-known graph colouring problems, such as the Four Colour Theorem, extend naturally to problems about flows. There are several outstanding problems about flows, such as Tutte's conjecture that every graph has flow number at most five. Circuit covers were introduced in 1979 when Seymour proposed the still-unsolved Circuit Double Cover Conjecture. This conjecture is closely related to the topic of Surface Embeddings of graphs. Relating these three areas together will be the focus of part of this workshop.

Recently, the theory of colourings has benefited from an introduction of algebraic techniques, through the vehicle of list homomorphisms. At the same time, generalizations of colourings, especially graph homomorphisms, have also enjoyed much popularity. List homomorphisms, like list colourings, exhibit certain properties that can be exploited in the design of efficient algorithms. Both list colourings and list homomorphisms owe a historical debt to constraint satisfaction problems (which in fact are more general than both these concepts), studied in artificial intelligence. In fact some of the AI techniques have only recently been rediscovered by graph theorists. Finally, any of these concepts lead naturally to practical applications in timetabling and scheduling.

The workshop attracted over 70 participants and consisted of a series of invited instructional lectures, addressed to graduate students, and highlighting recent developments in graph colourings and their generalizations, including circular and oriented colourings, and, more generally, graph homomorphisms. Algorithmic, combinatorial, and algebraic issues were also discussed, as well as applications in, and

connections to, constraint satisfaction problems, scheduling, etc. Generous amounts of time were reserved for informal talks and unstructured discussions. Graduate students found the environment very stimulating.

Main lecturers:

Michael Albertson (Smith College): *Extending graph colorings,*

Noga Alon (Tel Aviv Univ.): *Acyclic coloring, strong coloring, list coloring and graph embedding,*

Adrian Bondy (U. Claude Bernard): *Colourings and orientations of graphs,* Graham

Brightwell (London Sch. of Econ.): *Dismantlability,*

Karen Collins (Wesleyan): *Applications of the No-homomorphism lemma,*

Jerrold Griggs (U. South Carolina): *Channel Assigments with Distance Conditions,*

Joan Hutchinson (Macalester College): *A 3-color theorem for some graph evenly embedded on orientable surfaces,*

Tommy Jensen (U. of Hamburg): *25 Pretty colouring problems,*

Bojan Mohar (U. of Ljubljana): *Some topological methods in graph coloring theory,*

Jarik Nesetrild (Charles U., Prague): *Extension properties and universality of the coloring poset,*

Andre Raspaud (U. Bordeaux I): *Homomorphisms and Oriented Coloring,*

Bruce Reed (CNRS, U. Paris VI): *Graph colouring via the probabilistic method,*

Norbert Sauer (U. of Calgary): *The homomorphism lattice of graphs,*

Claude Tardif (U. of Regina): *Cones over a graph,*

Peter Winkler (Bell Labs): *Random homomorphisms,*

Xuding Zhu (Nat. Sun Yat-sen U., Taiwan): *Circular perfect graphs.*

Many of the lectures in the above workshops are available by streaming video files available over the internet, along with scans of the speaker's slides. They appear on the webpage **www.pims.math.ca/video**.

Theme 2000 (B): Algebra and Related Areas

Group Theory plays a central role in just about all the branches of mathematics and continue to be a very active area of research. We are now witnessing the culmination of a 3 directional attack on the Burnside problems. The first consists of the geometric methods of Ol'Shanskii in producing finitely generated groups of finite exponent that are infinite. The second is the positive solution of the restricted Burnside Problem for residually finite groups by Zelmanov, and the third is the p-adic analytic methods in dealing with questions of linearity of residually finite groups by Lubotzky and Mann. There are also the remarkable advances made by Shalev, Lubotzky, and others on pro-finite groups and results of Segal and others for residually finite solvable groups.

Representation theory continues to be fundamental importance in mathematics and other sciences. There has been much recent progress, especially, on the representation theory of finite groups of Lie type, which ties together the Lie theory and group theory themes of the programme. Modular representation theory is also an area of considerable activity.

Programme Organizers:

Bruce Allison (U. Alberta)
Gerald Cliff (U. Alberta)
Robert Moody (U. Alberta)
Arturo Pianzola (U. Alberta)
Akbar Rhemtulla (U. Alberta)
M. Schlottman (U. Alberta)
Mazi Shirvani (U. Alberta)
Alfred Weiss (U. Alberta)

Programme

Lie School,
U. Alberta, June 19–23, 2000

Lie Workshop,
U. Alberta, June 26–30, 2000

Groups School,
U. Alberta, June 26–30, 2000

Groups Workshop,
U. Alberta, July 3–7, 2000

Aperiodic School,
U. Alberta, July 3–7, 2000

Aperiodic Workshop,
U. Alberta, July 10–14, 2000

The Summer School/Workshop concentrated on three areas: groups and their representations, Lie theory, and the mathematics of aperiodic order. As its name suggests, it did incorporate both an instructional and research components in each of the three broad areas.

Each area was featured for a two week period and had lecturers of international stature. The first week was devoted to a series of introductory lectures, aimed at giving the students an introduction to the subject in question. The second week was dedicated to the workshop/conference which ran at a research level and which involved additional researchers and students.

The School was open to graduate students, recent Ph.D.'s, and advanced honours students. Financial support was available to support selected participants. Students were expected to participate in the teaching part of each of the three areas.

The main speakers stayed for the full 2 weeks of activity of their area. Trips to Jasper were scheduled for each of the 3 internal weekends, and the accommodation there was planned so as to allow the groups to continue their scientific interactions.

Lie Theory Component, U. Alberta, June 19–30, 2000

Canada has a strong representation in the algebraic side of Lie theory. The timing of this event was particularly favorable because during the fall of 2000, the Fields Institute was holding a semester on infinite dimensional Lie theory. The intention was to use the minicourses of this conference to prepare the students for the Fields' activities.

Mini-course Lecturers at the School:

A. Pianzola (U. Alberta): *Lie Algebras*

S. Donkin (U. London): *Algebraic Groups.*

Main speakers at the Workshop:

G. Benkart (University of Wisconsin)
N. Bergeron (York University)
S. Berman, (University of Saskatchewan)
Y. Billig (University of New Brunswick)
A. Broer (Univerité de Montréal)
C. Dong (Univ. of California, Santa Cruz)
S. Donkin (Queen Mary & Westfield College, London)
Y. Gao, (York University)
M. Gaberdiel (Cambridge University)
T. Gannon (University of Alberta)
Y.-Z. Huang (Rutgers University)
O. Mathieu (IRMA, Strasbourg)
K.-H. Neeb (Technische Universität Darmstadt)
E. Neher (University of Ottawa)
C. Schweigert (Université Paris VI)
O. Smirnov (Randolph-Macon)

Stephen Berman (U. Saskatchewan) who spoke at the **Lie Workshop**.

Group Theory Component, U. Alberta, June 16 – July 7, 2000

Groups play a central role in just about all the branches of mathematics and continue to be a very active area of research.

At present we have the culmination of a three directional attack on the Burnside problems. The first consists of the geometric methods of Ol'Shanskii in producing finitely generated groups of finite exponent that are infinite (a vast improvement of Adian's construction which is one of the technically most difficult piece of a 300+ page work). The second is the positive solution of the restricted Burnside Problem for residually finite groups by Zelmanov, and the third is the p-adic analytic methods in dealing with questions of linearity of residually finite groups by Alex Lubotzky and Avinoam Mann. There are also the remarkable advances made by Aner Shalev, Lubotzky, and others on pro-finite groups and results of Dan Segal and others for residually finite solvable groups.

