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Eidgenössische Technische Hochschule Zürich
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18.09.2006
http://idw-online.de/de/news175446

Personalia
Mathematik, Physik / Astronomie
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International Council for Industrial and Applied Mathematics (ICIAM) announces winners of the five ICIAM prizes

Professor Ian Sloan, President of the International Council for Industrial and Applied Mathematics (ICIAM) today announced the winners of the five ICIAM prizes. The prize winners are: Ingrid Daubechies (Princeton University, USA) and Heinz Engl (Johannes Kepler Universität Linz, Austria and Austrian Academy of Sciences), Felix Otto (Universität Bonn, Germany), Joseph Keller (Stanford University, USA), Peter Deuflhard (Zuse Institute Berlin, Germany), Gilbert Strang (Massachusetts Institute of Technology)

ICIAM Pioneer Prize: Awarded jointly to Ingrid Daubechies (Princeton University, USA) for her pioneering work in applied mathematics and applications which has found widespread use in image processing and time frequency analysis, and Heinz Engl (Johannes Kepler Universität Linz, Austria and Austrian Academy of Sciences), for his work on the applications of theoretical work to the solution of a wide range of industrial problems; for his promotion worldwide of industrial/applied mathematics problem solving; for his initiatives in the Austrian mathematical community; and for the founding of the Radon Institute for Computational and Applied Mathematics.

The Pioneer Prize--established for pioneering work 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. It was created on the initiative of ICIAM member society the Society for Industrial and Applied Mathematics (SIAM), and was first awarded in 1999. The Pioneer Prize is presently funded by SIAM.

ICIAM Collatz Prize: Felix Otto (Universität Bonn, Germany), one of the premier applied analysts of his generation, who has made fundamental contributions in areas ranging from micromagnetics to mass transportation problems.

The Collatz Prize -- established to provide international recognition to individual scientists under 42 years of age for outstanding work on industrial and applied mathematics. It was created on the initiative of ICIAM member society the Gesellschaft für Angewandte Matematik und Mechanik (GAMM), and was first awarded in 1999. The Collatz Prize is presently funded by GAMM.

ICIAM Lagrange Prize: Joseph Keller (Stanford University, USA), an internationally renowned applied mathematician of the highest quality, who developed the Geometrical Theory of Diffraction that provided the first systematic description of wave propagation around edges and corners of an obstacle. The theory 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.

The Lagrange Prize -- established to provide international recognition to individual mathematicians who have made an exceptional contribution to applied mathematics throughout their careers. It was created on the initiative of ICIAM member society the Société de Mathématiques Appliquées et Industrielles (SMAI), and first awarded in 1999. The Lagrange Prize is presently funded by the three member societies SMAI, the Sociedad Española de Matematica Aplicada (SEMA) and the Società Italiana di Matematica Applicata e Industriale (SIMAI).

ICIAM Maxwell Prize: Peter Deuflhard (Zuse Institute Berlin, Germany), for his contributions to mathematics applied to chemical engineering, microwave technology, medicine, and biotechnology.

The Maxwell Prize -- established to provide international recognition to a mathematician who has demonstrated originality in applied mathematics. It was created on the initiative of ICIAM member society The Institute of Mathematics and its Applications (IMA), with the support of the J. C. Maxwell Society, and first awarded in 1999. The Maxwell Prize is presently funded by IMA.

ICIAM Su Buchin Prize: Gilbert Strang (Massachusetts Institute of Technology, USA), for his great contributions in many areas of pure and applied mathematics, and has made remarkable contributions to the promotion of mathematical research and education in developing countries, with significant impact on human development in the area of mathematics.

The Su Buchin Prize -- established to provide international recognition of an outstanding contribution by an individual in the application of mathematics to emerging economies and human development, in particular at the economic and cultural level in developing countries. It was created on the initiative of ICIAM member society the Chinese Society for Industrial and Applied Mathematics (CSIAM), and is being awarded for the first time. The Su Buchin Prize is presently funded by CSIAM.

Prize Citations

Ingrid Daubechies -- ICIAM Pioneer Prize (joint)
The ICIAM/SIAM Pioneer Prize is awarded to Ingrid Daubechies, Princeton University, Princeton, USA, for 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.

Daubechies' best known achievement is her construction of compactly supported wavelets in the late 1980s. Since that time she has advanced the development of biorthogonal wavelet bases. These bases are currently the most commonly used bases for data compression. Daubechies name is widely associated with the biorthogonal 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 ground-breaking work including the discovery of Wilson bases. This discovery led to the existence of cosine packet libraries of orthonormal bases and Gaussian bases. These are now standard tools in time frequency analysis and numerical solutions of partial differential equations.

Peter Deuflhard -- ICIAM Maxwell Prize
Professor Peter Deuflhard'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 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 in his footsteps.

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

- Chemical engineering (chemical combustion, hydrogen motors, car engine catalysators, pollution reduction in coal power stations)
- Microwave technology up to nano-optics (numerical treatment of high-frequency Maxwell equations, Schrödinger-type equations, discrete transparent boundary conditions, design of nanophotonic devices)
- Medicine (optimal therapy planning in the cancer treatment hyperthermia, modelling and simulation of human motion for osteotomic surgery, thermoregulation in the human vascular system, computer-assisted facial surgery, 3D image segmentation)
- 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 Deuflhard has both invented and designed. Here are just 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 ordinary differential equations to adaptive multilevel finite-element methods for partial differential equations; extrapolation methods for ordinary differential equations (order and step-size 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.

Professor Deuflhard collaborates intensively with engineers, physicians, practitioners, and scientists in many different fields. He was instrumental 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.

Heinz Engl -- ICIAM Pioneer Prize (joint)
The ICIAM/SIAM Pioneer Prize is awarded to Heinz Engl, Johannes Kepler Universität Linz, Austria and Austrian Academy of Sciences, for his work on the applications of theoretical work in inverse problems to the solution of a wide range of industrial problems; for his promotion worldwide of industrial/applied mathematics problem solving; for his initiative to include very active applied mathematics components in the Austrian Mathematical Community; and for the founding of the Austrian Academy of Sciences sponsored RICAM, the Radon Institute for Computational and Applied Mathematics. Professor Engl's vigorous activity enables and promises many exciting new opportunities for applied mathematics and industrial problem solving.

Joseph Keller -- ICIAM Lagrange Prize
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 the 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.

Felix Otto -- ICIAM Collatz Prize
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.

Gilbert Strang -- ICIAM Su Buchin Prize
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, 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 OpenCourseWare 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 is well-deserving of the ICIAM Su Buchin Prize.

Prize Presentation
The prizes will be awarded at the Opening Ceremony of the International Congress for Industrial and Applied Mathematics, to be held at ETH Zurich from July 16 to July 20, 2007 (http://www.iciam07.ch). The four-yearly ICIAM Congress is a major international celebration of mathematics in action, and is the main event in the applied mathematical
calendar.

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About ICIAM
The International Council for Industrial and Applied Mathematics (ICIAM) is a world body which brings together all the national associations of professional mathematicians concerned with applications.

Photographs of the winners are available from Prof. Rolf Jeltsch (jeltsch@math.ethz.ch)]

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