Preface

In the last years, notable progresses were obtained in mathematical theory of stabilization of equilibrium solution to Newtonian fluid flows as a principal tool to eliminate or attenuate the turbulence. One of the main results obtained in this direction is that the equilibrium solutions to Navier–Stokes equations are exponentially stabilizable by finite-dimensional feedback controllers with support in the interior of the domain or on the boundary. This book was completed in the idea to present these new results and techniques which are in our opinion the core of a discipline still in development and from which one might expect in the future some spectacular achievements.

Beside internal and boundary stabilization of Navier–Stokes equations, the stochastic stabilization and robustness of stabilizable feedbacks are also discussed. We had in mind a rigorous mathematical treatment of the stabilization problem, which relies on some advanced results and techniques involving the theory of Navier–Stokes equations and functional analysis as well. We tried to answer to the following questions: which is the structure of the stabilizing feedback controller and how can be designed by using a minimal set of eigenfunctions of the Stokes–Oseen operator. Though most of the feedback controllers constructed here are conceptual and their practical implementation requires a computational effort which still remains to be done, the analysis developed here provides a rigorous pattern for the design of efficient stabilizable feedback controllers in most specific problems of practical interest. To this purpose, the exposition is in mathematical style: definitions, hypotheses, theorems, proof. It should be emphasized that no rigorous stabilization theory with internal or boundary controllers is possible without unique continuation theory for the solutions to Stokes–Oseen equations.

By including a preparatory chapter on infinite-dimensional differential equations and a few appendices pertaining unique continuation properties of eigenfunctions of the Stokes–Oseen operator and stochastic processes, we have attempted to make this work essentially self-contained and so, accessible to a broad spectrum of readers. What is assumed of the reader is a knowledge of basic results in linear functional analysis, linear algebra, probability theory and general variational theory of elliptic, parabolic and Navier–Stokes equations, most of these being reviewed in Chap. 1 and in Sects. 3.8 and 4.5. An important part of the material included in this book

represent the personal contribution of the author and his coworkers and, though we mentioned the basic references and a brief presentation of other significant works in this field, we did not present them, however, in details. In fact, the presentation was confined to the stabilization techniques based on the spectral decomposition of the linearized system in stable and unstable systems and so we have omitted other important results in literature.

The author is indebted to Cătălin Lefter who made pertinent observations and suggestions. I also thank Irena Lasiecka and Roberto Triggiani for useful discussions on several results presented in this book. Also, I am indebted to Mrs. Elena Mocanu from Institute of Mathematics in Iaşi who prepared this text for printing.

I wish to express my thanks to Professor Miroslav Krstic, from University of California, San Diego, for the invitation to write this book for the Springer series *Communication and Control Engineering* he is coordinating.

Special thanks are due to Mr. Oliver Jackson, Editor of Engineering at Springer, for understanding and assistance in the elaboration of this work.

http://www.springer.com/978-0-85729-042-7

Stabilization of Navier–Stokes Flows
Barbu, V.
2011, XII, 276 p., Hardcover
ISBN: 978-0-85729-042-7