Representation theory continues of fundamental importance in mathematics and other sciences. There has been much recent progress, especially, on the representation theory of finite groups of Lie type, which ties together the Lie theory and group theory themes of the programme. Modular representation theory is also an area of considerable activity.

The conference presented an excellent opportunity to get a broad picture of these manifold activities as told by the masters themselves to our graduate students and fresh Ph.D's. All main lectures were of the "colloquium" nature, reserving the afternoon sessions for specialized talks that were meant for the experts.

Mini-course lecturers in the School:

Michel Broué (Univ. de Paris VII): *Representations of Groups of Lie Type*

Peter Kropholler (Queen Mary & Westfield College, London): *Cohomological Methods*

Dan Segal (Oxford): *Residually finite groups*

Aner Shalev (Hebrew University, Jerusalem): *Profinite and p-adic analytic groups.*

Main speakers at the Workshop:

Michel Broué (Université Paris VII)
Steve Gersten (University of Utah)
Rod Gow (Dublin City University)
Peter Kropholler (Univ. of London)
A. Lubotzky (Hebrew University, Jerusalem)
A. Yu. Ol'shanskii (Moscow State University)
Geoffrey Robinson (University of Birmingham)
Dan Segal (Oxford University)
Aner Shalev (Hebrew University, Jerusalem)
Alex Turull (University of Florida)

Aperiodic Component, U. Alberta, July 3–14, 2000

Aperiodic order, as its name suggests, refers to the mathematical study of systems, typically in Euclidean spaces, that are highly ordered but are lacking in periodic translational symmetry. Stemming from the recent discoveries of such objects in mathematics (e.g. Penrose tilings) and physics (aperiodic crystals) the subject has blossomed into a new area of mathematics that cuts across many boundaries and has many fascinating possibilies for future research.

The course aimed to provide the students with the background to understand the main ideas being used at present in the development of the mathematics of aperiodic order. One of the appealing aspects of this subject is the way in which it draws together a number of diverse subdisciplines of mathematics: discrete geometry, algebra, analysis, and measure theory and topological dynamics. For this reason the instructional part was given by three speakers. The goal was to give the students a reasonable feel for main ideas and to provide sufficient background and lots of pointers so that they may pursue it more deeply later on.

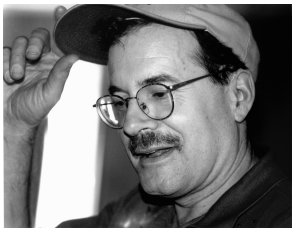
The conference/workshop part of the programme, which occured in the second week, focused on the most recent developments.

Mini-course Lecturers in the School:

M. Baake (Universität Tübingen): *Introduction to aperiodic order, tilings, and diffraction*

J. Lagarias (AT&T Labs), *Discrete geometry and aperiodic point sets*

B. Solomyak (University of Washington): *Dynamical systems and aperiodic order.*



Jeff Lagarias (AT&T Research Labs), mini-course lecturer at the **Aperiodic School** and speaker at the **Aperiodic Workshop**.

Main speakers at the Workshop:

Jean-Paul Allouche (CNRS, Orsay)
Michael Baake (Universität Tübingen)
Jean-Pierre Gazeau (Université Paris VII)
Uwe Grimm (Technische Universität Chemnitz)
Petra Gummelt (Universität Greifswald)
Jeff Lagarias (AT&T Labs)
Boris Solomyak (University of Washington)

Theme 2001 (A): Nonlinear Partial Differential Equations

Partial Differential Equations appear in the study of problems in material science, mathematical physics, fluid dynamics, Riemannian geometry, and many other related areas.

Differential Geometry has been a great source of problems and inspirational ideas for PDEs. Recent developments deal with harmonic maps, prescribed curvature problems, Monge-Ampère equations, Kahler-Einstein manifolds, Seiberg-Witten invariants and their connections to Gromov's invariants in Symplectic Geometry.

Concentration phenomena have been discovered in many different parts of science. Mathematically, they appear as vortices in Ginzburg-Landau equations, as spike-layers in biological diffusions, or as bubbles in geometrical problems occur.

Phase transitions often appear in material sciences problems such as the formation and evolution of grain boundaries in alloys, vortex states in superconducting materials, flame propogation, etc... The related equations include the Cahn-Hilliard equations, Allen-Cahn equations and again the Ginzburg-Landau equations.

The emphasized methods **(Variational and Viscosity solutions)** are very active areas of research, quite relevant to other areas of mathematics (Geometry, Topology, Analysis, Applied mathematics) with many applications in other disciplines (Physics, Chemistry, Biology, Economics and Engineering).

Programme Committee:

Jingyi Chen (UBC)
Michael Crandall (UC Santa Barbara)
Maria J. Esteban (U. Paris-Dauphine)
Nassif Ghoussoub (UBC)
Changfeng Gui (UBC)
Pierre-Louis Lions (U. Paris-Dauphine)
Wei-Ming Ni (U. Minnesota)
Paul Rabinowitz (U. Wisconsin)
Panagiotis Souganidis (U. Texas, Austin)

Programme

Viscosity Methods in Partial Differential Equations,
PIMS-UBC, July 2–10, 2001

Phase Transitions,
PIMS-UBC, July 11–18, 2001

Concentration Phenomena and Vortex Dynamics,
PIMS-UBC, July 19–27, 2001

Variational Methods and their Applications,
PIMS-UBC, July 30–August 07, 2001

Geometric PDEs,
PIMS-UBC, August 8–17, 2001

More than 500 researchers from 15 countries participated in the PIMS Thematic Programme on Nonlinear PDE, which was held at PIMS-UBC from July 2 to August 18. The programme dealt with several interrelated topics originating in finance, physics, chemistry, biology and material sciences, as well as in geometry. The common feature of these topics is the interplay between nonlinear, geometric and dynamic components of partial differential equations. The focal point of each workshop was a series of minicourses given by some of the best world experts in the field.

There was an emphasis on: Viscosity methods in partial differential equations, Phase Transitions, Concentration Phenomena and Vortex Dynamics, Variational methods in partial differential equations as well as Geometric PDEs. There were also several related events happening at PIMS during the summer of 2001: a workshop on *Theoretical and Numerical Fluid Mechanics*, organized by Giovanni P. Galdi (Pittsburgh), John Heywood (UBC), Rolf Rannacher (Heidelberg) and the *Second Canada-China Mathematics Congress* which had an important component in Geometry and PDEs. It was a highly successful plan to capitalize on this large gathering of expertise in Western Canada so as to create a favourable atmosphere for graduate training and collaborative research.

The program consisted of five consecutive workshops. The overlap between them was substantial enough and many participants were involved with several events. Each workshop had at least three mini-courses of up to four hours each. These ran in the morning and targetted mainly graduate students, postdocs and all non-specialists who were interested in learning new active directions of research. In addition, about 25 one-hour lecturers were selected and invited for each workshop by the program committee.

