Preface

The thirteenth biennial Summer Program of the Center for Turbulence Research was held during the period June 26 to July 23, 2010. This was the largest CTR Summer Program to date with 83 participants from 13 countries including participants from ten U.S. universities and national laboratories. The participants included experimentalists, theoreticians and computational scientists.

This proceedings volume contains 48 papers which are divided into eight groups: Uncertainty Quantification, Turbulent Boundary Layers, Large Eddy Simulation, Acoustics, Turbulent Combustion, Multi-phase Flows, Hypersonics and Solar Physics. Brief summaries of the accomplishments of each group are provided in the overviews that precede the grouped papers. The first group of papers addresses the emerging area of uncertainty quantification, UQ. There is a renewed appreciation for quantification of uncertainties in predictive computational science. Naturally, this field is at the core of Stanford's Predictive Science Academic Alliance Program (PSAAP) and is supported by both experimental and computational studies. The papers in this group cover both the science of UQ as well applications of its tools to fluid flow problems including quantification of epistemic uncertainties in a widely used turbulence model.

Recent direct numerical simulations of turbulent boundary layers at moderate Reynolds numbers has led to a renewed interest in the study of the structure of turbulent boundary layers. The ten papers in this group cover a broad set of topics ranging from identification of coherent structures to the dynamics of shock/boundary layer interactions. The Large Eddy Simulation group consisted of four papers, two of which introduced novel ideas to improve the performance of the dynamic subgrid scale models, first introduced in the 1990 Summer Program.

With the exponential increase in computer power over the past decade, high fidelity numerical simulations (DNS, LES) are making significant progress in prediction and analysis of multi-physics turbulent flows in complex domains. Aerodynamic noise, combustion and multi-phase turbulent flows are prime examples of areas where numerical simulations have had major impact. The next sixteen papers in the volume cover these three interrelated areas followed by fourteen articles in the areas of hypersonics and solar physics. The hypersonics group focused mostly on high Mach number flows encountered in atmospheric re-entry applications, and the Solar Physics group on astrophysical turbulent convection and magnetic effects in the Sun.

A key feature of the CTR Summer Programs are the weekly tutorials delivered by invited speakers. For the 2010 Program the four tutorials were: Shock/turbulence interaction (S. Lele, J. Larsson), New Programming Paradigms / Domain Specific Languages (P. Hanrahan), Uncertainty Quantification (G. Iaccarino), and Turbulent Boundary Layers (J. Jimenez). The participants presented their accomplishments on July 23, the final day of the program. In accordance to tradition, this full day event was attended by colleagues from other universities, industry, NASA and DOE laboratories.

We are grateful to Sara Bedin for her efficient organization of the Program. Financial support from the Department of Energy's ASC Program is gratefully acknowledged.

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