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Peter J. Schmid
Dan S. Henningson

Stability and Transition in Shear Flows



Springer

Stability And Transition In Shear Flows

Julia Schneider



Stability And Transition In Shear Flows:

Stability and Transition in Shear Flows Peter J. Schmid, Dan S. Henningson, 2012-12-06 The field of hydrodynamic stability has a long history going back to Reynolds and Lord Rayleigh in the late 19th century. Because of its central role in many research efforts involving fluid flow, stability theory has grown into a mature discipline firmly based on a large body of knowledge and a vast body of literature. The sheer size of this field has made it difficult for young researchers to access this exciting area of fluid dynamics. For this reason, writing a book on the subject of hydrodynamic stability theory and transition is a daunting endeavor, especially as any book on stability theory will have to follow into the footsteps of the classical treatises by Lin (1955), Betchov (1967), Joseph (1971), and Drazin & Reid (1981). Each of these books has marked an important development in stability theory and has laid the foundation for many researchers to advance our understanding of stability and transition in shear flows.

Physics of Transitional Shear Flows Andrey V. Boiko, Alexander V. Dovgal, Genrikh R. Grek, Victor V. Kozlov, 2011-09-15 Starting from fundamentals of classical stability theory, an overview is given of the transition phenomena in subsonic wall-bounded shear flows. At first, the consideration focuses on elementary small-amplitude velocity perturbations of laminar shear layers, i.e. instability waves in the simplest canonical configurations of a plane channel flow and a flat plate boundary layer. Then the linear stability problem is expanded to include the effects of pressure gradients, flow curvature, boundary layer separation, wall compliance, etc. related to applications. Beyond the amplification of instability waves is the non-modal growth of local stationary and non-stationary shear flow perturbations, which are discussed as well. The volume continues with the key aspect of the transition process that is receptivity of convectively unstable shear layers to external perturbations, summarizing main paths of the excitation of laminar flow disturbances. The remainder of the book addresses the instability phenomena found at late stages of transition. These include secondary instabilities and nonlinear features of boundary layer perturbations that lead to the final breakdown to turbulence. Thus, the reader is provided with a step-by-step approach that covers the milestones and recent advances in the laminar-turbulent transition. Special aspects of instability and transition are discussed throughout the book and are intended for research scientists, while the main target of the book is the student in the fundamentals of fluid mechanics. Computational guides, recommended exercises, and PowerPoint multimedia notes based on results of real scientific experiments supplement the monograph. These are especially helpful for the neophyte to obtain a solid foundation in hydrodynamic stability. To access the supplementary material, go to extras.springer.com and type in the ISBN for this volume.

Principles of Turbulence Control Baochun Fan, Gang Dong, 2022-05-17 This book introduces the mathematical techniques for turbulence control in a form suitable for inclusion in an engineering degree program at both undergraduate and postgraduate levels, whilst also making it useful to researchers and industrial users of the concepts. It uses a mix of theory, computation, and experimental results to present and illustrate the methodologies. It is based on the three-part structure: wall turbulence, open-loop control, and feedback control, with emphasis

on optimal control methodologies The book also includes an introduction of basic principles and fundamentals followed by a chapter on the structure of wall turbulence with emphasis on coherent structures Elsewhere there is focus on control methods of wall turbulence by manipulating the boundaries through their motion and by applying control forces throughout the flow volume The last two chapters will describe the linear and non linear optimal controls This integrated approach will help not only researchers interested in the topic but also graduate or advanced undergraduate students in their course work

Rheology of Complex Fluids Abhijit P. Deshpande, J. Murali Krishnan, Sunil Kumar, 2010-09-20 The aim of the School on Rheology of Complex fluids is to bring together young researchers and teachers from educational and R D institutions and expose them to the basic concepts and research techniques used in the study of rheological behavior of complex fluids The lectures will be delivered by well recognized experts The book contents will be based on the lecture notes of the school

Fluid Mechanics and Fluid Power (Vol. 3) Suvanjan Bhattacharyya, Saket Verma, A. R. Harikrishnan, 2023-04-17 This book presents the select proceedings of the 48th National Conference on Fluid Mechanics and Fluid Power FMFP 2021 held at BITS Pilani in December 2021 It covers the topics such as fluid mechanics measurement techniques in fluid flows computational fluid dynamics instability transition and turbulence fluid structure interaction multiphase flows micro and nanoscale transport bio fluid mechanics aerodynamics turbomachinery propulsion and power The book will be useful for researchers and professionals interested in the broad field of mechanics

New Trends in Fluid Mechanics Research F. G. Zhuang, J. C. Li, 2009-04-24 New Trends in Fluid Mechanics Research is the proceedings of the Fifth International Conference on Fluid Mechanics ICFM V it is the primary forum for the presentation of technological advances and research results in the fields of theoretical experimental and computational Fluid Mechanics Following the previous conferences in Beijing 1987 1993 and 1998 and Dalian 2004 organized by the Chinese Society of Theoretical and Applied Mechanics the Scientific Committee for ICFM presents ICFM V to provide a forum for researchers to exchange original ideas and recent advances in Fluid Mechanics and relevant interdisciplinary subjects Topics include flow instability and turbulence aerodynamics and gas dynamics hydrodynamics industrial and environmental fluid mechanics biofluid mechanics geophysical fluid mechanics plasma and magneto hydrodynamics multiphase flows non Newtonian flows and flows in porous media flow of reacting fluid microscale flow and others