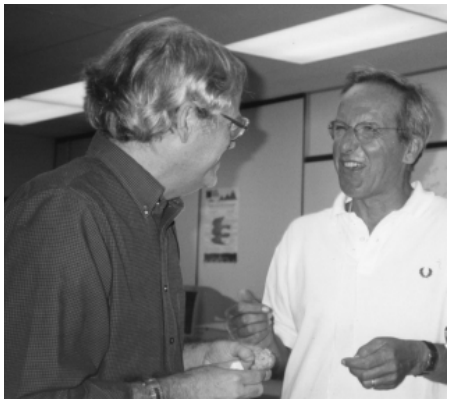
Viscosity Methods in Partial Differential Equations, PIMS-UBC, July 2–10, 2001

Organizers: P. L. Lions (Paris), M. Crandall (Santa Barbara), P. Souganidis (Maddison-Austin)

This workshop focused on the theory of viscosity solutions of differential equations and its applications. Viscosity solutions are the correct class of weak solutions of fully nonlinear first and second order, possibly degenerate partial differential equations. As such they provide the tools which are necessary for the analysis and further understanding of such equations. Some of the problems in this general context are:

- the theory of fully non-linear stochastic PDEs;
- boundary value problems with non-standard boundary conditions for fully non linear elliptic PDEs;
- equations with singular coefficients and/or non standard growth conditions;
- various questions regarding the Stefan problems, which are related to the motion of moving interfaces with velocity depending upon the interface, positions, direction, curvature, gradient difference of the temperature, etc;
- the studies of ray theory for multiphase geometrical optics and of generalized characteristics which connect the theory of viscosity solutions to contact and symplectic geometry;
- regularity problems for nonlinear second order elliptic equations and free boundary problems.

There was also an emphasis on the applications of the theory to Phase transition, Combustion, Control theory, Mathematical Finance, and Image Processing.



Craig Evans (Berkeley) and Italo Capuzzo-Dolcetta (Università di Roma "La Sapienza") during the **Viscosity Methods Workshop**.

Mini-course Lecturers:

Xavier Cabré (Universitat Politecnica de Catalunya) 2 lectures on *Nonconvex Fully Nonlinear Elliptic Equations: $C^{2,\alpha}$ Regularity for some Bellman-Isaacs Equations.*

Craig Evans (Berkeley): 2 lectures on *Hamilton-Jacobi Equations and Dynamical Systems.*

Robert Jensen (Loyola): 2 lectures on *Variational Problems in L^∞.*

Panagiotis Souganidis (Austin): 2 lectures on *Fully Nonlinear Stochastic PDEs.*

Andrzej Swiech (Georgia Tech): 5 lectures on *Viscosity Solutions in Infinite Dimensional Spaces and Optimal Control of PDEs.*

Thaleia Zariphopoulou (Austin): 2 lectures on *Viscosity Solutions in Finance.*

Main Speakers:

Maurizio Falcone (Università di Roma "La Sapienza"): *Semi-Lagrangian schemes for Hamilton Jacobi equations*

Pierpaolo Soravia (Università di Padova): *Uniqueness for degenerate elliptic equations with discontinuous coefficients*

Martino Bardi (Università di Padova): *Ergodicity, singular perturbations, and homogenization in the HJB equations of stochastic control*

Petri Juutinen (University of Jyväskylä): *The infinity eigenvalue problem*

Anne Bourlioux (University of Montreal): *Effective Hamiltonians for numerical turbulent combustion*

Espen Jakobsen (Norweigan University of Science and Technology): *Convergence rate for Approximation Schemes for Hamilton-Jacobi-Bellman equations*

Hitoshi Ishii (Tokyo Metropolitan University): *A model of the wearing process of a non-convex stone*

Fabiana Leoni (Universita Di Roma): *Diffusion generated motions in codimension > 1*

Elisabeth Rouy (Université de Tours): *Some applications of the theory of viscosity solutions to the problem of reflected stochastic differential equations*

Alexander Vladimirsky (UC Berkeley): *Ordered upwind methods for static PDEs*

Agnes Tourin (University of Toronto): *Approximation schemes for Hamilton-Jacobi equations*

Adam Oberman (University of Chicago): *Level set motion by growth, advection & mean curvature & reaction-diffusion advection equations*

I. Capuzzo Dolcetta (Università di Roma "La Sapienza"): *On Hopf - Lax formulas for Hamilton-Jacobi equations*

Mariko Arisawa (Tohoku University): *Long time averaged reflection force and homogenizations of oscillating Neumann type boundary conditions*

Shigeaki Koike (Saitama University): *On the limit of minimizers of variational problems*

Dejan Slepcev (University of Texas at Austin): *Approximation schemes for front propagation with nonlocal velocities*

Juan J. Manfredi (University of Pittsburgh): *The Subelliptic Maximum Principle*

Zhongdan Huan (Beijing Normal University): *On Removable Boundaries*

Michael Crandall (University of California, Santa Barbara): *Another way to say harmonic*

Phase Transitions, PIMS-UBC, July 11–18, 2001

Organizers: Nassif Ghoussoub (PIMS & UBC) and Changfeng Gui (UBC)

This workshop focused on problems in phase transition such as formation and evolution of grain boundaries in alloys, vortex states in superconducting materials, etc. The related equations include Cahn-Hilliard equations, Allen-Cahn equations, Ginzburg-Landau equations, and others.

Mini-course Lecturers:

Henri Berestycki (Université Paris VI): 4 lectures on *Propagation of fronts in excitable media*

David Kinderlehrer (Carnegie Mellon University): 4 lectures on *Topics in metastability and phase changes*

Main Speakers:

Yuxi Zheng (Indiana University, Bloomington): *The Semi-Classical Limit of Schrodinger-Poisson to Vlasov-Poisson Equations*

Hongming Yin (Washington State University): *A free boundary problem arising in microwave heating processes*

Xavier Cabré (Universitat Politecnica de Catalunya): *A conjecture of De Giorgi on symmetry for elliptic equations in R^n "*

Reiner Schaetzle (ETH Zentrum): *Quadratic tilt-excess decay and strong maximum principle for varifolds*

Masayasu Mimura (Hiroshima University): *Annihilation and Reflection of Travelling Spots in Reaction-Diffusion*

Maurizio Falcone (Università di Roma "La Sapienza"): *Large Time-Step Schemes for Front Propagation*

Jacob Rubinstein (Technion): *Phase transitions in quantum wires*

Gieri Simonett (Vanderbilt University): *On the Stefan problem with surface tension*

Nicholas Alikakos (University of Tennessee Knoxville): *Motion By Surface Tension In Curved Ambient Space*

Peter Sternberg (Indiana University, Bloomington): *Existence and Non-existence Results for Permanent Currents in Superconductivity*

Daniel Phillips (Purdue University): *Thermal effects in superconductivity*

Pablo Padilla (Institute of Investigations in Mathematics, Applied and in Systems (IIMAS)): *Global geometric properties of solutions in a phase transition model*

Jian-Jun Xu (McGill University): *Dynamics of Dendritic growth in solidification—global stability and limiting state selection*

Masaharu Taniguchi (Tokyo Institute of Technology): *Instability of planar traveling fronts in bistable reaction-diffusion systems*

Xiaofeng Ren (Utah State University): *Energy Equilibria of the Copolymer Problem*

Francois Hamel (Université Paris VI): *Speed of propagation of fronts for rection-diffusion equations in periodic and general domains*

Yoshi Tonegawa (Hokkaido University): *Singular perturbation problem with a variable mean curvature field*

Changfeng Gui (University of British Columbia): *About the De Giorgi conjecture in dimensions 4 and 5*

Michelle Schatzman (Université Claude Bernard Lyon 1): *Asymmetric layers and solutions of elliptic systems in full space*

Junping Shi (College of William and Mary): *Saddle solutions of semilinear elliptic equations*

Alberto Farina (Université de Picardie Jules Verne): *Phase Transition and Symmetry*

Danielle Hilhorst (Université Paris-Sud): *Singular limit of a reaction-diffusion system with resource-consumer interaction*

Yuan-Wei Qi (Hong Kong University of Science and Technology): *Global self-similarity and Renormalization Group of a thermal-diffusive combustion system with critical nonlinearity*

Yasumasa Nishiura (Hokkaido University): *Dynamics of interfaces for domain growth problems*

Xuefeng Wang (Tulane University): *Metastability and Stability of Patterns for a Convolution Model for Phase Transitions*

Concentration Phenomena and Vortex Dynamics, PIMS-UBC, July 19–27, 2001

Organizers: Changfeng Gui (UBC) and Wei-Ming Ni (Minnesota)

Concentration phenomena have been discovered in many different areas. Mathematically they appear in the form of vortices in Ginzburg-Landau equations and of spike-layers in biological diffusions, etc. This workshop dealt with the up-to-date advances in these phenomena and the variatonal methods involved. Related equations include Ginzburg-Landau equations, nonlinear Schrodinger equations, Gierer-Meinhardt systems, and others.

