# 2023 ICIAM Prizes: Recipients and Committees

The 2023 ICIAM prizes will be awarded at the Opening Ceremony of the International Congress for Industrial and Applied Mathematics, ICIAM 2023, to be held in Tokyo (Japan), on August 20-25, 2023. The Prize Committee was chaired by Ya-xiang Yuan, the President of ICIAM. Other members were:

- Gang Bao (Chair of Maxwell Prize Subcommittee).
- Alfredo Bermudez (Chair of Pioneer Prize Subcommittee).
- Nira Chamberlain (Chair of Industry Prize Subcommittee).
- Leah Edelstein-Keshet (Chair of Lagrange Prize Subcommittee).
- Lois Curfman McInnes (Chair of Su Buchin Prize Subcommittee).
- Kim-Chuan Toh (Chair of Collatz Prize Subcommittee).

ICIAM Collatz Prize

The 2023 ICIAM Collatz Prize is awarded to Maria Colombo (EPFL Lausanne, Switzerland) for her fundamental contributions to the regularity theory and the analysis of singularities in elliptic PDEs, geometric variational problems, transport equations, and incompressible fluid dynamics.

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 was created on the initiative of GAMM, and first awarded in 1999. Carrying a cash award of USD 5000, the Collatz Prize is presently funded by GAMM.
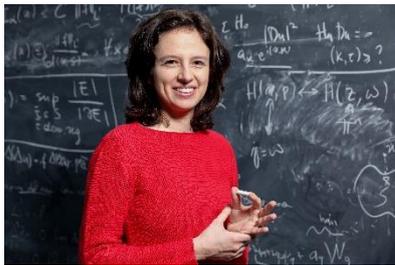
Maria Colombo was born in 1989 in Luino, Italy. She received her Bachelor and Master degrees in Mathematics from University of Pisa, and PhD degree from Scuola Normale Superiore of Pisa in 2015. After holding positions at the University of Zurich and ETH Zurich, she joined EPFL Lausanne as an Assistant Professor in 2018, where she is now a Full Professor of Mathematics. Maria Colombo has received several prizes and awards that include the 2022 Peter Lax award, the 2019 Bartolozzi Prize from the Italian Mathematical Union, and the 2015 Michele Cuozzo Prize for her PhD thesis.

Maria Colombo has made substantial contributions to the regularity theory and the analysis of singularities in elliptic PDEs, transport equations, and incompressible fluid dynamics. In particular, she has made significant advances in the understanding of the long-time behavior of solutions to fundamental equations in fluids such as Euler and Navier-Stokes equations. In her joint work with Buckmaster and Vicol, they showed the existence of badly behaved weak solutions of the Navier-Stokes equations which are smooth except for a singular set of times of Hausdorff dimension less than 1. Very recently, her joint work with Albritton and Brue' constructed for the first time nonunique Leray-Hopf solutions of the forced Navier-Stokes equations. Together with her student Haffter, they also proved that the singular set of Leray-Hopf weak solutions of the supercritical SQG (surface quasi-geostrophic) equation is contained in a compact set in spacetime whose Hausdorff dimension is also estimated. Maria Colombo has several works (with Spolaor, Edelen and Velichkov) on the structure of singularities for solutions to the obstacle problem and minimal surfaces. Their work on the log-epiperimetric inequality in GAFA is a beautiful discovery that has sparked subsequent major developments in the area.

The subcommittee for ICIAM Collatz Prize was:
- Kim-Chuan Toh (National University of Singapore, Singapore), Chair.
- Gregoire Allaire (Ecole Polytechnique, France).
- Ricardo Cortez (Tulane University, USA).
- Hiroshi Suito (Tohoku University, Japan).

ICIAM Lagrange Prize

Awarded to Alfio Quarteroni for his ground-breaking work in finite element and spectral methods, domain decomposition methods, discontinuous Galerkin methods, numerical solution of incompressible Navier-Stokes equations, multiphysics and multiscale modeling - with application to fluid dynamics, geophysics, the human heart and circulatory system, the Covid-19 epidemic, as well as improvement of sports performance for the America's Cup sailing competition.

The Lagrange Prize was 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 SEMA, SIMAI and SMAI and first awarded in 1999. Carrying a cash award of USD 5000, the Lagrange Prize is presently funded by the four member societies SBMAC, SEMA, SIMAI and SMAI.