NASA Technical Paper, 1992

Handbook of Fluid Dynamics Richard W. Johnson, 2016-04-06 Handbook of Fluid Dynamics offers balanced coverage of the three traditional areas of fluid dynamics theoretical computational and experimental complete with valuable appendices presenting the mathematics of fluid dynamics tables of dimensionless numbers and tables of the properties of gases and vapors Each chapter introduces a different fluid dynamics topic discusses the pertinent issues outlines proven techniques for addressing those issues and supplies useful references for further research Covering all major aspects of classical and modern fluid dynamics this fully updated Second Edition Reflects the latest fluid dynamics research and engineering applications Includes new sections on emerging fields

most notably micro and nanofluidics Surveys the range of numerical and computational methods used in fluid dynamics analysis and design Expands the scope of a number of contemporary topics by incorporating new experimental methods more numerical approaches and additional areas for the application of fluid dynamics Handbook of Fluid Dynamics Second Edition provides an indispensable resource for professionals entering the field of fluid dynamics The book also enables experts specialized in areas outside fluid dynamics to become familiar with the field **NASA Technical Paper** United States. National Aeronautics and Space Administration,1992 **Scientific and Technical Aerospace Reports** ,1995

Liutex-based and Other Mathematical, Computational and Experimental Methods for Turbulence Structure Chaoqun Liu,Yisheng Gao,2020-04-28 The knowledge of quantitative turbulence mechanics relies heavily upon the definition of the concept of a vortex in mathematical terms This reference work introduces the reader to Liutex which is an accepted accurate and mathematical definition of a vortex The core of this book is a compilation of several papers on the subject presented in the 13th World Congress of Computational Mechanics WCCM2018 Symposium 704 Mathematics and Computations for Multiscale Structures of Turbulent and Other Complex Flows New York United States on July 27 2018 This compilation also includes other research papers which explain the work done on the vortex definition vortex identification and turbulence structure from different insight angles including mathematics computational physics and experiments The thirteen chapters in this volume will be informative to scientists and engineers who are interested in advanced theories about fluid dynamics vortex science and turbulence research **Wave Interactions and Fluid Flows** Alex D. D. Craik,1988-07-07 Wave Interactions and Fluid Flows is a coherent up to date and comprehensive account of theory and experiment on wave interaction phenomena both in fluids at rest and in shear flows On the one hand this includes water waves internal waves their evolution and interaction and associated wave driven mean flows on the other phenomena of nonlinear hydrodynamic stability especially those leading to the onset of turbulence Close similarities and crucial differences exist between these two classes of phenomena and their treatment in this single study provides a particularly valuable bridge between more specialised but related disciplines As a result this unique book will appeal to researchers and graduate students of fluid mechanics in its widest sense including the study of wave interaction phenomena in such diverse fields as meteorology aeronautical and hydraulic engineering optics solar physics and population dynamics Dr Craik is an active researcher of long standing at the University of St Andrews and has wide experience in the field of fluid mechanics *Stability Study on Shear Flow and Vortices in Late Boundary Layer Transition* Jie Tang,2017 Turbulence is still an unsolved scientific problem it has been regarded as the most important unsolved problem of classical physics Dr Liu proposed a new mechanism about turbulence generation and sustenance after decades of research on turbulence and transition His new idea challenged the classical theorem in many aspects One of them is the flow stability of transition Dr Liu believes that inside the flow field shear dominant in laminar is very unstable while rotation dominant in turbulence is relative stable This inherent property of

flow creates the trend that non vertical vorticity must transfer to vertical vorticity and causes the occurrence of transition To verify this new idea this dissertation analyses the linear stability on twodimensional shear flow and quasi rotation flow 1 Chebyshev collocation spectral method is discussed to solve Orr Sommerfeld equation the famous eigenvalue function describing the linear modes of disturbance Several typical parallel shear flows are tested as the basicstate flows in the equation The instability of shear flow is demonstrated by the existence of positive eigenvalues associated with disturbance modes eigenfunctions i e the growth of these linear modes 2 Quasi rotation flow is considered under Cylindrical coordinate An eigenvalue perturbation equation is derived to study the stability problem with symmetric flows Shifted Chebyshev polynomial with Gauss collocation points is used to solve the equation To investigate the stability of vortices generation in real world case I tracked a ring like vortex and a leg like vortex over time from our Direct Numerical Simulation DNS data The result shows that with the generation over time both ring like vortex and leg like vortex become more stable in the fact of decreasing positive eigenvalues

4th AIAA Theoretical Fluid Mechanics Meeting: 05-5053 - 05-5386 ,2005 **Applied Mechanics Reviews** ,1965 *NBS Special Publication* ,1976 **Hydraulic Research in the United States and Canada** United States. National Bureau of Standards,1978 *Hydraulic Research in the United States and Canada*, 1974 Pauline H. Gurewitz,1976 *Hydraulic Research in the United States and Canada*, 1978 Pauline H. Gurewitz,1980 *Agard Index of Publications*, 1992-1994 ,1995

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