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International Council for Industrial and Applied Mathematics

The ICIAM Prizes for 2011

Professor Rolf Jeltsch, President of the International Council for Industrial and Applied Mathematics (ICIAM) today announced the winners of the five ICIAM prizes. The prize winners are:

ICIAM Collatz Prize: *Emmanuel J. Candès* (Stanford & Pasadena, USA)

Emmanuel J. Candès of Stanford University and of the California Institute of Technology is awarded the 2011 ICIAM Collatz Prize in recognition of his outstanding contributions to numerical solution of wave propagation problems and compressive sensing, as well as anisotropic extensions of wavelets.

The **Collatz Prize** was established to provide international recognition to individual scientists under 42 years of age for outstanding work on industrial and applied mathematics. It carries a cash award of USD 1000. This prize was created on the initiative of ICIAM member society **GAMM**, and was first awarded in 1999. The Collatz Prize is presently funded by **GAMM**.

ICIAM Lagrange Prize: *Alexandre J. Chorin* (Berkeley, USA)

Alexandre J. Chorin of University of California Berkeley and the Lawrence Berkeley National Laboratory receives the 2011 ICIAM Lagrange Prize in recognition of his fundamental and original contributions to applied mathematics, fluid mechanics, statistical mechanics, and turbulence modelling. His methods for the numerical solution of Navier–Stokes equations stand at the basis of the most popular codes in computational fluid mechanics.

The **Lagrange Prize** was established to provide international recognition to individual mathematicians who have made an exceptional contribution to applied mathematics throughout their career. It carries a cash award of USD 3000. This prize was created on the initiative of ICIAM member societies **SMAI**, **SEMA** and **SIMAI** and first awarded in 1999. The Lagrange Prize is presently funded by the three member societies **SMAI**, **SEMA** and **SIMAI**.

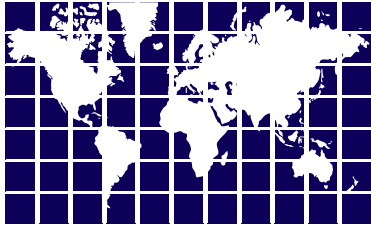### ICIAM Maxwell Prize: *Vladimir Rokhlin* (New Haven, USA)

Vladimir Rokhlin of Yale University has been selected for the 2011 ICIAM Maxwell Prize for his work on fast multipole methods which have revolutionized fields like numerical electromagnetism for radar and molecular dynamics for chemistry.

The **Maxwell Prize** was established to provide international recognition to a mathematician who has demonstrated originality in applied mathematics. It carries a cash award of USD 1000. This prize was created on the initiative of ICIAM member society **IMA** (with support also from the **J. C. Maxwell Society**), and first awarded in 1999. The Maxwell Prize is presently funded by **IMA**.

ICIAM Pioneer Prize: *James Albert Sethian* (Berkeley, USA)

James Albert Sethian of the University of California Berkeley and the Lawrence Berkeley National Laboratory receives the 2011 ICIAM Pioneer Prize for his fundamental methods and algorithms which have had a large impact in applications such as in imaging and shape recovery in medicine, geophysics and tomography and drop dynamics in inkjets.

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The **Pioneer Prize** was established for pioneering work introducing applied mathematical methods and scientific computing techniques to an industrial problem area or a new scientific field of applications. It carries a cash award of USD 1000. This prize was created on the initiative of ICIAM member society **SIAM**, and was first awarded in 1999. The Pioneer Prize is presently funded by **SIAM**.

ICIAM Su Buchin Prize: *Edward Lungu* (Gabarone, Botswana)

Edward Lungu of the University of Botswana receives the 2011 ICIAM Su Buchin Prize for his mathematical modelling of problems related to Africa and his fundamental contribution to developing teaching, research and organizational structures for applied mathematics in Southern Africa.

The **Su Buchin Prize** was 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 carries a cash award of USD 1000. This prize was created on the initiative of ICIAM member society **CSIAM**, and is being awarded for the second time. The Su Buchin Prize is presently funded by **CSIAM**.

Prize Citations

Extended citations for the five ICIAM Prizes can be found at the end of this release.

Prize Presentation

The prizes will be awarded at the Opening Ceremony of the International Congress for Industrial and Applied Mathematics, ICIAM 2011, to be held 18–22 July 2011 in Vancouver, BC, Canada (see website at `http://www.iciam2011.com/`). The four-yearly ICIAM Congress is a major international celebration of mathematics in action, and it is the main event in the applied mathematics calendar.

About ICIAM

The International Council for Industrial and Applied Mathematics (ICIAM) is a world body bringing together many of the national and international associations of professional mathematicians concerned with applications.