Alfio Quarteroni became a Full Professor at the Catholic University of Brescia (1986-1989), at the University of Minnesota (Minneapolis, 1990-1992), and at the Ecole Polytechnique Fédérale de Lausanne (1989-2017). He is currently a professor at the Politecnico di Milano (since 1989), where he was the founder and first Director of the Lab for Modeling and Scientific Computing (MOX). Quarteroni was a plenary speaker at the International Congress of Mathematicians (ICM Madrid 2006), at the International Congress for Applied and Industrial Mathematics (ICIAM Hamburg 1995), and at many international conferences all over the world. In 1992, his innovative work in Computational Fluid Dynamics gained a NASA Group Achievement Award. He has also been awarded the Galileo Galilei International Prize for Science (2015), the Feng Kang Prize of the Chinese Academy of Sciences (2013), the Euler medal from ECCOMAS (2022), among many others. He is a fellow of the International Association of Computational Mechanics (2004), the Accademia dei Lincei (2004), the Society for Industrial and Applied Mathematics (SIAM, 2009), the European Academy of Sciences (2010), Academia Europaea (2014), the Lisbon Academy of Sciences (2018), European Community on Computational Methods in Applied Science (ECCOMAS, 2010), and the Swiss Academy of Engineering Sciences (2012).

Alfio Quarteroni has made significant impact on mathematics by developing finite elements and spectral methods, domain decomposition techniques, reduced order methods and their integration with machine learning techniques. His career has been marked by outstanding innovations in numerical methods for partial differential equations, and myriad practical applications, including earthquake simulations, models of the human heart and cardiovascular system, the improvement of sports performance, and industrial applications. His mathematical optimization methods contributed to the winning Swiss team in the America's cup sailing competition (2003, 2007).

Alfio Quarteroni has a prolific record of over 400 peer-reviewed publications and 26 books, some of which have been translated into many languages. He has trained over 200 young scientists (MSc and PhD). He is well known for his contributions to fostering the applied mathematics community, particularly in Europe.

The subcommittee for the Lagrange prize was:
- Leah Edelstein-Keshet (University of British Columbia, Canada), Chair
- Rosa Donat (University of Valencia, Spain)

- Maurizio Falcone (University of Rome, Italy)
- Irena Lasiecka (University of Memphis, USA)
- Hiroshi Matano (University of Tokyo, Japan)
- Lloyd N. Trefethen (University of Oxford, UK)

ICIAM Maxwell Prize

Awarded to Weinan E for his seminal contributions to applied mathematics and in particular on analysis and application of machine learning algorithms, multi-scale modeling, the modeling of rare events and stochastic partial differential equations.

The Maxwell Prize was established to provide international recognition to a mathematician who has demonstrated originality in applied mathematics. It was created on the initiative of the IMA (with the support of the James Clerk Maxwell Foundation), and first awarded in 1999. Carrying a cash award of USD 5000, the Maxwell Prize is presently funded by the IMA and by the James Clerk Maxwell Foundation.
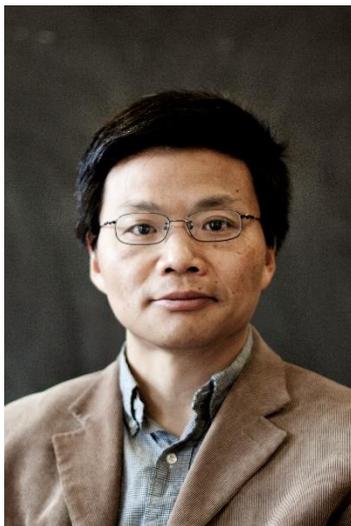
Weinan E is the director of the Center for Machine Learning Research at Peking University and professor in the Department of Mathematics and Program in Applied and Computational Mathematics at Princeton University. He obtained his undergraduate degree at the University of Science and Technology of China in 1982, his master's degree at the Chinese Academy of Sciences in 1985, and his Ph.D. at the University of California, Los Angeles in 1989. Professor E was the recipient of the ICIAM Collatz Prize in 2003, the Peter Henrici Prize of SIAM and ETH in 2019, and the Gordon Bell Prize from ACM in 2020. He has been invited to deliver a plenary lecture at ICM 2022. Professor E was elected fellow of the Institute of Physics in 2005, fellow of SIAM in 2009, member of the Chinese Academy of Sciences in 2011 and fellow of the American Mathematical Society in 2012.

Professor E's research work draws inspiration from various disciplines of sciences. He has made

profound impact in fluid dynamics, chemistry, material sciences, and soft condensed matter physics. He has contributed to the resolution of many long standing scientific problems such as the Burgers turbulence problem, and the Cauchy-Born rule for crystalline solids. A common theme of his work is to bring clarity to scientific issues through mathematics. A second theme is multi-scale and/or multi-physics modeling. He has made fundamental contributions to building the mathematical framework and finding effective numerical algorithms for modeling rare events. He has also made original contributions to multiscale analysis and algorithms through his work on heterogeneous multi-scale methods, multi-scale stochastic simulation algorithms, complex fluids and homogenization problems. In addition, Professor E and collaborators made fundamental contributions to the analysis and numerical algorithms of density functional theory, including studying its continuum limit and developing the PEXSI algorithm. More recently, Professor E pioneered the development of deep learning-based algorithms in scientific computing and computational science. His work on solving high dimensional stochastic control problems using deep learning-based algorithms in 2016 was the first paper on deep learning-based algorithms for high dimensional problems in scientific computing. He and collaborators have developed deep learning-based methodologies in molecular dynamics and quantum mechanics, and he pioneered the dynamical systems and control theory approach to machine learning and maximum principle-based algorithms for deep learning.

