PIERRE-LOUIS LIONS

MATHEMATICAL TOPICS IN FLUID MECHANICS

Volume 2 Compressible Models

OXFORD

Mathematical Topics In Fluid Mechanics Compressible Models

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Mathematical Topics in Fluid Mechanics: Volume 2: Compressible Models Pierre-Louis Lions,1996 Fluid mechanics models consist of systems of nonlinear partial differential equations for which despite a long history of important mathematical contributions no complete mathematical understanding is available The second volume of this book describes compressible fluid mechanics models The book contains entirely new material on a subject known to be rather difficult and important for applications compressible flows It is probably a unique effort on the mathematical problems associated with the compressible Navier Stokes equations written by one of the world s leading experts on nonlinear partial differential equations Professor P L Lions won the Fields Medal in 1994 *Mathematical Topics in Fluid Mechanics: Volume 2: Compressible Models* Pierre-Louis Lions,1998-03-19 Fluid mechanics models consist of systems of nonlinear partial differential equations for which despite a long history of important mathematical contributions no complete mathematical understanding is available The second volume of this book describes compressible fluid mechanics models The book contains entirely new material on a subject known to be rather difficult and important for applications compressible flows It is probably a unique effort on the mathematical problems associated with the compressible Navier Stokes equations written by one of the world s leading experts on nonlinear partial differential equations Professor P L Lions won the Fields Medal in 1994 **Mathematical Topics in Fluid Mechanics: Volume 1: Incompressible Models** Pierre-Louis Lions,1996-06-27 One of the most challenging topics in applied mathematics over the past decades has been the development of the theory of nonlinear partial differential equations Many of the problems in mechanics geometry probability etc lead to such equations when formulated in mathematical terms However despite a long history of contributions there exists no central core theory and the most important advances have come from the study of particular equations and classes of equations arising in specific applications This two volume work forms a unique and rigorous treatise on various mathematical aspects of fluid mechanics models These models consist of systems of nonlinear partial differential equations like the incompressible and compressible Navier Stokes equations The main emphasis in Volume 1 is on the mathematical analysis of incompressible models After recalling the fundamental description of Newtonian fluids an original and self contained study of both the classical Navier Stokes equations including the inhomogeneous case and the Euler equations is given Known results and many new results about the existence and regularity of solutions are presented with complete proofs The discussion contains many interesting insights and remarks The text highlights in particular the use of modern analytical tools and methods and also indicates many open problems Volume 2 will be devoted to essentially new results for compressible models Written by one of the world s leading researchers in nonlinear partial differential equations Mathematical Topics in Fluid Mechanics will be an indispensable reference for every serious researcher in the field Its topicality and the clear concise and deep presentation by the author make it an outstanding contribution to the great theoretical problems in science concerning

rigorous mathematical modelling of physical phenomena *Mathematical Topics in Fluid Mechanics: Volume 1: Incompressible Models* Pierre-Louis Lions,1996-06-27 One of the most challenging topics in applied mathematics over the past decades has been the development of the theory of nonlinear partial differential equations Many of the problems in mechanics geometry probability etc lead to such equations when formulated in mathematical terms However despite a long history of contributions there exists no central core theory and the most important advances have come from the study of particular equations and classes of equations arising in specific applications This two volume work forms a unique and rigorous treatise on various mathematical aspects of fluid mechanics models These models consist of systems of nonlinear partial differential equations like the incompressible and compressible Navier Stokes equations The main emphasis in Volume 1 is on the mathematical analysis of incompressible models After recalling the fundamental description of Newtonian fluids an original and self contained study of both the classical Navier Stokes equations including the inhomogeneous case and the Euler equations is given Known results and many new results about the existence and regularity of solutions are presented with complete proofs The discussion contains many interesting insights and remarks The text highlights in particular the use of modern analytical tools and methods and also indicates many open problems Volume 2 will be devoted to essentially new results for compressible models Written by one of the world s leading researchers in nonlinear partial differential equations Mathematical Topics in Fluid Mechanics will be an indispensable reference for every serious researcher in the field Its topicality and the clear concise and deep presentation by the author make it an outstanding contribution to the great theoretical problems in science concerning rigorous mathematical modelling of physical phenomena

