

# Preface

In an era of continuously increasing computer power and increasing quality of algorithms and software Direct Numerical Simulations and Large Eddy Simulations receive continuously increasing interest and face widespread use. Nevertheless, developments are still needed and performed by researchers in various directions. The ERCOFTAC series of workshops on Direct and Large Eddy Simulation organized since 1994 by various people reflect this activity and serve as catalyst to stimulate scientific exchange on this topic. During September 8–10 2007, the seventh workshop of this series was held in Trieste, Italy. As the earlier workshops it aimed at establishing the state-of-art in turbulence modelling and numerical methodologies of Direct and Large Eddy Simulation as well as their use in fundamental research and applications.

Six plenary sessions, 16 parallel sessions and 2 poster sessions have been run during the three days.

The nine keynote lectures have dealt with different fields of fundamental, industrial and environmental fluid mechanics. Prof. S. Pope (Cornell University, USA) has discussed recent modelling techniques (LES/FDF) for reacting flows, like flames in combustors, and new methodologies to treat the transport of scalars in the flow field. Prof. G. Pedrizzetti (University of Trieste, Italy) has shown recent numerical results of the unsteady flow field within the left ventricular, and comparison with data obtained in real cases by means of eco-Doppler analysis. Prof. C. Meneveau's talk (Johns Hopkins University, USA) has dealt with LES modelling of environmental fluid mechanics, discussing large scale LES of pollen dispersion in the atmosphere, and comparison between numerical and field data. Prof. U. Piomelli (Queen's University, Canada) has given a summary of the state-of-art of wall-modelling techniques within the LES framework for high Reynolds number flows. Prof. S. Elghobashi (UC Irvine, USA) has discussed Lagrangian techniques for multiphase flows, focussing on new formulations of the particle motion equation and on two-way coupling between the Eulerian field and the Lagrangian techniques. Prof. R. Verzicco (University of Rome, Tor Vergata, Italy) has shown recent results regarding natural convection in confined flows, aimed at explaining disagreements among experimental data and numerical simulations. Prof. T. Hughes (University of Texas at Austin, USA) has discussed a novel approach to LES methodology, based on the multi-scale methodology. Two

sets of equations are considered, one for the large scales of motion and one for the small ones. Results of simulations on simple validation cases prove the reliability of the technique. This methodology is far from the classical ones where the small scales of motions are parameterized in a statistical sense using a SGS model, and it can be a good alternative to classic SGS techniques in cases of very complex-physics flows, where the direct knowledge of the small scales of motion is required. Prof. R. Friedrich (TU Munich, Germany) has discussed recent results of boundary layer dynamics in compressible flows, considering both subsonic and supersonic conditions. Finally, Dr. Flohr (Alstom, Switzerland) has discussed results of high-Reynolds number large eddy simulation of gas turbine combustors, giving a nice example of the superiority of the LES approach when compared to classic RANS methodologies.

The regular sessions focussed on different topics. Environmental applications were shown, from the laboratory-scale numerical experiments carried out using both DNS and wall-resolving LES to applicative full-scale simulations carried out through LES with wall-layer models. Also fundamental studies of turbulence were discussed in a wide range of basic fields, from the canonical boundary layer to the isotropic turbulence. A session of compressible flows ranged from basic studies of interaction between compressible effects and turbulence to wall-layer modelling for LES of compressible flows. The multiphase flows session covered classical particle laden flow analyses as well as the study of bubbles and featured state-of-art approaches where the dispersed phase is treated as an ensemble of finite-size particles. The session on aerodynamics and wakes treated classical aerodynamics problems, approached through the use of state-of-the-art numerical techniques and SGS models. Also, more challenging problems were discussed such as turbulent wakes affected by stratification. The session on evolution of active scalars, comprised both reactive flows (for combustion problems) and classical natural convection problems. A session of analysis and quantification of modelling errors in LES discussed and rigorously quantified the numerical errors associated with the use of low order numerical schemes in conjunction with SGS models. Finally, in the LES modelling session new ideas for robust and accurate SGS models were discussed. The number of oral presentation was 74. Short presentations of 15 posters completed the program. The number of participants was about 120, of which 37 were undergraduate and graduate students.

As a whole, based on the scientific contributions presented during the workshop, LES seems to be a robust and reliable technique for practical applications in numerous high-end technological applications. However, many problems still remain open and were discussed during the workshop, e.g. regarding SGS closure in special applications, validation of numerical results against experimental, real-life data, and accuracy of the algorithms currently in use for the numerical integration of the governing equations. A general trend in fluid mechanics conferences is that the amount of work presented on very fundamental issues such as subgrid-scale modelling is observed to persist, while complex physical phenomena and applications are treated to an

increasing extent. In this scenery, the series of DLES workshops sees itself as a host for fundamental research on DNS and LES and will continue to be that in the future.

The present book summarizes the written contributions to the seventh DLES workshop. As usual for a DLES workshop, the quality of the presentations was very high, and the same applies to the corresponding papers. This was furthermore ensured by an extensive peer-review process.

The organizers were delighted about the stimulating atmosphere and the constructive discussions at this workshop. This is to a large extent due to the participants and the organizers are grateful for that. They find it rewarding that the work of organizing this meeting turned into such a success. May this book be of much use for the reader and find widespread distribution.

*Vincenzo Armenio*  
*Jochen Fröhlich*  
*Bernard J. Geurts*

Direct and Large-Eddy Simulation VII

Proceedings of the Seventh International ERCOFTAC

Workshop on Direct and Large-Eddy Simulation, held at

the University of Trieste, September 8-10, 2008

Armenio, V.; Geurts, B.; Fröhlich, J. (Eds.)

2010, IV, 646 p., Hardcover

ISBN: 978-90-481-3651-3