Modeling Complex Turbulent Flows

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Modeling Complex Turbulent Flows

George Tzabiras

Modeling Complex Turbulent Flows:

Modeling Complex Turbulent Flows Manuel D. Salas,Jerry N. Hefner,Leonidas Sakell,1999-04-30 Turbulence modeling both addresses a fundamental problem in physics the last great unsolved problem of classical physics and has far reaching importance in the solution of difficult practical problems from aeronautical engineering to dynamic meteorology However the growth of supercom puter facilities has recently caused an apparent shift in the focus of tur bulence research from modeling to direct numerical simulation DNS and large eddy simulation LES This shift in emphasis comes at a time when claims are being made in the world around us that scientific analysis itself will shortly be transformed or replaced by a more powerful paradigm based on massive computations and sophisticated visualization Although this viewpoint has not lacked ar ticulate and influential advocates these claims can at best only be judged premature After all as one computational researcher lamented the com puter only does what I tell it to do and not what I want it to do In turbulence research the initial speculation that computational meth ods would replace not only model based computations but even experimen tal measurements have not come close to fulfillment It is becoming clear that computational methods and model development are equal partners in turbulence research DNS and LES remain valuable tools for suggesting and validating models while turbulence models continue to be the preferred tool for practical computations We believed that a symposium which would reaffirm the practical and scientific importance of turbulence modeling was both necessary and timely *Modeling Complex Turbulent Flows* Xiaohua Wang,2000 **Modeling Complex Turbulent Flows** Manuel D. Salas,Jerry N. Hefner,Leonidas Sakell,2012-12-06 Turbulence modeling both addresses a fundamental problem in physics the last great unsolved problem of classical physics and has far reaching importance in the solution of difficult practical problems from aeronautical engineering to dynamic meteorology However the growth of supercom puter facilities has recently caused an apparent shift in the focus of tur bulence research from modeling to direct numerical simulation DNS and large eddy simulation LES This shift in emphasis comes at a time when claims are being made in the world around us that scientific analysis itself will shortly be transformed or replaced by a more powerful paradigm based on massive computations and sophisticated visualization Although this viewpoint has not lacked ar ticulate and influential advocates these claims can at best only be judged premature After all as one computational researcher lamented the com puter only does what I tell it to do and not what I want it to do In turbulence research the initial speculation that computational meth ods would replace not only model based computations but even experimen tal measurements have not come close to fulfillment It is becoming clear that computational methods and model development are equal partners in turbulence research DNS and LES remain valuable tools for suggesting and validating models while turbulence models continue to be the preferred tool for practical computations We believed that a symposium which would reaffirm the practical and scientific importance of turbulence modeling was both necessary and timely Calculation of Complex Turbulent Flows George Tzabiras,2000 A selection of

invited chapters focusing on developments in the application of Computational Fluid Dynamics CFD to compressible or incompressible flows dominated by turbulence effects These may be applied to complex geometrical configurations or flow fields in simpler geometries requiring higher order turbulence modelling or suitably modified low order models to calculate crucial parameters such as instabilities transition separation accurate description of velocity and scalar fields and local and total forces **Non-Equilibrium Modeling of Complex Turbulent Flows** ,1998 The non equilibrium modeling of complex turbulent flows is considered from a theoretical standpoint Both two equation models and full second order closures are considered Non equilibrium two equation models can be obtained via a regularization scheme based on a Pade approximation Second order closures that are extended to non equilibrium flows are obtained in the same fashion Applications to rapidly distorted flows including homogeneous shear flow and homogeneous plane strain turbulence are considered The prospects for future research are discussed in detail *Second Moment Closure Modeling of Complex Turbulent Flows* Sharath Girimaji,Jeremy T. Pinier,Mark N. Glauser,Lawrence Ukeiley,2007 Turbulence subject to unsteady forcing can exhibit novel features that cannot be explained using the well known steady turbulence paradigm Modeling and prediction of such statistically unsteady flows are important in many practical AFOSR applications turbine flows wake flows with vortex shedding etc Further many flow control strategies depend upon the knowledge of unsteady turbulence dynamics to achieve the desired objectives However our understanding of unsteadily forced turbulence dynamics or our ability to predict them is inadequate **Scientific and Technical Aerospace Reports** ,1981-04 Implicit Large Eddy Simulation Fernando F. Grinstein,Len G. Margolin,William J. Rider,2011-02-17 The numerical simulation of turbulent flows is a subject of great practical importance to scientists and engineers The difficulty in achieving predictive simulations is perhaps best illustrated by the wide range of approaches that have been developed and are still being used by the turbulence modeling community In this book the authors describe one of these approaches Implicit Large Eddy Simulation ILES ILES is a relatively new approach that combines generality and computational efficiency with documented success in many areas of complex fluid flow This book synthesizes the theoretical basis of the ILES methodology and reviews its accomplishments ILES pioneers and lead researchers combine here their experience to present a comprehensive description of the methodology This book should be of fundamental interest to graduate students basic research scientists as well as professionals involved in the design and analysis of complex turbulent flows Calculation of Complex Turbulent Flows George Tzabiras,2000 A selection of invited chapters focusing on developments in the application of Computational Fluid Dynamics CFD to compressible or incompressible flows dominated by turbulence effects These may be applied to complex geometrical configurations or flow fields in simpler geometries requiring higher order turbulence modelling or suitably modified low order models to calculate crucial parameters such as instabilities transition separation accurate description of velocity and scalar fields and local and total forces **Near-wall Modelling of Complex Turbulent Flows** Yong-gen Lai,1990 **On Explicit Algebraic Stress**