Advances in Mathematical Fluid Mechanics Josef Malek,Jindrich Necas,Mirko Rokyta,2012-12-06 This book consists of six survey contributions that are focused on several open problems of theoretical fluid mechanics both for incompressible and compressible fluids The first article Viscous flows in Besov spaces by M area Cannone ad dresses the problem of global existence of a uniquely defined solution to the three dimensional Navier Stokes equations for incompressible fluids Among others the following topics are intensively treated in this contribution i the systematic description of the spaces of initial conditions for which there exists a unique local in time solution or a unique global solution for small data ii the existence of forward self similar solutions iii the relation of these results to Leray s weak solutions and backward self similar solutions iv the extension of the results to further nonlinear evolutionary problems Particular attention is paid to the critical spaces that are invariant under the self similar transform For sufficiently small Reynolds numbers the conditional stability in the sense of Lyapunov is also studied The article is endowed by interesting personal and historical comments and an exhaustive bibliography that gives the reader a complete picture about available literature The papers The dynamical system approach to the Navier Stokes equa tions for compressible fluids by Eduard Feireisl and Asymptotic problems and compressible incompressible limits by Nader Masmoudi are devoted to the global in time properties of solutions to the Navier Stokes equa

and three tions for compressible fluids The global in time analysis of two dimensional motions of compressible fluids were left open for many years *Mathematical Topics in Fluid Mechanics* Jose Francisco Rodrigues,Adelia Sequeira,2020-10-02 This Research Note presents several contributions and mathematical studies in fluid mechanics namely in non Newtonian and viscoelastic fluids and on the Navier Stokes equations in unbounded domains It includes review of the mathematical analysis of incompressible and compressible flows and results in magnetohydrodynamic and electrohydrodynamic stability and thermoconvective flow of Boussinesq Stefan type These studies along with brief communications on a variety of related topics comprise the proceedings of a summer course held in Lisbon Portugal in 1991 Together they provide a set of comprehensive survey and advanced introduction to problems in fluid mechanics and partial differential equations **Mathematical Fluid Mechanics** Jiri Neustupa,Patrick Penel,2012-12-06 Mathematical modeling and numerical simulation in fluid mechanics are topics of great importance both in theory and technical applications The present book attempts to describe the current status in various areas of research The 10 chapters mostly survey articles are written by internationally renowned specialists and offer a range of approaches to and views of the essential questions and problems In particular the theories of incompressible and compressible Navier Stokes equations are considered as well as stability theory and numerical methods in fluid mechanics Although the book is primarily written for researchers in the field it will also serve as a valuable source of information to graduate students Handbook of Mathematical Fluid Dynamics S. Friedlander,D. Serre,2007-05-16 This is the fourth volume in a series of survey articles covering many aspects of mathematical fluid dynamics a vital source of open mathematical problems and exciting physics **New Directions in Mathematical Fluid Mechanics** Andrei V. Fursikov,Giovanni P. Galdi,Vladislav V. Pukhnachev,2010-01-11 On November 3 2005 Alexander Vasil evich Kazhikhov left this world untimely and unexpectedly He was one of the most in uential mathematicians in the mechanics of uids and will be remembered for his outstanding results that had and still have a c siderablysigni cantin uenceinthe eld Amonghis manyachievements werecall that he was the founder of the modern mathematical theory of the Navier Stokes equations describing one and two dimensional motions of a viscous compressible and heat conducting gas A brief account of Professor Kazhikhov s contributions to science is provided in the following article Scienti c portrait of Alexander Vasil evich Kazhikhov This volume is meant to be an expression of high regard to his memory from most of his friends and his colleagues In particular it collects a selection of papers that represent the latest progress in a number of new important directions of Mathematical Physics mainly of Mathematical Fluid Mechanics These papers are written by world renowned specialists Most of them were friends students or colleagues of Professor Kazhikhov who either worked with him directly or met him many times in o cial scienti c meetings where they had the opportunity of discussing problems of common interest *Perfect Incompressible Fluids* Jean-Yves Chemin,1998 The aim of this book is to offer a direct and self contained access to some of the new or recent results in fluid mechanics It gives an authoritative account on the theory of the Euler equations describing

