

Presentation of the ICIAM Prizes 2007 by Ian Sloan, Chair of the Prize Committee

Five prizes are awarded, in connection with the ICIAM Congresses¹. Prize winners are selected by the ICIAM Prize Committee. For 2007 this committee was chaired by Ian Sloan (The University of New South Wales, Australia), who was President of ICIAM at that time.

The other members of the committee were:

- Li Da-Qian (Fudan University, China);
- Joyce McLaughlin (Rensselaer Polytechnic Institute, USA);
- Volker Mehrmann (Technische Universität Berlin, Germany);
- Mario Primicerio (Università degli Studi di Firenze, Italy);
- Juan Luis Vazquez (Universidad Complutense Madrid, Spain).

Each prize has its own subcommittee, chaired by one member of the Prize Committee. These subcommittees work independently, but the final decision is made by the Prize Committee as a whole. Members of subcommittees are made public at the time the prize winners are announced; these are listed below, along with the prize specifications and recipient.

The Prizes were presented by the President of ICIAM, Ian Sloan.

ICIAM Pioneer Prize

This prize is funded by the Society for Industrial and Applied Mathematics (SIAM). It was established for pioneering work in introducing applied mathematical methods and scientific computing techniques to an industrial problem area or a new scientific field of applications. The prize commemorates the spirit and impact of the American pioneers.

Two ICIAM Pioneer Prizes are awarded in 2007. Since the chair of the ICIAM Pioneer Prize subcommittee, Joyce McLaughlin, could not attend the ceremony the President of SIAM, Cleve Moler, presented the Prize Winners and the appreciations.

¹Four prizes were awarded for the first time at ICIAM'99, held in Edinburgh. At that time they were called the CICIAM Prizes. In 2007 a new prize has been awarded for the first time, the ICIAM Su Buchin Prize

An ICIAM Pioneer Prize for 2007 is awarded to **Ingrid Daubechies** (Princeton University, USA) *in recognition of her pioneering work in applied mathematics and applications. Her work is a permanent contribution to mathematics, science and engineering and has found widespread use in image processing and time frequency analysis.*



C. Moler, I. Daubechies, I. Sloan

Daubechies' best known achievement is her construction of compactly supported wavelets in the late 1980's. Since that time she has advanced the development of bi-orthogonal wavelet bases. These bases are currently the most commonly used bases for data compression. Daubechies' name is widely associated with the bi-orthogonal CDF wavelet. Wavelets from this family are currently used in JPEG 2000 for both lossless and lossy compression. Her continuing wavelet research also resulted in path breaking work including the discovery of Wilson bases. This discovery led to the existence of cosine packet libraries of orthonormal bases and Gaussian bases. They are now standard tools in time frequency analysis and numerical solutions of partial differential equations.

An ICIAM Pioneer Prize for 2007 is awarded to **Heinz Engl** (Johannes Kepler University Linz, Austria, and Austrian Academy of Sciences, Austria) *in recognition of his application of inverse problems to a wide range of industrial problems, his promotion worldwide of industrial/applied mathematics problem solving and his initiative to significantly advance applied mathematics components in the Austrian Mathematical Community.*



C. Moler, H. Engl, I. Sloan

Engl is well known for his exceptional organizational leadership. His activities include founding RICAM, the Johann Radon Institute for Computational and Applied Mathematics, located in Linz, Austria and funded by the Austrian Academy of Sciences and leading the Industrial Mathematics Competence Center which has major industrial funding. He is currently Vice Rector for Research at the University of Vienna. At the same time, Engl has made substantial contributions to the convergence theory of regularization methods including lifting those theories to a stochastic setting and producing a standard reference, the 1996 book, *Regularization of Inverse Problems* by Engl, Hanke and Neubauer. Engls applications of these methods include heat conduction, semiconductor equations and, most recently, inverse problems for ion channels with application to systems biology. While Engl has overseen a large number of industrial mathematics projects, one of the exceptional projects includes contributions to inverse problems in continuous casting and hot rolling of steel and the development of a detailed simulation model for the blast furnace in iron making.

