Special Issue: Progress in Direct and Large Eddy Simulation

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This Special Issue contains extended versions of 16 papers, selected from a total of about 100 contributions presented at the ERCOFTAC Workshop Direct and Large-Eddy Simulation (DLES12), held in Madrid, Spain on June 5–7, 2019. The DLES Workshop series, which started in 1994, focuses on modern techniques designed to simulate turbulent flows based on a partial or full resolution of the instantaneous turbulent flow structures, such as Direct Numerical Simulation (DNS), Large-Eddy Simulation (LES) and hybrid models combining LES and RANS approaches.

In the 25 years of history of the Workshop, a significant evolution of the topics can be observed. In the first few editions, most of the contributions dealt with the study of canonical problems and the development of the DNS and LES methodologies, mostly in the context of single-phase flows. In recent years, the complexity of the phenomena that are computationally tractable has increased considerably. It is now possible to handle increasingly complex geometries and multi-physics phenomena—for example, the effects of bubbles, solid particles, gas–liquid interaction, heat transfer and combustion, all of which require ad-hoc models, whether within RANS, LES or hybrid LES-RANS methodologies. These models must be appropriately accurate, but at the same time, computationally affordable for industrial use. Sufficiently detailed experimental data suitable for validation purposes are often lacking, and the validation of closure models for these complex phenomena has, therefore, to rely in many cases on DNS. As in other fields of scientific knowledge, the amount of data being used is increasing at an exponential rate, and there is a tendency to increasingly exploit data assimilation and machine learning for the development of turbulence models, in the context of both LES and hybrid approaches. DLES12 offered an opportunity to survey and discuss recent advances on all the above fronts and in a variety of different application areas.

The Special Issue aims at providing an archival record of some of the best papers presented at DLES12. These carefully selected papers were subjected to the same rigorous review process as that followed for any other contribution to FTaC. They cover methodological aspects—i.e. advances in numerical methods, subgrid-scale modelling and new

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methodologies for complex phenomena—and applications in several fields—namely, multiphase and reactive flows, particle-laden flows, hypersonic flow of dense gases, flow in porous media, aerodynamics, roughness, and shock/boundary layer interaction in transitional flows.

The Guest Editors wish to thank all authors and reviewers for their contributions towards making this Special Issue a valuable addition to the literature on the methodology and applications of DNS and LES.

The Special Issue Guest Editors

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