a perfect incompressible fluid First of all the text derives the Euler equations from a variational principle and recalls the relations on vorticity and pressure Various weak formulations are proposed The book then presents the tools of analysis necessary for their study Littlewood Paley theory action of Fourier multipliers on L spaces and partial differential calculus These techniques are then used to prove various recent results concerning vortext patches or sheets essentially the persistence of the smoothness of the boundary of a vortex patch even if that smoothness allows singular points as well as the existence of weak solutions of the vorticity sheet type The text also presents properties of microlocal analytic or Gevrey regularity of the solutions of Euler equations and provides links of such properties to the smoothness in time of the flow of the solution vector field Handbook of Differential Equations: Evolutionary Equations C.M. Dafermos,Eduard Feireisl,2004-08-24 This book contains several introductory texts concerning the main directions in the theory of evolutionary partial differential equations The main objective is to present clear rigorous and in depth surveys on the most important aspects of the present theory The table of contents includes W Arendt Semigroups and evolution equations Calculus regularity and kernel estimatesA Bressan The front tracking method for systems of conservation lawsE DiBenedetto J M Urbano V Vespri Current issues on singular and degenerate evolution equations L Hsiao S Jiang Nonlinear hyperbolic parabolic coupled systemsA Lunardi Nonlinear parabolic equations and systemsD Serre L1 stability of nonlinear waves in scalar conservation laws B Perthame Kinetic formulations of parabolic and hyperbolic PDE s from theory to numerics

Topics in Hyposonic Flow Theory Radyadour Kh. Zeytounian,2005-12-20 Hyposonic fluid flows characterized by a low Mach number are mainly linked with geophysical and environmental fluid flows In addition they are relevant to engineers because of their connection with aerodynamics The books brings together insights derived from mathematically rigorous results and combines them with a number of realistic fluid flow situations Asymptotic analytic solutions for the low Mach number cases are developed to provide both insights into the underlying physics as well as benchmarks for numerical computations **Mathematical Geophysics** Jean-Yves Chemin,2006-04-13 Aimed at graduate students and researchers in mathematics engineering oceanography meteorology and mechanics this text provides a detailed introduction to the physical theory of rotating fluids a significant part of geophysical fluid dynamics The Navier Stokes equations are examined in both incompressible and rapidly rotating forms **Fluid Mechanics of Viscoplasticity** Raja R. Huilgol,2015-01-09 In this book we shall consider the kinematics and dynamics of the flows of fluids exhibiting a yield stress To highlight the principal characteristics of such fluids the first chapter emphasizes the role played by the yield stress Next a careful description of the continuum mechanics behind the constitutive equations for incompressible and compressible viscoplastic fluids is given in Chapters 2 4 In Chapters 5 and 6 analytical solutions to several steady and unsteady flows of Bingham fluids are presented The subsequent Chapters 7 10 are concerned with the development of variational principles and their numerical solutions along with perturbation methods which play a significant role in numerical simulations Fluids Under Pressure Tomáš