Changfeng Gui (UBC), Fang Hua Lin (Courant), Michael Struwe (ETH) and Wei-Ming Ni (Minnesota), the minicourse lecturers for the **Concentration Phenomena and Vortex Dynamics Workshop**.

Mini-course Lecturers:

Michael Struwe (ETH Zurich): 4 lectures on *Concentration problems in two dimensions*

Wei-Ming Ni (University of Minnesota): 2 lectures on*Diffusions, cross-diffusions, and their steady states*

Changfeng Gui (University of British Columbia), 2 lectures on *Diffusions, cross-diffusions, and their steady states*

Fang-Hua Lin (Courant Institute): 4 lectures on *Vortex Dynamics of Ginsburg-Landau and Related Equations.*

Main Speakers:

Robert Jerrard (University of Illinois at Urbana-Champaign): *Vortex filament dynamics for the Gross-Pitaevsky equation*

Yuan Lou (Ohio State University): *A Semilinear Parabolic System for Migration and Selection in Population Genetics*

Yung-Sze Choi (University of Connecticut): *On the blowup of heat flow for conformal 3-harmonic maps*

Henry Warchall (National Science Foundation USA): *Spectrally stable encapsulated-vortex solutions of nonlinear Schrodinger equations (with Robert L. Pego Department of Mathematics University of Maryland)*

Norman Dancer (University of Sydney): *Peak solutions on annular regions and non-degeneracy conditions*

Amandine Aftalion (Université Paris VI): *Vortex energy and vortex bending in Bose Einstein condensates*

Dongho Chae (Seoul National University): *Nontopological Chern-Simons vortices-statics and evolutions*

Jun Cheng Wei (Chinese University of Hong Kong): *Multiple Clusters Generated By Reaction-Diffusion Systems*

Izumi Takagi (Tohoku University): *Remarks on the stability of single-spike patterns in annuli*

Hirokazu Ninomiya (University of Minnesota): *Reaction-diffusion approximation to cross diffusion systems*

Sylvia Serfaty (École Normale Supérieure de Cachan): *Vortices in the static Ginzburg-Landau equations of superconductivity*

Xingbin Pan (National University Singapore): *Concentration Phenomena of Ginzburg-Landau System and Surface Superconductivity*

Fang Hua Lin (Courant Institute): *Vortex dynamics of Ginsburg-Landau and related equations*

Changfeng Gui (University of British Columbia): *Diffusions, cross-diffusions, and their steady states*

Eiji Yanagida (Tohoku University): *Stability analysis for reaction-diffusions systems with gradient/skew-gradient structure*

Matthias Winter (Universitaet Stuttgart): *Concentrated solutions for the two-dimensional Gierer-Meinhardt system*

Patricio Felmer (Universidad de Chile): *Semi-classical limit for the one dimensional Nonlinear Schrodinger Equation*

Masaharu Taniguchi (Tokyo Institute of Technology): *Instability of planar traveling waves in bistable reaction-diffusion systems*

Joseph McKenna (University of Connecticut)

Jack Xin (University of Texas at Austin): *Focusing PDEs and their Applications in Optics and Speech Processing*

Stanley Alama (McMaster University): *Vortices in the Lawrence-Doniach Model of Layered Superconductors in a Parallel Field*

Salome Martinez (University of Minnesota): *Cross-Diffusion for 3x3 competitive systems*

Shoji Yotsutani (Ryokoku University): *Limiting equations for a cross-diffusion system*

Patricia Bauman (Purdue University): *Results on a Ginzburg-Landau Model including Pinning of Vortices*

Vieri Benci (Università degli Studi di Pisa): *Concentration phenomena and solitary waves*

Michael Ward (University of British Columbia): *The Dynamics of Spikes for the Gierer-Meinhardt Model (joint work with David Iron UBC grad student, Juncheng Wei Chinese Univ. of Hong Kong)*

Zheng Chao Han (Rutgers University):

Dmitry Golovaty (University of Akron): *On uniqueness of vector-valued minimizers of the Ginzburg-Landau functional in annular domains*

Gabriella Tarantello (Università Roma II): *On Liouville type equations with singular data*

Variational Methods and their Applications in PDEs, Hamiltonian Systems & Mathematical Physics, PIMS-UBC, July 30 – Aug. 7, 2001

Organizers: Maria J. Esteban (Paris), Nassif Ghoussoub (UBC), Paul Rabinowitz (Wisconsin)

This session dealt with modern variational methods which have been at the core of mathematics for a long time, yet still experiencing major development: Various infinite dimensional extensions of Morse theory, new "gluing" techniques and useful duality methods. Variational methods have had enormous new applications in the study of problems in phase transition, Hamitonian systems, pattern formation, fluid dynamics, Riemannian geometry, etc., as they are used to answer questions about existence, multiplicity, location, asymptotics, concentration, etc.

Mini-course Lecturers:

Maria Esteban (Université Paris IX): 4 lectures on *Variational problems related to operators with gaps and applications in relativistic quantum mechanics*

Eric Séré (Université Paris IX): 4 lectures on *Variational problems in relativistic quantum mechanics: Dirac-Fock equations*

Yann Brenier (Paris): 4 lectures on *Variational problems related to fluid and plasma modelling.*

Main Speakers:

Vieri Benci (Università degli studi du Pisa): *Variational principles for Lorentz invariant field equations*

Jedrzej Sniatycki (University of Calgary): *Structure of a space of solutions for Yang-Mills equations and its quantization*

Robert McCann (University of Toronto): *Optimal Transportation - from Monge and Kantorovich to Beckmann and Beyond: Uniqueness and Transport Density*

Kazunaga Tanaka (Waseda University): *An elementary method for construction of complex solutions in 1-dimensional singular perturbation problems*

Zhi-Qiang Wang (Utah State University): *On weighted Sobolev inequalities and related PDEs*

Patricio Felmer (Universidad de Chile): *Peaks and Multipeaks for Nonlinear Schrodinger equation: A Variational Appproach*

Nassif Ghoussoub (Pacific Institute for the Mathematical Sciences): *On De Giorgi's conjecture in dimensions 4 and 5*

Ugo Bessi (Universita degli studi Roma III):

Gero Friesecke (Oxford University): *2D Curvature functionals as Gamma-limits of 3D non-linear elasticity theory*

Yiming Long (Nankai University): *Closed characteristics on convex and star-shaped hypersurfaces in R^{2n}*

Bernhard Ruf (Università degli studi di Milano): *On a result by Carleson-Chang concerning the Trudinger-Moser inequality*

Pietro Majer (Università di Parma):

Sergey Bolotin (University of Wisconsin–Madison): *Variational methods for connecting orbits of Hamiltonian systems*

Claude Le Bris (CERMICS, École Nationale des ponts et chaussées), *On the ground state energy of systems composed of infinitely many particles*

Susanna Terracini (Politecnico di Milano), *Nehari's method and systems with large interaction*

Pietro Montecchiari (Università degli studi di Ancona), *Multiplicity of entire solutions for non autonomous Allen-Cahn type equations*

Vittorio Coti Zelati (Università di Napoli), *Chaotic behavior for rapidly oscillating Hamiltonian systems*

Gabriella Tarantello (Universit‘a Roma II), *Elliptic problems in vortex theory*

Eric Paturel (Université Paris IX).

