



# The Navier-Stokes Problem in the 21st Century

By Pierre Gilles Lemarie-Rieusset

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**The Navier-Stokes Problem in the 21st Century** By Pierre Gilles Lemarie-Rieusset

*Up-to-Date Coverage of the Navier–Stokes Equation from an Expert in Harmonic Analysis*

The complete resolution of the Navier–Stokes equation—one of the Clay Millennium Prize Problems—remains an important open challenge in partial differential equations (PDEs) research despite substantial studies on turbulence and three-dimensional fluids. **The Navier–Stokes Problem in the 21st Century** provides a self-contained guide to the role of harmonic analysis in the PDEs of fluid mechanics.

The book focuses on incompressible deterministic Navier–Stokes equations in the case of a fluid filling the whole space. It explores the meaning of the equations, open problems, and recent progress. It includes classical results on local existence and studies criterion for regularity or uniqueness of solutions. The book also incorporates historical references to the (pre)history of the equations as well as recent references that highlight active mathematical research in the field.

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## **Editorial Review**

### Review

"This monograph addresses a difficult question in the mathematical theory of a viscous incompressible fluid: global well-posedness of the Cauchy problem for the Navier-Stokes equations. ... The author is an outstanding expert in harmonic analysis who has made important contributions. The book contains rigorous proofs of a number of the latest results in the field. I strongly recommend the book to postgraduate students and researchers working on challenging problems of harmonic analysis and mathematical theory of Navier-Stokes equations."

?Gregory Seregin, St Hildas College, Oxford University

"This is a great book on the mathematical aspects of the fundamental equations of hydrodynamics, the incompressible Navier-Stokes equations. It covers many important topics and recent results and gives the reader a very good idea about where the theory stands at present. The book contains an excellent overview of the history, a great modern exposition of many important classical theorems, and an outstanding presentation of a number of very recent results from the frontiers of research on the subject. The writing is flawless, the clarity of the presentation is exceptional, and the author's choice of the topics is outstanding. I recommend the book very highly to anybody interested in the mathematics surrounding the PDEs of hydrodynamics, including the famous Navier-Stokes regularity problem. The book is perhaps even better than the author's first book on the Navier-Stokes theory published about 10 years ago, which is regularly used by many mathematicians."

?Vladimir Sverak, University of Minnesota

"This book by Lemarié-Rieusset reports on recent fundamental progress toward understanding the existence, regularity, and stability of solutions to Navier-Stokes equations. This is a must-have book for all researchers working in fluid dynamics equations, and it will become a reference in the field. The very clear and self-contained presentation of this complex and deep subject makes it a very useful textbook for graduate and Ph.D. students as well."

?Marco Cannone, Professor, Université Paris-Est

"This is an outstanding reference and textbook on the Clay Millennium Problem of Navier–Stokes. The book brings together all the essential knowledge of this field in a unified, compact, and up-to-date way. Many noticeable results are stated and re-proved in a new manner, and some important results are even appearing in the literature for the first time. The book stresses on the usage of Morrey spaces, which has its internal advantage both in the framework of mild solutions and weak solutions, and the corresponding results have already been, and will be, very useful in the study of Navier–Stokes problem. The physical meaning, the history, and the classical solutions of the Navier–Stokes equations are included in the first chapters, which are helpful to newcomers of the field. In sum, the book is highly recommended and it will be immensely useful for scientists and students interested in the Navier–Stokes problem."

?Changxing Miao, Distinguished Professor, Institute of Applied Physics and Computational Mathematics

### About the Author

**Pierre Gilles Lemarié-Rieusset** is a professor at the University of Evry Val d'Essonne. Dr. Lemarié-Rieusset has constructed many widely used bases, such as the Meyer-Lemarié wavelet basis and the Battle-

Lemarié spline wavelet basis. His current research focuses on the application of harmonic analysis to the study of nonlinear PDEs in fluid mechanics. He is the author or coauthor of several books, including *Recent Developments in the Navier-Stokes Problem*.

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