Preface

This report contains the 1994 annual progress reports of the Research Fellows and students of the Center for Turbulence Research. A separate report documenting the findings from the fifth CTR Summer Program was published earlier this year.

Since its inception in 1987, the objective of the Center for Turbulence Research has been to advance the physical understanding of turbulence in order to develop fundamentally-based predictive methods for engineering analysis and techniques for turbulence control. We believe that the pacing item for turbulence modeling and control is new fundamental ideas, which must be motivated by engineering applications. CTR strives to create an environment conducive to generation of new ideas, and this has been the guiding principle in the appointment of the CTR Fellows. In the past eight years, CTR has been able to attract over two hundred very bright postdoctoral researchers and established experts in turbulence and related fields for research, for the Summer Programs, and for other technical exchanges. From their research and interactions between them, a number of important new ideas for turbulence modeling and simulation have emerged, and several have already been implemented in engineering codes. CTR contributions include new models for compressibility effects in high-speed flows, the elliptic relaxation method for treatment of flow inhomogeneities and solid boundaries, the dynamic subgrid-scale modeling approach for large-eddy simulation, structure-based turbulence modeling, new methods for computation of aerodynamic sound, and new insights into the physics and modeling of chemically reacting turbulence obtained through a combination of experiments and direct numerical simulations.

Last year CTR hosted thirteen resident Postdoctoral Fellows, three Research Associates, and five Senior Research Fellows, and it supported two doctoral students and four short-term visitors. In addition, CTR sponsored its fifth Summer Program in July 1994 with thirty participants. The major portion of Stanford's doctoral research program in turbulence is sponsored by the United States Air Force Office of Scientific Research and the Office of Naval Research. Many students supported by these programs also conduct their research at the CTR. This report includes work only for those students who were directly supported by the CTR.

The first group of reports in this volume are directed towards turbulence combustion. A notable progress in this area was the successful completion of an experimental and numerical study designed for validation of simple chemical mechanisms for prediction codes. The second and the largest group of reports are concerned with the prediction of turbulent flows. A significant fraction of CTR's effort in large-eddy simulation and Reynolds-averaged turbulence modeling was focused on the *application* of models developed at the CTR to complex, unsteady separated flows. The remaining articles are devoted to experimental and numerical studies of turbulence control, physics of turbulence and sound generation, and simulation techniques. The last report is on the advanced postprocessing project, which has

now produced functioning software for the analysis of the database of numerical simulations of turbulence.

The CTR roster for 1994 is provided in the Appendix. Also listed are the members of the Advisory Committee, which meets annually to review the Center's program, and the Steering Committee, which acts on Fellowship applications.

It is a great pleasure to thank Debra Spinks, the Center's Administrative Assistant, for her skillful compilation of this report.

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William C. Reynolds