Louis Jeanjean (Université de Franche Comté), *An asymptotically linear problem on R^N autonomous at infinity*

Chao-Nien Chen (National Changhua University of Education)

Boris Buffoni (École Polytechnique Fédérale de Lausanne), *Interfaces between homogeneous configurations for elastic cylinders of infinite length*

Patrick Bernard (École Normale Superieure)

Paul Rabinowitz (University of Wisconsin–Madison)

Geometric PDEs, PIMS-UBC, August 8–17, 2001

Organizers: Gang Tian (MIT) and Jingyi Chen (UBC)

This workshop focused on PDE problems arising from geometry particularly in the study of Kahler-Einstein manifolds, minimal surfaces, scalar curvature, harmonic maps, and other phenomena.

Mini-course Lecturers:

Cliff Taubes (Harvard University), 4 lectures on *Pseudoholomorphic geometry as a tool to study smoothe 4-dimensional manifolds*

Richard Schoen (Stanford University), 4 lectures on *Geometric Variational Problems*

Gang Tian (Massachusetts Institute of Technology), 4 lectures on *Recent progress in complex geometry*

Main Speakers:

George Daskalopoulos (Brown University), *The Yang-Mills flow in higher dimensions*

Pengfei Guan (McMaster University), *Hessian equations in classical and conformal geometry*

Nicholas Kapouleas (Brown University), *Singular perturbation constructions for minimal surfaces in the Sphere*

Jiaping Wang (University of Minnesota) *Counting harmonic functions and massive sets*

McKenzie Wang (McMaster University)

Daniel Pollack (University of Washington), *Gluing and wormholes for the Einstein constraint equations*

Jose Escobar (Cornell University), *New results on conformal deformation of metrics*

Robert Gulliver (University of Minnesota), *Embedded Minimal Surfaces and Total Curvature of Curves in a Manifold*

Jim Bryan (University of British Columbia), *Curves in Calabi-Yau 3-folds, Gromov-Witten invariants, and BPS states of M2-branes*

Jeff Cheeger (Courant Institute), *L_2-bounds on curvature and rectifiability of singular sets*

Jiayu Li (Chinese Academy of Sciences)

Ignasi Mundet i Riera (Universidad Autonoma de Madrid), *Hamiltonian Gromov-Witten invariants*

Peter Li (University of California, Irvine), *Duality of local and global estimates for elliptic PDEs*

Yong Geun Oh (Korea Institute for Advanced Study, currently visiting University of Wisconsin–Madison), *Holomorphic volume preserving maps and special Lagrangian submanifolds*

Richard Wentworth (University of California, Irvine)

Emmanuel Hebey (Université de Cergy-Pontoise), *Sharp Sobolev-Poincaré inequalities on Riemannian manifolds*

Bo Guan (University of Tennessee), *A Minkowski Problem for Convex Hypersurface*

Tom Ilmanen (ETH Zentrum), *Minimal surfaces and mean curvature flows with L^2 curvature bounds*

Bill Minicozzi (Johns Hopkins University), *Embedded Minimal Surfaces*

Jingyi Chen (University of British Columbia), *Quaternionic maps between hyperkahler manfolds.*

Theme 2001 (B): Theoretical, Numerical and Industrial Fluid Dynamics

The mathematical **theory of waves** has a wide spectrum of cross-disciplinary applications. In geophysical contexts waves are a primary method by which energy is transported in fluids and they are thus responsible for global circulation of the atmosphere, the oceans and the earth's mantle. In biological contexts, waves are used in the study of haemodynamic neural networks and respiratory flows. Waves are also studied for their use in remote sensing and have been exploited to map our atmosphere from space, to explore and see the deep oceans and to detect biological disease by non-invasive methods.

The equations that describe the most fundamental behavior of a fluid were derived by Euler in 1755. They are the equations of conservation of momentum and conservation of mass of a fluid that is incompressible, has constant density and is inviscid. The initial boundary value problem for the **Euler equations** is surprising difficult and it is perhaps the most challenging of all problems in PDE that arises directly from physics. Incorporation of the effects of viscosity (for friction) leads to the **Navier-Stokes equations**. The fundamental open questions are all related to the issues of the formation of singularities in finite time.

Programme Organizers:

Giovanni P. Galdi (Pittsburgh)
John Heywood (UBC)
Rolf Rannacher (Heidelberg)
Bruce Sutherland (U. Alberta)
Andrew Bush (U. Alberta)
T. Bryant Moodie (U. Alberta)

Workshops:

3rd Annual PIMS Summer School in Industrial Fluid Dynamics,
U. Alberta, June 4–8, 2001

Wave Phenomena III: Waves in fluids from the microscopic to the planetary scale,
U. Alberta, June 11–15, 2001

Workshop on Theoretical and Numerical Fluid Mechanics,
Vancouver, August 20–25, 2001

Participants in the Summer School.

3rd PIMS Summer School in Industrial Fluid Dynamics, University of Alberta, May 27 – June 8, 2001

Organizers: B. R. Sutherland and T. B. Moodie (U. Alberta)

This summer school offered an enriched learning environment in which the theoretical, experimental and computational aspects of fluid dynamics are synthesized. Participants attended a comprehensive series of lectures, and were given hands-on experience performing and analyzing experiments in the Environmental and Industrial Fluid Dynamics Laboratory. In addition, they ran numerical simulations using research-level codes. Topics included fluid dynamics fundamentals, industrial and environmental flows, geophysical fluid dynamics, turbulence modeling and computational fluid dynamics.

This year's summer school was particularly rewarding for the students since it was held in conjunction with the PIMS Thematic Programme on Wave Phenomena and Fluid Dynamics. Special invited speakers were T. G. Shepherd (U. Toronto) who spoke on *The Fluid Dynamics of the Middle Atmosphere* and H. J. S. Fernando (Arizona State) who spoke on *Turbulence and Mixing in Stably Stratified Fluid Layers.*

Core Lecturers from U. Alberta

John C. Bowman, *Turbulence Modelling*;
Andrew B. G. Bush, *Climate Modelling*;
Peter Minev, *Computational Fluid Dynamics*;
T. Bryant Moodie, *Wave Theory*;
Bruce R. Sutherland, *Stratified Flows* and
Gordon E. Swaters, *Physical Oceanography.*

Wave Phenomena III: Waves in fluids from the microscopic to the planetary scale, University of Alberta, Edmonton, June 11–15, 2001

Conference Organisers: T. B. Moodie, Andrew Bush, Bruce Sutherland, Gordon Swaters (U. Alberta)

Bruce Sutherland & John Bowman having a break.

The wave concept links together such diverse disciplines as geophysics, oceanography, meteorology, astrophysics, physiology, and biology. In geophysical contexts, waves are a primary method by which energy is transported in fluids and they are thus responsible for global circulation of the atmosphere, the oceans, and the earth's mantle. In biological contexts, waves are used in the study of haemodynamics, neural networks, and respiratory flows. Waves are also studied intensively for their use in remote sensing and have been exploited to map our atmosphere from space, to explore and see the deep oceans, and to detect disease by non-invasive methods. The enormous range of spatial scales spanned by waves is indicative of their relevance to many disciplines.