The subcommittee for ICIAM Maxwell Prize was:
- Gang Bao (Zhejiang, University，China), Chair
- Wolfgang Dahmen (University of South Carolina, USA)
- Qiang Du (Columbia University, USA)
- Erwan Faou (INRIA and University of Rennes, France)
- Des Higham (University of Edinburgh, UK)
- Amy Novick-Cohen (Technion, Israel)

ICIAM Pioneer Prize

Awarded to Leslie Greengard (Courant Institute, New York University and Flatiron Institute, Simons Foundation) for his pioneering work on fast algorithms including the fast multipole method (one of the top-ten algorithms of the 20th century), fast Gauss transform, and fast direct solvers; and for the development of innovative high-order, automatically adaptive algorithms for differential and integral equations.

Leslie Greengard was born in London, England, but grew up in the United States in New York City, Boston, and New Haven. He holds a B.A. in mathematics from Wesleyan University (1979), an M.D, from the Yale University School of Medicine (1987), and a Ph.D. in computer science from Yale University (1987).

From 2006-2011, Greengard was director of the Courant Institute of Mathematical Sciences, an independent division of the New York University (NYU) and is currently a professor of mathematics and computer science at this prestigious Center. He is also director of the Center for Computational Mathematics at the Flatiron Institute, a division of the Simons Foundation. He formerly served as the director at the Center for Computational Biology in the Flatiron Institute.

Professor Greengard has had a profound impact on computational mathematics. The Fast Multipole Method (FMM), developed together with Vladimir Rokhlin, is one of the top ten algorithms of the 20th century. Its impact has been further enhanced by complementary techniques such as

- Fast Gauss transforms for the rapid computation of Gauss convolution over unstructured point sets;
- Fast algorithms and implementations for three types of non-uniform Fourier transforms;
- Fast direct solvers for non-oscillatory and oscillatory integral equations based on the idea of recursive skeletonization.

These contributions have enabled simulations that would otherwise be completely intractable in áreas such as electromagnetics, acoustics, computational biology, fluid and solid mechanics, heat transfer, quantum mechanics, and biomedical imaging.

Besides its immediate impact for solving fast summation problems that arise directly in computational simulations, the other dramatic impact of the FMM was that it unlocked integral equation formulations as a tool for mathematical modeling of large scale problems. Leslie has spearheaded a decades long effort to extend integral equations techniques to apply to not only elliptic problems, but also parabolic ones like the heat equation, or the Navier-Stokes equations.

Professor Greengard is a prolific writer with more than 120 professional articles. Many of these articles are highly cited and some of his review articles have strongly influenced the field of applied and computational mathematics.

He was an invited speaker for the International Congress of Mathematicians (ICM) in 1998 and an invited speaker for the International Congress on Industrial and Applied Mathematics (ICIAM) in 1999. He gave the prestigious von Neumann Lecture of SIAM in 2014. He has been elected to National Academy of Sciences (USA), National Academy of Engineering (USA), and American Academy of Arts and Sciences.

The subcommittee for ICIAM Pioneer Prize was:
- Alfredo Bermudez (University of Santiago de Compostela, Spain)   Chair
- Poul G. Hjorth (Technic University of Denmark, Denmark)
- Narayan Rangaraj (India, IIT Bombay)
- Carola Bibiane Schönlieb (University of Cambridge, UK)
- Jin Keun Seo (Yonsei University, South Korea)
- Joseph Teran (UC Davis, US)

ICIAM Su Buchin Prize

The 2023 ICIAM Su Buchin Prize is awarded to Jose Mario Martinez Perez (University of Campinas, Brazil) for outstanding achievements in research---a combination of theory, practice, software, and applications for solving large-scale optimization problems---and in fostering the development of the optimization and applied mathematics communities in Latin America.

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. This includes efforts to improve mathematical research and teaching in those countries. Created as an initiative of CSIAM and first awarded in 2007, the prize carries a cash award of USD 5000 and is presently funded by CSIAM.
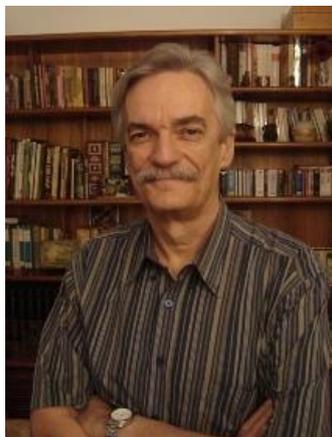
In 1971, Jose Mario Martinez Perez received his 1st degree in mathematics from the University of Buenos Aires, Argentina.   In 1978 he received a Ph.D. in systems engineering and computer sciences from the Federal University of Rio de Janeiro, Brazil.   He was a professor at the University of Campinas, Brazil, between 1978 and 2018, transitioning to emeritus professor in 2019. Professor Martinez Perez was awarded the Brazilian National Order of Scientific Merit and is a full member of the Brazilian Academy of Sciences.