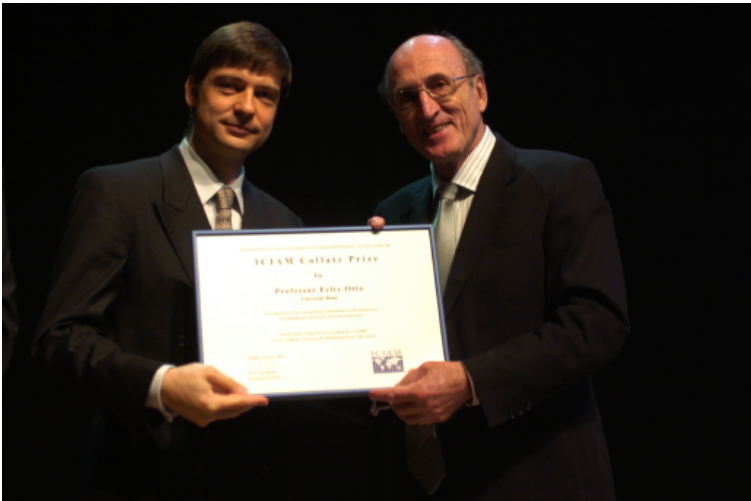
The subcommittee for ICIAM Pioneer Prizes was:

- Joyce McLaughlin (Chair; Rensselaer Polytechnic Institute, Troy, USA);
- Roderick Wong (City University Hong Kong, China);
- Helmut Neunzert (Technische Universität Kaiserslautern, Germany);
- John Maddocks (Ecole Polytechnique Lausanne, Switzerland);
- Stan Osher (University of California Los Angeles, USA);
- Masahiro Yamamoto (The University of Tokyo, Japan).

ICIAM Collatz Prize

This prize is funded by Gesellschaft für Angewandte Mathematik und Mechanik (GAMM). It was established to provide international recognition to individual scientists under 42 years of age for outstanding work on industrial and applied mathematics.

The ICIAM Collatz Prize for 2007 is awarded to **Felix Otto** (University Bonn), *in recognition of his outstanding contributions to the analysis of micromagnetics problems and coarsening rates.*



F. Otto, I. Sloan

The Chair of the ICIAM Collatz Prize Subcommittee, Volker Mehrmann, presented the Prize Winner and the appreciation.

Felix Otto is among the premier applied analysts of his generation. As an analyst, he has made fundamental contributions in areas ranging from micromagnetics, to coarsening rates during phase separation, to mass transportation problems. His work has given these areas a sense of clarity and definitiveness that has gone far beyond the reach of existing heuristic arguments.

In a series of papers, some joint with Cantero-Alvarez, Antonio Desimone, Bob Kohn and Stefan Müller, Felix Otto and co-workers have analyzed the Landau-Lifshitz model of micromagnetics in considerable detail. It is through the work of Felix Otto and his co-workers that we now understand the scaling and the energy landscape of this complex problem in many different regimes.

Felix Otto's work is a unique combination of deep physical insight, sophisticated scaling and heuristic arguments, and above all deep and interesting analysis. His work is applied analysis at its very best – applying rigorous analysis to clarify issues

that were previously confused, and providing fresh insight through the introduction of entirely new models and methods.

The subcommittee for the ICIAM Collatz Prize was:

- Volker Mehrmann (Chair; Technische Universität Berlin, Germany);
- Miloslav Feistauer (Charles University Prague, Czech Republic);
- Alfio Quarteroni (Ecole Polytechnique Lausanne, Switzerland);
- Weinan E (Princeton University, USA);
- Barbara Keyfitz (Fields Institute, Toronto, Canada).

ICIAM Lagrange Prize

This prize is funded by SMAI, SEMA and SIMAI. It was established to provide international recognition to individual mathematicians who have made an exceptional contribution to applied mathematics throughout their careers.

The ICIAM Lagrange Prize for 2007 is awarded to **Joseph Keller** (Stanford University, USA), *in recognition of his original and profound contributions that span the most varied areas of modern science. His work is marked by deep mathematical analyses and has deeply influenced the course of modern applied mathematics.*



J.L. Vazques, J. Keller, I. Sloan

The Chair of the ICIAM Lagrange Prize Subcommittee, Juan Luis Vazquez, presented the Prize Winner and the appreciation.