Bodnár,Giovanni P. Galdi,Šárka Nečasová,2020-04-30 This contributed volume is based on talks given at the August 2016 summer school Fluids Under Pressure held in Prague as part of the Prague Sum series Written by experts in their respective fields chapters explore the complex role that pressure plays in physics mathematical modeling and fluid flow analysis Specific topics covered include Oceanic and atmospheric dynamics Incompressible flows Viscous compressible flows Well posedness of the Navier Stokes equations Weak solutions to the Navier Stokes equations Fluids Under Pressure will be a valuable resource for graduate students and researchers studying fluid flow dynamics **Mean Field Theories and Dual Variation - Mathematical Structures of the Mesoscopic Model** Takashi Suzuki,2015-11-19 Mean field approximation has been adopted to describe macroscopic phenomena from microscopic overviews It is still in progress fluid mechanics gauge theory plasma physics quantum chemistry mathematical oncology non equilibirum thermodynamics spite of such a wide range of scientific areas that are concerned with the mean field theory a unified study of its mathematical structure has not been discussed explicitly in the open literature The benefit of this point of view on nonlinear problems should have significant impact on future research as will be seen from the underlying features of self assembly or bottom up self organization which is to be illustrated in a unified way The aim of this book is to formulate the variational and hierarchical aspects of the equations that arise in the mean field theory from macroscopic profiles to microscopic principles from dynamics to equilibrium and from biological models to models that arise from chemistry and physics **Fundamental Directions in Mathematical Fluid Mechanics** Giovanni P. Galdi,John G. Heywood,Rolf Rannacher,2012-12-06 This volume consists of six articles each treating an important topic in the theory ofthe Navier Stokes equations at the research level Some of the articles are mainly expository putting together in a unified setting the results of recent research papers and conference lectures Several other articles are devoted mainly to new results but present them within a wider context and with a fuller exposition than is usual for journals The plan to publish these articles as a book began with the lecture notes for the short courses of G P Galdi and R Rannacher given at the beginning of the International Workshop on Theoretical and Numerical Fluid Dynamics held in Vancouver Canada July 27 to August 2 1996 A renewed energy for this project came with the founding of the Journal of Mathematical Fluid Mechanics by G P Galdi J Heywood and R Rannacher in 1998 At that time it was decided that this volume should be published in association with the journal and expanded to include articles by J Heywood and W Nagata J Heywood and M Padula and P Gervasio A Quarteroni and F Saleri The original lecture notes were also revised and updated Scientific Computing Bertil Gustafsson,2018-10-03 This book explores the most significant computational methods and the history of their development It begins with the earliest mathematical numerical achievements made by the Babylonians and the Greeks followed by the period beginning in the 16th century For several centuries the main scientific challenge concerned the mechanics of planetary dynamics and the book describes the basic numerical methods of that time In turn at the end of the Second World War scientific computing took a giant step forward

with the advent of electronic computers which greatly accelerated the development of numerical methods As a result scientific computing became established as a third scientific method in addition to the two traditional branches theory and experimentation The book traces numerical methods journey back to their origins and to the people who invented them while also briefly examining the development of electronic computers over the years Featuring 163 references and more than 100 figures many of them portraits or photos of key historical figures the book provides a unique historical perspective on the general field of scientific computing making it a valuable resource for all students and professionals interested in the history of numerical analysis and computing and for a broader readership alike *Infinite-Dimensional Dynamical Systems* James C. Robinson,2001-04-23 This book develops the theory of global attractors for a class of parabolic PDEs which includes reaction diffusion equations and the Navier Stokes equations two examples that are treated in detail A lengthy chapter on Sobolev spaces provides the framework that allows a rigorous treatment of existence and uniqueness of solutions for both linear time independent problems Poisson s equation and the nonlinear evolution equations which generate the infinite dimensional dynamical systems of the title Attention then switches to the global attractor a finite dimensional subset of the infinite dimensional phase space which determines the asymptotic dynamics In particular the concluding chapters investigate in what sense the dynamics restricted to the attractor are themselves finite dimensional The book is intended as a didactic text for first year graduates and assumes only a basic knowledge of Banach and Hilbert spaces and a working understanding of the Lebesgue integral *Mathematical Analysis in Fluid Mechanics* Raphaël Danchin,Reinhard Farwig,Jiří Neustupa,Patrick Penel,2018-06-26 This volume contains the proceedings of the International Conference on Vorticity Rotation and Symmetry IV Complex Fluids and the Issue of Regularity held from May 8 12 2017 in Luminy Marseille France The papers cover topics in mathematical fluid mechanics ranging from the classical regularity issue for solutions of the 3D Navier Stokes system to compressible and non Newtonian fluids MHD flows and mixtures of fluids Topics of different kinds of solutions boundary conditions and interfaces are also discussed

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