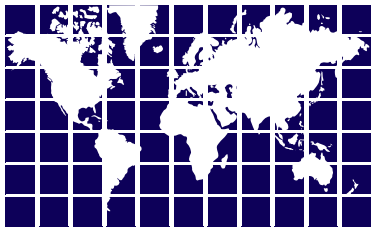For further information on ICIAM and the ICIAM Prizes, see `http://www.iciam.org/`.

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President ICIAM

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Extended Citations

ICIAM Collatz Prize: *Emmanuel J. Candès* (Stanford & Pasadena, USA)

Emmanuel Candès is a professor on mathematics and statistics at Stanford University, on leave from the department of Applied and Computational Mathematics at the California Institute of Technology. He was born in 1970 in Paris, France. He received his diploma as an engineer from the École Polytechnique France in 1993 and the M.Sc. in applied mathematics from the Universities Paris VI and Paris IX in 1994. In 1998 he earned the Ph.D. from Stanford University.

Emmanuel Candès has accomplished various deep and brilliant mathematical works. First, in joint work with L. Demanet, he proposed and mathematically justified the first linear complexity method for the fast numerical solution of wave propagation problems. The analysis involved the proof that, within a curvelet representation, the propagation operator for the associated evolution problem is approximately equivalent to a permutation matrix, and that the compressed representation of the operator can be computed in $O(N)$ operations. The significance of this result is only now beginning to be explored.

Then, in compressive sensing, together with David Donoho, Justin Romberg and Terence Tao, he developed a spectacular advance based on harmonic analysis, approximation theory and optimization. This result has been widely applied to image processing, sensor design, control and many other fields.

He identified the fundamental role of the restricted isometry property (RIP) in compressive sensing. He has also a major contribution to anisotropic extensions of wavelets, which has deeply advanced both applications and mathematical theory. In fact, concepts such as ridgelets, curvelets, chirplets and so on, are his inventions.

His work is highly innovative and shows off well his mathematically sophisticated talent. We are confident that it impacts widely-ranged fields of application. It should also be mentioned that he has served as the Ph.D. or the postdoctoral advisor for a number of excellent young mathematicians and that he himself performs as an important leader of scientific research.
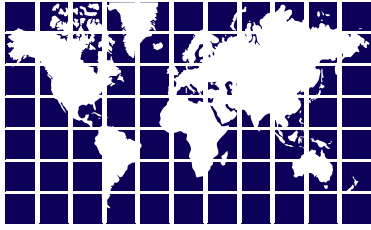
ICIAM Lagrange Prize: *Alexandre J. Chorin* (Berkeley, USA)

Alexandre J. Chorin is a professor of mathematics at the University of California Berkeley and also a member of the Lawrence Berkeley National Laboratory. He was born in Warsaw, Poland, on 25 June 1938. He graduated from École Polytechnique Fédérale (EPFL) of Lausanne, Switzerland. He then received his M.S. and his Ph.D. from the Courant Institute of New York University.

Beginning with his pioneering work 40 years ago, Chorin developed some of the key mathematical and algorithmic ideas that underlie many of the most powerful computer codes in computational fluid

dynamics, by blending mathematical intuition, physical insight and a deep attention to practical implementation.

In the mid 1960s, Chorin invented the Projection Method and the Artificial Compressibility Method. These techniques were the first practical and accurate methods for approximating the full Navier–Stokes equations. By performing careful numerical experiments along with theoretical convergence studies, Chorin has placed the numerical solution of complex flow on a solid mathematical foundation for the first time.

Chorin followed this with the invention and design of Vortex Methods, for which he was given the U.S. National Academy of Sciences Award in Applied Mathematics and Numerical Analysis. These techniques, based on the critical role of vorticity, are particularly suited to modelling the complex mixing and instabilities of turbulent flow. They allow the computation of the large transitory fluid structures critical to fluid mixing, wake development and chemical transport.

In addition to the above work, Chorin was one of the pioneers in the development of high resolution methods for gas dynamics and combustion, in particular through his work on random-choice methods.

Chorin has also made profound contributions to the application of methods of modern physics to turbulence modelling, numerical path integration, numerical methods for front motion, the kinetic theory of gases, phase transitions and Monte-Carlo methods.

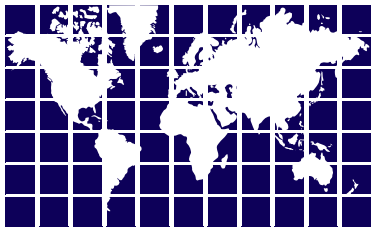## ICIAM Maxwell Prize: *Vladimir Rokhlin* (New Haven, USA)

Vladimir Rokhlin is a professor in the Computer Science Department and the Mathematics Department of Yale University. He was born in Voronezh, Russia on 4 August 1952 and received his M.S. in Mathematics in 1973 at the Vilnius University in Lithuania. He earned his Ph.D. in Applied Mathematics at Rice University in 1983.