Professor J.B. Keller is an internationally renowned applied mathematician of the highest quality, a scientist who has deeply influenced the course of modern applied mathematics. In the last 50 years he has made many original and profound contributions that span the most varied areas of modern science. His profound contributions to applied mathematics have had great impact in science and engineering as well as in pure mathematics. He developed the Geometrical Theory of Diffraction that provided the first systematic description of wave propagation around edges and corners of an obstacle. It has been widely used for radar reflection from targets, elastic wave scattering from defects in solids, acoustic wave propagation in ocean radar and many other fields. It also served as a starting point for development of the modern theory of linear partial differential equations. Keller formulated the Einstein-Brillouin-Keller (EBK) method to determine energy levels of atoms and molecules in quantum mechanics and to solve characteristic value problems in other fields. As part of this work, he derived the Keller-Maslov index for the change in a wave as it passes along a caustic. He has also made important and often seminal contributions to many other fields, including singular perturbation theory, bifurcation studies in partial differential equations, nonlinear geometrical optics and acoustics, inverse scattering, effective equations for composite media, biophysics, biomechanics, carcinogenesis, optimal design, hydrodynamic surface waves, transport theory and waves in random media.

Keller combines a very special creativity in the development of mathematical techniques with deep physical insight. He has the ability to describe real-world problems by simple yet realistic mathematical models, to create sophisticated techniques to solve these problems and to explain the results and their consequences in simple terms. He has greatly influenced several generations of applied mathematicians, including more than 50 PhD students, many postdoctoral researchers, and a large number of co-workers.

Juan Luis Vazquez, the chair of the Subcommittee for the Lagrange Prize.

The subcommittee for the ICIAM Lagrange Prize was:

- Juan Luis Vazquez (Chair; Universidad Complutense Madrid, Spain);
- Li Da-Qian (Fudan University, Shanghai);
- Irene Fonseca (Carnegie Mellon, USA);
- Peter Markowitch (Technische Universität Wien, Austria);
- George Papanicolaou (Stanford University, USA);
- Pierre-Arnaud Raviart (CNRS Jussieu, France).

ICIAM Maxwell Prize

This prize is funded jointly by the Institute of Mathematics and its Applications (IMA) and the James Clerk Maxwell Foundation. It was established to provide international recognition to a mathematician who has demonstrated originality in applied mathematics.

The ICIAM Maxwell Prize for 2007 is awarded to **Peter Deuffhard** (Free University Berlin, Germany), *in recognition of the contributions he made in many fields of applied mathematics; his results in modelling, visualizations and optimisations had a relevant impact in many branches of medical and surgical practice.*



M. Primicerio, P. Deuffhard, I. Sloan

The Chair of the ICIAM Maxwell Prize Subcommittee, Mario Primicerio, presented the Prize Winner and the appreciation.

Peter Deuffhard's contributions to applied mathematics have a breadth, depth and originality that is almost without parallel. His contributions to algorithm oriented numerical analysis are fundamental and range from highly nonlinear algebraic systems through large scale ordinary and partial differential equations to Markov chains. Within these fields they cover direct and inverse problems, optimization aspects and optimal control. Characteristic of his work is that he always lays a firm, often innovative mathematical basis on which he constructs his highly efficient algorithms for hard real life problems in science and technology. His style of research has revolutionized scientific computing, a large number of highly reputed scholars follow his tracks.

The range of application areas Peter has contributed to is stunning. Among them are (just in recent years):

- Chemical engineering (chemical combustion, car engine catalysators, hydrogen motors, pollution reduction in coal power stations, ...)
- Microwave technology up to nano-optics (numerical treatment of high frequency Maxwell equations, Schroedinger-type equations, discrete transparent boundary conditions, design of nano-phonic devices, ...)

- Medicine (optimal therapy planning in hyperthermia treatment of cancer, thermoregulation in the human vascular system, modelling and simulation of human motion for osteotomic surgery, 3D image segmentation, computer assisted facial surgery, ...)
- Biotechnology (molecular conformation dynamics, computational drug design, virtual screening, understanding of prion diseases, ...)

The efficiency of his algorithms typically originates from new mathematical and algorithmic concepts that Peter has invented and designed. Let me mention a few of them: affine invariant Newton and Gauss-Newton techniques, from small nonlinear algebraic systems (e.g., in multiple shooting or collocation methods for boundary value problems for ODEs) to adaptive multilevel finite element methods for PDEs; extrapolation methods for ordinary differential equations (order and stepsize control for non-stiff, stiff, and differential- algebraic equations, linearly implicit methods for stiff and differential equations); discrete Galerkin methods for countable differential equations (important in polymer chemistry); cascadic multigrid methods; and, most recently, Perron cluster analysis.

