Direct and Large-Eddy Simulation IX

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Direct and Large-Eddy Simulation IX

Springer

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Preface

Representing turbulence by a small number of quantities, such as intensity and length scale, for example, is appropriate and efficient in many engineering situations. Resolving most of or even all turbulent motion by means of Large-Eddy Simulation (LES) or Direct Numerical Simulation (DNS), respectively, provides much more information but is computationally very demanding. Recent years have witnessed an ever-increasing availability of computer power so that the approach can now be applied by many researchers. Indeed, a minimum number of operations, determined by the grid size and the required time steps, needs to be executed to obtain sound separation of length and timescales between the smallest and the largest resolved ones.[1] During recent years, the required performance threshold is met by more and more computer systems. Also, discretization methods and solution algorithms have improved as a result of decades of scientific activities in this field. As a consequence, meaningful DNS and LES can now be performed for more and more applications. For the same reason, a central issue of LES, subgrid-scale modelling, has become less critical today as the grid scales are further away from the resolved scales than before. Still, these methods present lots of pitfalls, and a cost-effective simulation requires optimal models. Much work has been done on improving discretization schemes, subgrid-scale models and other model contributions such as generation of inflow turbulence. On this basis, the development and application of these methods and models continues to be a very active field of research. More and more data sets from DNS nowadays provide detailed and accurate reference for improved understanding and development of physical models.

"Direct and Large-Eddy Simulation 9" was organized in Dresden, Germany, with a local team from the Institute of Fluid Mechanics at TU Dresden and the Helmholtz Center Dresden Rossendorf. This ninth edition took place almost two decades after the start of this ERCOFTAC workshop series in 1994. The first event, DLES1, had been organized by Peter Voke at the University of Surrey and seen 25

[1] S.B. Pope, New J. Phys. 6:35, 2004.

papers, almost equally partitioned into four sessions, turbulent structures and round jets, subgrid-scale modelling, stratified and atmospheric flows and transition. The papers mainly came from those European countries in possession of large computers, six from Great Britain, four from France, the Netherlands and Germany, each, two from Italy and Sweden, one from Switzerland and Norway and two from overseas, USA and Japan, all attributed according to the first author.

During the 20 years since then, the workshop has substantially increased in size and has been tracing the development of the subject from an exclusive one to a broadly applied and fast developing area of research. DLES9 in 2013 so far was the biggest event of the series with 86 contributed talks and 23 poster presentations, selected after a careful reviewing process. Naturally, the range of session topics has become much broader compared to DLES1. Beyond the traditional core subjects of DLES, LES modelling, numerics, turbulent structures, transition and environmental flows, they have been spreading to further applications, among which reactive flows and combustion together with multiphase flows being the larges ones, in terms of the number of papers. Certain methodological topics which have come up over recent years were also featured at DLES9, such as quality of LES and extension to hybrid LES/RANS methods, while other sessions dealt with developments and results in further application areas. A special session on MHD turbulence was put together by HZDR. In addition to the regular contributions, nine keynote presentations provided overviews of recent developments and state of the art for transition (Dan Henningson), cavitation (Stefan Hickel), marine boundary layers (Peter Sullivan), combustion (Heinz Pitsch), LES modelling (Roel Verstappen), MHD turbulence (Annick Pouquet), multiphase flow (Alfredo Soldati), jet noise (Tim Colonius) and applications to industrial flows (Florian Menter).

Most of the invited and contributed papers have been submitted for inclusion in the Proceedings of DLES9 and after a careful review procedure most of these can be found in this volume. The papers are grouped into themes, mostly along the order of the sessions of the workshop. These contributions give a good overview of the most important current issues and application areas in DNS and LES. Fundamental issues related to the usage of LES and the development of the various models required for LES are still an important research topic. The applications to various research questions show that LES and DNS have become important tools for fundamental research able to generate substantial physical insight into numerous phenomena related to various and diverse turbulent flows.

The organization of the ERCOFTAC DLES9 Workshop and the preparation of these proceedings would not have been possible without the support of many. We thank the members of the Scientific Committee for their contribution to the reviewing process and the numerous helpers involved in preparing and managing the event as well as handling the proceedings. We also gratefully acknowledge financial support from the J.M. Burgerscentrum, ANSYS Germany, Innius GTD, Howden Germany, DFG priority programme MetStröm, Gesellschaft der Freunde und Förderer der TU Dresden and Helmholtz-Zentrum Dresden Rossendorf. The European Research Community on Flow, Turbulence and Combustion, ERCOFTAC, supported the attendance and contribution of young scientists to DLES9 by making available scholarships to Ph.D. students.

Dresden, May 2014

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