The previous two Wave Phenomena meetings were also successful and focused on wave propagation phenomena in a wide spectrum of applications. For the third Wave Phenomena Meeting, we chose to focus on the fluid medium for wave transmission. We did this first because of the general importance of the subject at this time with its relation to world climate change and our concerns with this change and second in order to better mesh with the topics of the **3rd PIMS Summer School in Fluid Dynamics**, which immediately preceded the conference.

Waves III was attended by 145 delegates from Canada, Mexico, USA, Turkey, Ghana, France, Germany, The Netherlands, Scotland, Italy, India, Denmark, China, Japan, Sweden, New Zealand, Taiwan, Australia, and Russia.

There were a total of 23 plenary talks that were given in the morning session each day. These were then followed by the contributed talks that were held in 5 parallel sessions during the afternoons.

The opening address was given by **Dick Peter** (Dean of Science, University of Alberta) who emphasized the important role that has been played in the mathematics community by The Pacific Institute for the Mathematical Sciences and how meetings of this calibre would not be possible without the support of PIMS.

Plenary Speakers:

Carlo Cercignani (Poli. di Milano) *On the Structure of Infinitely Strong Shock Waves*

Jerry L. Bona (Univ. of Texas at Austin) *Nearshore Zone Dynamics and Beach Protection*

David Benney *Some Evolution Equations for Selective Disturbances in Hydrodynamics*

Colin Rogers (Univ. of New South Wales) *Intrinsic Geometry in Soliton Theory: Hydodynamic and Magnetohydrostatic Connections*

Michael S. Longuet-Higgins (Univ. of California, San Diego) *Dynamics of Standing Surface Waves: a Review*

S. George Philander (Princeton Univ.) *How El Nino Changes when Climate Changes*

Andrew J. Majda (Courant Institute) *Convectively Coupled Tropical Waves*

Michael E. McIntyre (Univ. of Cambridge) *The Pseudomomentum Rule Revisited: Wave-Mean Interaction*

Melvin E. Stern (Florida State Univ.) *Internal Waves Amplified by Salt Fingers*

J.A. Whitehead (Woods Hole Oceanographic Inst.) *Upstream and Downstream Adjustment of Controlled Hydraulic Flows*

P.L. Sachdev (Indian Inst. of Science, Bangalore) *Asymptotic Behavior of Some Nonlinear Partial Differential Equations*

Peter G. Baines (CSIRO, Australia) *Dynamics of the Antarctic Circumpolar Wave*

H.J.S. Fernando (Arizona State Univ.) *Turbulence and Mixing in Stably Stratified Fluid Layers*

Roger Grimshaw (Monash Univ.) *Coupled Korteweg-de Vries Equations; Solitary Wave Interactions Growth and Saturation*

Richard S. Lindzen (MIT) *What Limits Linear Growth?*

Peter B. Rhines (Univ. of Washington) *Teaching Waves in the GFD Lab*

R.T. Pierrehumbert (Univ. of Chicago) *Martian Baroclinic Amplitude Internal Solitary Waves in the Slope-shelf Area*

A. Newell (Univ. of Warwick) *Wave Turbulence and Intermittency*

James C. McWilliams, Lee Paul Graves, Michael T. Montgomery (Univ. of California, Los Angeles) *A Formal Theory for Vortex Rossby Waves and Vortex Evolution: Natural Selection of Anticyclones at F*

W.R. Peltier (Univ. of Toronto) *Breaking Waves and Mixing in Stratified Flows*

Robert M. Miura, Jennifer Enns-Tuttan, Yuquing Wang (UBC) *Waves in the Brain*

Theodore G. Shepherd (Univ. of Toronto) *Wave-vortex Interactions and Implications for Mixing in the Middle Atmosphere*

Interested readers may view a complete list of speakers together with their abstracts, contact information, and pictures on the website **waves3.math.ualberta.ca**.

Workshop on Theoretical and Numerical Fluid Mechanics Vancouver, August 20–25, 2001

Organizers: Giovanni P. Galdi (Pittsburgh), John Heywood (UBC, chairman), Rolf Rannacher (Heidelberg)

The meeting brought together leading researchers from several areas of fluid dynamics to share recent developments, discuss their significance, and bring into focus new directions and problems. The topics considered shared a unifying theme, in that their theoretical starting points are in the mathematical theory of the Navier-Stokes equations. Specifically, the focus was on: Nonlinear Fluids, Turbulence, Viscous Compressible Flow, Classical Navier-Stokes Problems, and Numerical Methods for these various types of problems.

Another focus was to bring to attention interesting problems for numerical computation. Presently, we have achieved the capability to compute two and three dimensional incompressible Navier-Stokes flow in complicated geometries, provided that the complexity of the solution (its range of scales) does not exceed the limitations of our hardware. The aim was to promote the extension of current numerical meth-

ods to problems for compressible and nonlinear fluids, and also to the modeling of turbulent flow. Also, with improved computational ability, many classical Navier-Stokes problems have become suggestive of interesting situations for numerical computation. Many of these raise interesting questions concerning artificial boundary conditions, for the restriction of idealized problems to bounded computational domains. Other problems for numerical computation involve questions of stability and bifurcation, and of attractors, and of the statistical properties of attractors, and of the energy dissipation in different regions of the spectrum.

Finally, the meeting brought Canadian and American research in mathematical fluid dynamics into better contact with European and Japanese research.

Main Speakers:

Pironneau, Olivier (U. of Montpellier II and of Paris VI, France) *Optimal Shape Design with Turbulent flows*

Hughes, Thomas J.R. (Stanford U., USA) *Large eddy simulation and the variational multiscale method*

Masuda, Kyuya (Meiji U., Japan) *Equations in Fluid Mechanics and analyticity*

Mahalov, Alex (Arizona State U., USA) *3D Navier-Stokes and Euler Equations with Initial Data Characterized by Uniformly Large Vorticity*

Neustupa, Jiri (Charles U., Prague, Czech Republic) *Conditions for Local Regularity of a Weak Solution to the Navier-Stokes Equations*

Choe, Hi Jun (KAIST, Korea) *On the regularity criterion of Navier-Stokes equations*

Turek, Stefan (U. of Dortmund, Germany) *On the next generation of CFD Tools*

Kevlahan, Nicholas (McMaster U., Canada) *An adaptive wavelet method for fluid-structure interaction*

Rautmann, Reimund (U. of Paderborn, Germany) *Navier-Stokes Approximations in Interpolation Spaces*

Matsumura, Akitaka (Osaka U., Japan) *Inflow problems for a one-dimensional isentropic model system of compressible viscous gas*

Hoff, David (U. of Indiana, USA) *Dynamics of Singularity Surfaces for Multidimensional, Compressible Navier-Stokes Flows*

Pileckas, Konstantin (Vilnius U., Lithuania) *Asymptotics of Solutions to Navier-Stokes Equations in a Three- Dimensional Layer*

Kroener, Dietmar (U. of Freiburg, Germany) *Transparent boundary conditions for compressible flows*

Novotny, Antonin (U. of Toulon, France) *Navier-Stokes equations when the density is not square integrable*

Bause, Markus (U. of Erlangen, Germany) *Approximation schemes for stationary compressible viscous flow*

Nagata, Wayne (U. of British Columbia, Canada) *Bifurcations on spheres and hemispheres: convection in planets and branching of plant tips*

Bermejo, Rodolfo (Universidad Complutense de Madrid, Spain) *A numerical study of the attractor of 2D Navier-Stokes equations applied to Ocean dynamics*

