

## Preface

This volume contains the 2021 Annual Research Briefs that summarize the research activities at the Center for Turbulence Research (CTR) in its thirty-fifth year of operation. Central scientific objectives of CTR are the fundamental understanding of turbulent flows and the development of physical models and computational tools for multi-scale analysis and prediction of engineering systems.

Despite the challenges posed by the Covid-19 pandemic, the 18th biennial CTR Summer Program is expected to be held in July-August of 2022 as of the time of writing. A document listing the 584 reports produced during the seventeen biennial CTR Summer Programs held so far (1987-2018) has been uploaded to the CTR website (see link below). The document includes hyperlinks to the actual reports and sorts them by research topic.

The twenty reports contained in this volume are arranged as follows. The first two reports are focused on novel engineering applications of LES and wall modeling to aircraft aerodynamics and twin-jet noise. The next five reports are devoted to LES model development and near-wall turbulence, including dynamic non-Boussinesq subgrid-scale models and slip-wall models, along with hydrodynamic stability analyses for transition. Studies on compressible flows, including hypersonics, are collected in the next group of three reports. Combustion, multiphase flows, and numerical methods are the focus of the second half of this volume. Here, a progress report is included that focuses on simulations of laser ignition of a model combustor, which represents the focus of the Stanford PSAAP-III Center in its first year of operation. The remaining reports are related to numerical methods for compressible and multi-phase flows, along with an engineering application to rarefied flows, and a short formulary of differential operators for flow-structure interaction problems.

The investigations reported in this volume have been supported by a number of different organizations. These include the Department of Energy's National Nuclear Security Administration (NNSA) through the Advanced Simulation and Computing (ASC) Program, along with the National Aeronautics and Space Administration (NASA), Office of Naval Research (ONR), Defense Advanced Research Projects Agency (DARPA), and Boeing Research & Technology (BR&T).

Last year CTR hosted nine resident Postdoctoral Fellows. The CTR roster for 2021 is provided in the Appendix. Also listed are the members of the CTR Steering Committee, which has met quarterly to act on fellowship applications.

It is a great pleasure to thank Pamela Nelson Foster and Vi Nguyen for their help in the day to day operation of CTR.

This volume is available online at the CTR website:  
<http://ctr.stanford.edu>

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