

Preface

This report contains the 2004 annual progress reports of the Research Fellows and students of the Center for Turbulence Research in its eighteenth year of operation. A separate report documenting the findings from the tenth biennial CTR Summer Program which included fifty participants from fourteen countries was published earlier this year. CTR publications, including this report and the Summer proceedings are available on the world wide web (<http://ctr.stanford.edu>).

Since its inception in 1987, the objective of the CTR has been to advance the physical understanding of turbulent flows and development of physics based predictive tools for engineering analysis and turbulence control. Turbulence is ubiquitous in nature and in engineering devices. The studies at CTR have been motivated by applications where turbulence effects are significant; these include a broad range of technical areas such as planetary boundary layers, formation of planets, solar convection, magnetohydrodynamics, environmental and eco systems, aerodynamic noise, propulsion systems and high speed transportation. Numerical simulation has been the predominant research tool at CTR which has required a critical mass of researchers in numerical analysis and computer science in addition to core disciplines such as applied mathematics, chemical kinetics and fluid mechanics. Maintaining and promoting this interdisciplinary culture has been a hallmark of CTR and has been responsible for the realization of the results of its basic research in applications. Continued demonstration of the utility of research results in applications has, in turn, led to a strong and mutually beneficial relationship with industry through Stanford's Thermal and Fluid Sciences Industrial Affiliate Program.

Last year CTR hosted thirteen resident Postdoctoral Fellows, eleven Research Associates, and ten Senior Fellows. The support for the Research Associates and Senior Fellows were largely provided by the Department of Energy's ASC program at Stanford. The major portion of Stanford's graduate student research in turbulence which is carried out at CTR is sponsored by the United States Air Force Office of Scientific Research, the Office of Naval Research and the Department of Energy.

The first group of reports in this volume are directed towards development, analysis and application of novel numerical methods for flow simulations. Development of methods for large eddy simulation of complex flows has been a central theme in this group. The second group is concerned with turbulent combustion, scalar transport and multi-phase flows. The final group is devoted to geophysical turbulence where the problem of solar convection has been a new focus of considerable attention recently at CTR.

The CTR roster for 2004 is provided in the Appendix. Also listed are the members of the CTR Steering Committee which has met quarterly to act on fellowship applications. We have also included, with a deep sense of gratitude, a list of all members of the Advisory Committee who have served the Center for Turbulence Research since its inception in 1987. Without their invaluable insights, and the intellectual and infrastructure support of NASA, CTR would not have been able to serve the international turbulence research community in the comprehensive fashion it has become known for.

It is a great pleasure to thank Millie Chethik for her day to day management of the Center and together with Dr. Xiaohua Wu for their skillful compilation of this report.

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