Morrison, Philip (U. of Texas, Austin, USA) *Transport by chaotic advection with nontwist Hamiltonian flows and symplectic maps of the plane*

Amann, Herbert (Institute for Mathematics, U. of Zrich, Switzerland) *Navier-Stokes equations in spaces of low regularity*

Beale, Thomas J. (Duke U., USA) *Computational Methods for Singular and Nearly Singular Integrals in Incompressible Fluid Flow*

Straskraba, Ivan (Mathematical Institute, Czech Academy of Sciences, Czech Republic) *A brief summary of global properties of solutions to the compressible Navier-Stokes equations*

Jindrich Necas (Charles U. Institute of Mathematics, Prague, Czech Republic) *Global Analysis for fluids with pressure dependent viscosities*

Frigaard, Ian (U. of British Columbia, Canada) *Stability problems in parallel shear flows of visco-plastic fluids*

Schonbek, Maria (U. of California at Santa Cruz, USA) *On zero mass solutions of viscous conservation laws*

Shibata, Yoshihiro (Waseda U., Japan) *Stokes resolvent problem with Neumann type boundary condition*

Wiegner, Michael (Institute of Technology at Aachen, Germany) *The Stokes Semigroup on an Infinite Layer*

Sawada, Okihiro (Hokkaido U., Japan) *Global existence of two-dimensionl Navier-Stokes flow with nondecaying initial velocity*

Galdi, Giovanni P. (U. of Pittsburgh, USA) *Sedimentation of Symmetric Particles in Newtonian and Viscoelastic Liquids: A Mathematical Analysis with Applications*

Glowinski, Roland (U. of Houston, USA) *On the motion of pendula in incompressible viscous fluids: A numerical approach*

Finn, Robert (Stanford U., USA) *Six remarkable properties of capillary surfaces*

Padula, Mariarosaria (U. of Ferrara, Italy) *Stability of an isolated fluid drop rotating with finite angular velocity*

Heine, Claus (Institute of Technology at Aachen, Germany) *A Numerical Method for Shape and Stability of the Rotating Drop*

Siegel, David (U. of Waterloo, Canada) *Equilibrium Configurations For A Floating Drop*

Farwig, Reinhard (Institute of Technology at Darmstadt, Germany) *Maximal Regularity of the Stokes Operator in an Infinite Cylinder*

Guenther, Ronald (Oregon State U., USA) *Hydrodynamic Forces and Torques on Submerged Rigid Bodies - Steady Flow*

Avrin, Joel (U. of North Carolina at Charlotte, USA) *A Large-Frequency One Point Attractor Theory for the incompressible Navier-Stokes Equation on Bounded Domains*

Rannacher, Rolf (U. of Heidelberg, Germany) *Adaptive discretization in optimal control of flows*

Illner, Reinhard (U. of Victoria, Canada) *Diffusive equilibria in granular flow*

Fujita, Hiroshi (Tokai U., Tokyo) *Nonlinear Semigroup Theory and Nonstationary Stokes Flows under Boundary Conditions of Friction Type*

Sauer, Niko (U. of Pretoria, South Africa) *A model for boundary permeation*

Bowman, John (U. of Alberta, Canada) *A Statistical Description of Two and Three-Dimensional Turbulence*

Tran, Chuong (U. of Alberta, Canada) *Constraints on the spectral distribution of energy and enstrophy dissipation in forced two-dimensional turbulence*

Theme 2002 (A): Asymptotic Geometric Analysis

Asymptotic Geometric Analysis is concerned with the geometric and linear properties of finite-dimensional convex bodies, especially with the asymptotics of various quantitative parameters as the dimension of the underlying space tends to infinity. The techniques here combine geometric, analytic, probabilistic and combinatorial methods. The main directions of study are:

- *Convex Geometric Analysis* including problems from Classical Convexity and Isomorphic Geometry.
- *Asymtotic Combinatorics* including questions in Complexity Theory and Computational Geometry.
- Certain aspects of *Statistical Physics* that deals with "Threshold" and "Phase Transition" phenomena.

The main probabilistic tools used are deviation inequalities and the concept of concentration of measure phenomenon, which in fact is, an isomorphic form of isoperimetric type inequalities. Measure Transport methods and related PDEs have provided new and powerful *Geometric Inequalities* of Brunn-Minkowski and Brascamp-Lieb type as well as novel approaches to Log-Sobolev and Talagrand-type inequalities. The subject is also connected with *quantized functional analysis* via important estimates for the distribution of eigenvalues and norms of random matrices, as well as with some aspects of free and quantum information theories, operator spaces and non-commutative L_p spaces.

Scientific Committee:

Vitali Milman (co-chair, Tel Aviv)
Nicole Tomczak-Jaegermann (co-chair, U. Alberta)
Nassif Ghoussoub (PIMS and UBC)
Robert McCann (U. Toronto)
Gideon Schechtman (Weismann Inst.)
Gilles Pisier (U. of Paris VI and Texas A&M)

Programme:

Advanced Graduate Camp
PIMS-UBC, June 15–30, 2002

Conference on Convexity and asymptotic theory of normed spaces
PIMS-UBC, July 1–5, 2002

Concentration period on Measure Transportation and Geometric Inequalities
PIMS-UBC, July 8–12, 2002

Workshop on Phenomena of large dimensions
PIMS-UBC, July 14-20, 2002

Focused Research Groups on Random Methods and High Dimensional Systems
PIMS-UBC, July 21–August 5, 2002

Workshop on Non-commutative Phenomena and Random Matrices
PIMS-UBC, August 6–9, 2002

Workshop on Banach Spaces
PIMS-UBC, August 12–15, 2002

Programme Summary and Schedule:

The goal of this thematic program is to bring together some areas of Mathematics and Computer Science which are dealing with asymtotic behavior of different parameters when the dimension, or a number of other relevant free parameters, increases to infinity . The main directions of this subject of study are Convex Geometric Analysis (Asymptotic Theory of convex bodies and Normed spaces), some problems of Discrete Mathematics (one may call it Asymptotic Combinatorics) including problems of Complexity Theory, and some problems of Statistical Physics. Closely connected are also some directions in Probability and in PDE, including non linear PDEs arising from problems in Convex Analysis and Geometric Inequalities. The main activity will concentrate around Convex Geometric Analysis, but understood in a very broad sense, as the intent is to involve a large number of main people of other related fields.

The intent is to bring together senior experts and young researchers, postdocs and advanced Ph.D. students, with an emphasis on a major participation from the young generation.

Advanced Graduate Camp
PIMS-UBC,
June 15–30, 2002

Organizers: Vitali Milman (Tel Aviv) and Nicole Tomczak-Jaegermann (U. Alberta).

Lectures on subjects connected with the whole program directed to young participants, advanced Ph.D. students and PDFs.

Conference on Convexity and asymptotic theory of normed spaces
PIMS-UBC,
July 1–5, 2002

Organizers: Erwin Lutwak (Warsaw) and Alain Pajor (Marne-La-Vallée).

Topics include classical convexity, Radon transform and Fourier methods in convexity, asymptotic theory of high dimensional convex bodies, geometric functional inequalities and probabilistic methods in convexity, isoperimetric-type inequalities.

Concentration period on Measure Transportation and Geometric Inequalities
PIMS-UBC,
July 8–12, 2002

Organizer: Robert McCann (U. Toronto).

This concentration period will focus on transportation of measure methods and their applications, concentration of measure phenomenon, geometric functional inequalities (Brascamp-Lieb, Sobolev, entropy, Cramer-Crao, etc), "isomorphic" form of geometric inequalities and probabilistic methods.

