

Preface

This volume contains the 2006 annual progress reports of the CTR postdoctoral fellows and visiting scholars. A separate report of the proceedings of the eleventh biennial CTR Summer Program was published earlier this year. CTR will be twenty years old by the time this volume reaches its worldwide readership. In the past twenty years CTR research has evolved significantly. Many of the fundamental research areas of the early days of CTR, such as direct numerical simulation of canonical shear flows and combustion phenomenon have now been adopted as mainstream research tools in the engineering science community. As is evident from the technical reports in this and recent volumes of the Annual Research Briefs, current CTR scholars are tackling much more complex and interdisciplinary problems. However, the most important feature that remains the same is the continued emphasis on the development of computational tools for conducting experiments of discovery and for flow prediction in engineering analysis. To conduct effective research in predictive science in complex systems, CTR has strived to maintain a critical mass in numerical analysis, computer science and physics based modeling, all under one roof. CTR has also always maintained close ties to laboratory experiments and experimentalists in several institutions. Over the last ten years, this infrastructure has benefited greatly from the sustained financial and intellectual support of the Department of Energys Advanced Simulation and Computing Program.

The first group of papers in this volume are concerned with uncertainty quantification and validation of numerical simulations. This is an emerging area of importance in computational science, and we have assembled a strong group of students, postdoctoral fellows and faculty to meet the challenges in this area. The next group of papers are concerned with fundamental developments in LES, including new subgrid scale models, and its applications in multi-physics areas such as aero-optics and combustion. There was a substantial effort in numerical analysis of partial differential equations, which are reported in the next group of papers. Provable stable schemes were developed and implemented in complex flow applications. An important pacing item in computational science for complex systems is the problem of integration of multiple codes simulating multiple physical effects. The utility of the coupler code and environment for integrated simulations was demonstrated in two massive calculations: end to end hybrid simulation of a gas turbine engine and a hybrid simulation of flow around helicopter rotors and the associated acoustics. Computational acoustics, and flow control are receiving renewed attention at CTR in part because of the development of high fidelity large eddy simulation technology for computation of realistic flows of aeronautical interest. Several papers on these and more fundamental studies of turbulence constitute the final group of papers in this volume.

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