Peter collaborates intensively with engineers, physicians, practitioners, and scientists in many different fields. He was quintessential in forming modern scientific computing as a field integrating a wide range of applied mathematicians, computer and other scientists aiming at a fundamental understanding of phenomena and processes by combining mathematics and computing technology.

The subcommittee for the ICIAM Maxwell Prize was:

- Mario Primicerio (Chair; Universit degli Studi di Firenze, Italy);
- Michael Berry (University of Bristol, United Kingdom);
- Stephen Davis (Northwestern University, USA);
- Leah Edelstein-Keshet (University of British Columbia, Canada);
- Etienne Guyon (Ecole Supérieure de Physique et de Chimie Industrielles de la ville de Paris, France);
- Masayasu Mimura (Hiroshima University, Japan).

ICIAM Su Buchin Prize

This prize was created on the initiative of The China Society for Industrial and Applied Mathematics (CSIAM) and is awarded for the first time in 2007. It is fully sponsored by CSIAM with the fund of Higher Education Press, China. Established in 2003 to provide international recognition of an outstanding contribution by an individual in the application of mathematics to emerging economics and human development, in particular at the economic and cultural level in developing countries.

The ICIAM Su Buchin Prize for 2007 is awarded to **Gilbert Strang** (Massachusetts Institute of Technology, USA), *in recognition of his outstanding contribution in the application of mathematics to emerging economies and human development.*



D. Li, G. Strang, I. Sloan

The Chair of the ICIAM Su Buchin Prize Subcommittee, Li Da-Quian, presented the Prize Winner and the appreciation.

Gilbert Strang has made great contributions in many areas of pure and applied mathematics, including finite element methods, linear algebra and matrix theory, wavelet analysis, signal and image processing, geodesy and telecommunications. He has also made remarkable contributions to the promotion of mathematical research and education in developing countries, and has had significant impact on human development in the area of mathematics. He has visited China eight times, and during these visits has spent much time in discussing mathematics and sharing teaching experiences with many Chinese students, researchers and teachers. His book “An Analysis of the Finite Element Method” (with George Fix, Prentice-Hall, 1973) has been very popular in China since it was published and is still influential now. He has visited many other developing countries, including Vietnam, Malaysia, Singapore (5 trips), Brazil, Mexico(4 trips), Tunisia, South Africa, Egypt, India, Korea and Cyprus etc. As President of SIAM from 1999 to 2000 he made efforts to extend SIAM membership in Asia, and helped to plan, arrange and organize visits by US based mathematicians to Vietnam and to Africa. He also made significant contributions to the National Academy of Sciences document “Report on Advanced Mathematics in Africa: Opportunities for Capacity Building.” Through MIT’s Open Course Ware his educational materials are available on the Web free of charge to any user anywhere in the world. In this way Gilbert Strang’s dream to effectively

promote mathematics and its education in developing countries, in particular in regions that are hard to reach, becomes true. He has devoted much time on creating, improving and promoting his popular web course on Linear Algebra in an effort to better serve his audience.

In summary, Gilbert Strang has made himself one of the most recognized mathematicians in the developing countries. His great contribution in mathematics and his dedication to advancing public awareness of the power and potential of mathematics have made outstanding contributions to human development, which have benefited many students, teachers and mathematicians. Gilbert Strang well deserves the ICIAM Su Buchin Prize.

The subcommittee for the ICIAM Su Buchin Prize was:

- Li Da-Qian (Fudan University, China), chair;
- Samuel Shen (San Diego State University, USA);
- Doina Cioranescu (Université Pierre et Marie Curie, France);
- Philippe Ciarlet (City University Hong Kong, China);
- Jacob Palis (Instituto Nacional de Matematica Pura e Aplicada (IMPA), Brazil);
- Sibusiso Sibisi (The Council for Scientific and Industrial Research (CSIR), South Africa).

The group photo below shows all prize winners, the president of ICIAM, I. Sloan, and the Congress Director, R. Jeltsch.



From left to right: H. Engl, G. Strang, F. Otto, P. Deuffhard, I. Sloan, I. Daubechies, J. Keller, R. Jeltsch