Workshop on Phenomena of large dimensions
PIMS-UBC,
July 14–20, 2002

Organizers: Vitali Milman (Tel Aviv), Michael Krivilevich, Laszlo Lovasz (Microsoft Research) and Leonid Pastur (U. Paris VII).

Topics include different phenomena observed in complexity theory, asymptotic combinatorics, asymptotic convexity, statistical physics and other theories of very high parametric families (or large dimensional spaces).

Focused Research Groups on Random Methods and High Dimensional Systems
PIMS-UBC,
July 21–August 5, 2002

Organizers: Vitali Milman (Tel Aviv) and Nicole Tomczak-Jaegermann (U. Alberta).

Topics include the asymtotic behavior of different parameters when the dimension, or a number of other relevant free parameters, increases to infinity. The main direction is the study of the asymptotic theory of convex bodies and normed spaces as well as their applications to combinatorics and phase transition phenomena.

Workshop on Non-commutative Phenomena and Random Matrices PIMS-UBC, August 6–9, 2002

Organizers: Gilles Pisier (U. Paris VI and Texas A & M) and Stanislaw Szarek (U. Paris VI and Case Western Reserve).

Topics include the distribution of eigenvalues of random matrices, norms of such matrices, some aspects of free and quantum information theories, applications in many fields, quantized functional analysis and operator spaces and non-commutative L_p spaces.

Workshop on Banach Spaces PIMS-UBC, August 12–15, 2002

Organizers: Bill Johnson (Texas A & M and Ted Odell (U. Texas, Austin).

This workshop will focus on the asymptotic theory of Banach spaces and other applications of local theory to the geometry of infinite dimensional Banach spaces.

Theme 2002 (B): Selected Topics in Mathematical and Industrial Statistics

Statistical models became, in the late 20th century extremely complex and high dimensional. One goal is to identify opportunities and challenges for model development and criticism and to begin to outline approaches to assessment of complex models. This requires bringing together leading practitioners and philosophers of scientific, Bayesian and frequentist modelling statistics with leading researchers in model assessment, validation and goodness-of-fit.

Robust Statistics and Statistical Computing deal with methods designed for processing large data sets of uneven quality (databases containing outliers, gross errors, missing data, etc.). One focus is on the efficient computation of robust estimates using very large data sets.

Design and Analysis of Experiments are at the heart of the statistical sciences. Yet –unlike the designs originating from agricultural problems developed by Sir Ronald Fisher in the 1920's– many industrial problems are not well-explored in the statistical literature. To help North American industry compete globally, advanced statistical methods suitable for real applications need to be further developed.

Programme Organizers:

Richard Lockhart (SFU)

Charmaine Dean (SFU)

Peter Guttorp (U. Washington)

Chris Field (Dalhousie)

R. H. Zamar (UBC)

Randy Sitter (SFU)

Agnes Herzberg (Queen's)

Programme:

Workshop on the Role of Statistical Modelling in the 21st Century
PIMS-SFU, May 4–6, 2002

International Conference on Robust Statistics (ICORS 2002)
UBC, May 12–18, 2002

3rd MITACS Annual General Meeting: Statistics for Large Scale Industrial Modeling
UBC, Vancouver, May 23-25, 2002

Design and Analysis of Experiments
Vancouver, July 14–18, 2002

Workshop on the Role of Statistical Modelling in the 21st Century, PIMS-SFU, May 4–6, 2002

Organizers: Richard Lockhart and Charmaine Dean (SFU) and Peter Guttorp (U. Washington).

Statistical models became, in the late 20th century extremely complex and high dimensional. This workshop will bring together leading practitioners and philosophers of scientific, Bayesian and frequentist modelling statistics with leading researchers in model assessment, validation and goodness-of-fit. The goals are to identify opportunities and challenges for model development and criticism and to begin to outline approaches to assessment of complex models.

Confirmed Speakers:

David Brillinger (UC at Berkeley)
Alan Gelfand (University of Connecticut)
Jim Berger (Duke University – tentative)
Jerry Lawless (University of Waterloo)
Iain Currie (Heriot-Watt University)
Karim Abadir (University of York, York, UK)
Federico O'Reilly (IIMAS, UNAM – Mexico)

Invited Speakers:

Joe Gani (Australian National University)
Anthony Pettitt (Queensland University of Technology)
Christian Genest (Universite Laval)
Persi Diaconis (Stanford University)
Jianqing Fan (North Carolina and Chinese Univ of Hong Kong)

International Conference on Robust Statistics (ICORS 2002), University of British Columbia, May 12–18, 2002

Conference Organisers: Luisa Fernholz (Temple Univ.), Ursula Gather (Dortmund), Chris Field (Dalhousie) and R. H. Zamar (UBC).

This conference will be a forum for new developments and applications of robust statistics and statistical computing. Experienced researchers and practitioners, as well as younger researchers, will come together to exchange knowledge and to build scientific contacts.

The conference will centre on methods designed for processing large datasets of uneven quality (databases containing outliers, gross errors, missing data, etc.). This conference expects to touch upon many different aspects of data analysis in a fashion which integrates theoretical and applied statistics. One focus will be on the efficient computation of robust estimates using very large data sets.

Confirmed Participants:

Laury Davies (Univ. of Essen, Germany)
Luisa Fernholz (Temple Univ.)
Chris Field (Dalhousie Univ.)
Ursula Gather (Univ. of Dortmund, Germany)
Xuming He (Univ. of Illinois)
Ricardo Maronna (Univ. of La Plata, Argentina)
Doug Martin (Univ. of Washington)
Stephan Morgenthaler (EPFL, Switzerland)
Elvszio Ronchetti (Univ. of Geneva)
Peter Rousseeuw (Univ. of Antwerpen, Belgium)
Werner Stahel (ETH Zurich)
David Tyler (Rutgers University)
Doug Wiens (Univ. of Alberta)
Victor Yohai (Univ. of Buenos Aires)
Julie Zhu (Univ. of Victoria)
Christopher Croux (Univ. of Brussels)

Design and Analysis of Experiments, Coast Plaza Suites Hotel, Vancouver, July 14–18, 2002

Organizers: Randy Sitter (SFU), Derek Bingham (Michigan), Bruce Ankenman (Northwestern) and Agnes Herzberg (Queen's U.).

Many industrial problems are not well-explored in the statistical literature. To help North American industry compete globally, advanced statistical methods suitable for real applications need to be further developed. Statistical experimental designs, developed by Sir Ronald Fisher in the 1920's, largely originated from agricultural problems. Although the design of experiments for industrial and scientific problems may have

the same basic concerns as design for agricultural problems, there are many differences: (i) industrial problems tend to require investigation of a much larger number of factors and usually involve a much smaller total number of runs (observations), (ii) industrial results are more reproducible, (iii) industrial experimenters are obliged to run their experimental points in sequence and are thus able to plan their follow-up experiments guided by previous results, unlike agriculture, in which all results are often harvested at one time, and (iii) models can be very complicated in industrial and scientific experimentation, sometimes requiring the need for nonlinear models or for computer modelling and finite element analysis.

Invited Speakers:

C. S. Cheng (UC at Berkeley)
V. Federov (SmithKline Beecham Pharmaceutical)
M. Hamada (Los Alamos National Laboratory)
J. Lawless (University of Waterloo)
M. Morris (Iowa State University, Ames)
R. Mukerjee (Indian Institute of Management, Calcutta)
V. Nair (University of Michigan, Ann Arbor)
J. Stufken (Iowa State University, Ames)
C. F. J. Wu (University of Michigan, Ann Arbor)
J. Zidek (UBC)