Vladimir Rokhlin has had a profound impact on scientific computing and applied mathematics, most notably in developing "analysis-based fast algorithms". These include the fast multipole method for the Laplace equation, the fast multipole method for the Helmholtz equation, and the non-equispaced fast Fourier transform and also most recently in randomized matrix compression schemes. He has also made fundamental contributions to inverse scattering and to approximation theory.

Rokhlin was the first person who took a systematic approach to combining approximation theory, the classical theory of special functions, and modern computer science to reduce the computational cost associated with handling the basic integral operators of mathematical physics. Earlier fast algorithms (like the fast Fourier transform) had had great impact, but they were brittle. They had required uniform data structures and could not cope with complex

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geometries. An interesting consequence of the approximate nature of this new class of methods is that they are more flexible as well as being more robust.

His work on Fast Multipole Methods (FMM) has been cited as one of the ten algorithmic revolutions of the second half of the 20th century. These methods have revolutionized fields like numerical electromagnetism for radars and molecular dynamics for chemistry because the computing time to solve the problems is drastically reduced. For instance, for an airplane described by ten thousand points the radar cross-section can be computed in forty thousand operations instead of the millions of billions by earlier methods. FMM depends heavily on mathematical analysis and proper computer implementation and here too Vladimir Rokhlin has had a major role. By his close contact as advisor to industries and his interests for applications and above all his mathematical genius he has also produced exceptional Ph.D. students.

ICIAM Pioneer Prize: *James Albert Sethian* (Berkeley, USA)

James Albert Sethian is a professor of mathematics at the University of California Berkeley and a member of the Lawrence Berkeley National Laboratory. He was born on 10 May 1954. He received the B.A. in Mathematics from Princeton University in 1976 and earned his Ph.D. in Applied Mathemati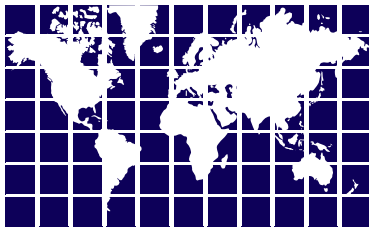cs from the University of California Berkeley in 1982. Sethian has done pioneering work in applied mathematics. He introduced with Andrew Majda a widely used asymptotic analysis of combustion. The level set method pioneered by Sethian and S. Osher has had a very major impact on many fields of application, and is one of the most widely used new algorithms of the past few decades. Sethian's algorithms for imaging and shape recovery in medical scanning devices are imbedded in current medical imaging workstations. He developed tools for solving Hamilton–Jacobi equations with applications in geophysics and tomography, including problems with multiple arrivals. Sethian has created startlingly accurate numerical methods of drop dynamics for use with inkjets. This extraordinary range of successes is made possible by Sethian's unparalleled eagerness to learn thoroughly the engineering aspects of problems he works on, the accuracy and depth of his feelings for mathematical structure, and his broad mathematical knowledge. His body of work is emblematic of what an applied mathematician should aspire to achieve.

ICIAM Su Buchin Prize: *Edward Lungu* (Gabarone, Botswana)

Edward Lungu is a professor of mathematics at the University of Botswana, in Gabarone, Botswana. His first degree came in 1975 from the University of Zambia. A Master's degree and also his 1980 Ph.D. followed, being awarded by the University of Bristol.

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Edward Lungu has been described as a "fundamental person" in the development of teaching and research in applied mathematics in Southern Africa. As founder and leader of SAMSA (Southern Africa Mathematical Sciences Association) and later of AMMSI (the Millenium Initiative) he has simply done everything that one person could do: organized, encouraged, supervised, and led by his personal example in teaching and research.

For Botswana itself Professor Lungu has developed models in:

- hydrology — Botswana relies on storing rainfall;

- ecology — domestic livestock as well as wildlife are keys to the economy; and

- epidemiology — to understand the progression of HIV/AIDS and how to help the victims.

In choosing these three research areas, he has responded to the greatest needs of his fellow men and women. The series of recent papers in mathematical biosciences model the differential progression of HIV/AIDS based on characteristics of patients and the care they receive.

In developing mathematical education and research Edward Lungu has been described as a "giant force" — a force with organizational talent, tireless energy, and a friendly personality. That is a most wonderful combination. His years of work have brought successes for applied mathematics that we are very happy to recognize today.