Jose Mario Martinez Perez is both an outstanding researcher with numerous contributions to applied mathematics and an exemplary teacher, whose efforts have motivated countless students. He has devoted his career to optimization and numerical analysis, authoring numerous articles that address topics such as augmented Lagrangians, sequential quadratic programming, and trust region methods. His contributions represent remarkable advances for solving large-scale optimization problems through published algorithms and software, along with deep involvement in a wide range of applications.

The work of Jose Mario Martinez Perez has been fundamental in the development of applied mathematics research in Latin America. He has supervised more than 30 master's students and more than 30 Ph.D. students from various countries in the region, maintaining strong connections over time and promoting collaborations that strengthen the development of research groups in each of those countries. For example, his former students are now professors at universities in Brazil, Argentina, Venezuela, Colombia, and Chile. Also, he has been an important actor in the creation, expansion and consolidation of Sociedade Brasileria de Mathematica Aplicada e Computacional (SBMAC), which was created in 1978. Taken together, Professor Martinez Perez's achievements in research and in building the optimization and applied mathematics communities in Latin America are an extraordinarily influential body of professional work.

The subcommittee for the ICIAM Su Buchin Prize was:

- Lois Curfman McInnes (Argonne National Laboratory, US), Chair.
- Tanniemola Liverpool (University of Bristol, UK).
- Amiya Kumar Pani (Indian Institute of Technology Bombay, India).
- Precious Sibanda (University of Kwazulu-Natal, South Africa).
- Pingwen Zhang (Peking University, China).

ICIAM Industry Prize 2023

Awarded to Cleve B. Moler for his outstanding contributions to the development of mathematical and computational tools and methods for the solution of science and engineering problems and his invention of MATLAB, which allows industrial users to harness efficient and reliable numerical methods to execute numerical simulations in ever-expanding domains of science and engineering.

The ICIAM Industry Prize was established to provide international recognition to scientists who have made outstanding contributions to innovative mathematical techniques with demonstrated

impact in Industry. It was created in 2020 and will be awarded for the first time in 2023. Carrying a cash award of USD 5000, the Industry prize is currently funded by JSIAM.

Cleve B. Moler is the Founder and Chief Mathematician of Math Works, Inc.. He received his B.Sc. degree in Mathematics from California Institute of Technology, in 1961, and his M.S. in 1963 and Ph.D. 1965 in Mathematics from Stanford University. He has received a de Florez Award from AIAA, a John von Neuman Medal from IEEE, a Computer Pioneer Award and a Sidney Fernbach Award from IEEE Computer Society, the SIAM-ACM Prize in Computational Science and Engineering and the SIAM Prize for Distinguished Service to the Profession. He is a Fellow of SIAM and a member of National Academy of Engineering.

In creating MATLAB and co-founding MathWorks, Moler changed the applied mathematics world. MATLAB is a high-level programming environment for scientific and engineering computing that is used worldwide. MATLAB and its associate software Simulink are used in industries including automotive, aerospace, communications, electronics, industrial automation, financial services, and computational biology. According to the MathWorks, there are more than 4 million MATLAB users worldwide. Moler also is one of the authors of the LINPACK and EISPACK scientific subroutine libraries, the original dense linear algebra software libraries. These libraries encapsulated the state-of-the-art numerical algorithms to make them more widely available to scientists and engineers who needed to solve the linear systems and eigenvalue problems ubiquitous in science and engineering without requiring them to become experts in the algorithms or software

Moler is an outstanding mathematician. In his abbreviated career in academia, he advised students who took the field to the next level: Charlie Van Loan, Jack Dongarra, Alan Cline, Stan Eisenstat and others. His contributions include a fundamental algorithm, the QZ algorithm (jointly invented with Pete Stewart), for reduction of a matrix to Hessenberg form as a necessary first step in computing the eigenpairs for the generalized eigenproblem $Ax = \lambda Bx$.

The subcommittee for ICIAM Industry Prize was
- Nira Chamberlain (Institute of Mathematics and its Application, UK), Chair
- Jose A. Cuminato (University of Sao Paulo, Brazil)
- Irene Fonseca (Carnegie Mellon University, USA)
- Volker Mehrmann (Technische Universitat Berlin, Germany)

- Giovanni Russo (University of Catania, Italy)
- Kazue Sako (Waseda University, Japan)