Models for Complex Turbulent Flows National Aeronautics and Space Administration (NASA),2018-07-09 Explicit algebraic stress models that are valid for three dimensional turbulent flows in noninertial frames are systematically derived from a hierarchy of second order closure models This represents a generalization of the model derived by Pope who based his analysis on the Launder Reece and Rodi model restricted to two dimensional turbulent flows in an inertial frame The relationship between the new models and traditional algebraic stress models as well as anistropic eddy visosity models is theoretically established The need for regularization is demonstrated in an effort to explain why traditional algebraic stress models have failed in complex flows It is also shown that these explicit algebraic stress models can shed new light on what second order closure models predict for the equilibrium states of homogeneous turbulent flows and can serve as a useful alternative in practical computations Gatski T B and Speziale C G Langley Research Center NAS1 18605 NAS1 19480 RTOP 505 90 52 01 **On Explicit Algebraic Stress Models for Complex Turbulent Flows** T. B. Gatski,C. G. Speziale,1992 Implicit Large Eddy Simulation Rider William Margolin Len G Grinstein Fenando F,2014-05-14 **Complex Turbulent Flows: Taxonomies, reporters' summaries, evaluation, and conclusion** Stephen J. Kline,Stephen Jay Kline,Brian Cantwell,G. M. Lilley,1981 *Simulation Strategies for Complex Turbulent Flows* Markus Weinmann,2011 **Numerical Simulation of 3D, Complex, Turbulent Flows with Unsteady Coherent Structures** Liang Ge,2004 A new state of the art CFD solver capable of simulating a broad range of complex engineering flows at real life Reynolds numbers is developed The method solves the three dimensional incompressible unsteady Reynolds averaged Navier Stokes URANS equations closed with statistical turbulence models Three such models are incorporated in the solver the standard k e model with wall functions the Spalart Allmaras model and the detached eddy simulation DES model The numerical solver employs domain decomposition with structured Chimera overset grids to handle complex multi connected geometries The governing equations are discretized with second order accuracy schemes both in space and time The capabilities and versatility of the numerical method are demonstrated by applying it to simulate two widely different flow problems a flow past a geometrical complex array of multiple bridge piers mounted both on a natural river reach and on a flat bed experimental flume and b flow in mechanical bileaflet prosthetic heart valve with the leaflets fixed in the fully open position Overset grid systems with several millions of grid nodes are used and grid refinement and other numerical dependency studies are carried out to explore the sensitivity of the computed solutions to various numerical parameters For all simulated cases large scale unsteadiness appears naturally as a result of excited mean flow instabilities and the computed mean flowfields are shown to be in good quantitative agreement with experimental measurements By analyzing the instantaneous flowfields numerous novel insights into the physics of both flow cases are obtained and discussed extensively The results of this thesis demonstrate the potential of the new method as a powerful simulation tool for a broad range of cross disciplinary engineering flow problems and underscore the need for physics based numerical modeling by integrating CFD with

laboratory experimentation **Engineering Turbulence Modelling for CFD with Focus on Explicit Algebraic Reynolds Stress Models** Stefan Wallin,2000 **Advanced Approaches in Turbulence** Paul Durbin,2021-07-30 Front Cover Advanced Approaches in Turbulence Copyright Contents Contributors Preface 1 Basics of turbulence 1 1 Introduction 1 2 Eddy diffusion 1 3 Scales of turbulence 1 3 1 Isotropic decay 1 3 2 Stretching and diffusion of vorticity 1 4 Spectral equations 1 4 1 Isotropic turbulence 1 4 2 Shear and streaks 1 5 Averaged equations 1 5 1 Jets 1 5 2 Boundary layer 1 6 The form of turbulence models 1 6 1 Two equation models 1 6 2 Reynolds stress transport 1 7 Conclusion References 2 Direct numerical and large eddy simulation of complex turbulent flows 2 1 Introduction 2 2 Error as a function of scale 2 2 1 Modified wavenumber 2 2 2 Nonlinear sources of error 2 2 3 Time advancement error as a function of scale 2 3 Analysis of numerical errors in large eddy simulation using statistical closure theory 2 3 1 EDQNM closure 2 3 2 EDQNM LES and the inclusion of numerical error 2 3 3 EDQNM model 2 3 4 Relative magnitudes of error 2 4 Simulations in complex geometries 2 4 1 Decay of isotropic turbulence 2 4 2 Gas turbine combustor 2 5 Simulating the flow around moving bodies 2 5 1 Fluid phase 2 5 2 Solid phase 2 5 3 The effects of interpolation 2 5 4 Particles in a turbulent channel 2 6 What is a canonical flow 2 6 1 Jets in crossflow 2 6 2 DNS of turbulent channel flow over random rough surfaces 2 7 The analysis of big data 2 7 1 DMD of large datasets and numerical error 2 7 2 Analysis of wall pressure fluctuation sources in turbulent channel flow 2 8 Bridging the Reynolds number divide 2 9 Concluding remarks Acknowledgments References 3 Large eddy simulations 3 1 Introduction 3 1 1 Motivation 3 2 Governing equations 3 2 1 Filtering *Proceedings of the 5th Joint ASME/JSME Fluids Engineering Summer Conference, 2007: Fora (2 pt.)* American Society of Mechanical Engineers. Fluids Engineering Division. Summer Meeting,2007 **Government Reports Announcements & Index** ,1988

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