abstract
The interaction between a premixed flame and the turbulence in which it propagates is a fundamental problem in combustion theory. The ability to describe these interactions both qualitatively and quantitatively is required for practical problems ranging from the design of clean and efficient combustion engines to the prevention of gas explosions. Turbulence-flame interactions are also central to astrophysical problems, such as explosions of type Ia supernovae, which have many properties analogous to terrestrial gas-phase combustion. In all of these applications, properties of both the turbulence and the flame depend on the relative strengths of chemical and turbulent processes, which are nonlinearly coupled. Chemical reactions result in heat release, which leads to changes in fluid properties such as the density and viscosity. These changes, in turn, affect the structure and dynamics of the turbulence. At the same time, turbulence transports the reactants and products and affects the structure of the flame. In this talk, we consider the nonlinearly coupled interactions between turbulence and premixed flames using large eddy and direct numerical simulations of stoichiometric hydrogen-air combustion in unconfined domains. The effects of premixed flames on the dynamics of the vorticity, turbulence intermittency, and kinetic energy spectral dynamics are presented, and the implications for modeling of turbulent combustion are discussed. Through this analysis, vorticity suppression by premixed flames is shown to be anisotropic, turbulence intermittency is shown to vary through premixed flames, and the fundamental nature of inter-scale turbulent energy transfer is altered.

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biosketch
Dr. Peter Hamlington is an Assistant Professor and a Vogel Faculty Fellow in the Department of Mechanical Engineering at the University of Colorado, Boulder. Research in his group, the Turbulence and Energy Systems Laboratory (TESLa, tesla.colorado.edu), is focused on understanding and modeling turbulent flows in both engineering and geophysical problems using large eddy and direct numerical simulations. At TESLa, numerical simulations are used to study a broad range of applications, including unsteady, boundary layer, chemically reacting, and oceanic flows, as well as boundary layer flows relevant to renewable energy systems. The primary emphasis in many of these studies is to understand fundamental flow physics and to use the resulting insights for the development of physically accurate, computationally efficient models for large-scale simulations of real-world problems. Dr. Hamlington has a B.A. in Physics from the University of Chicago and M.S. and Ph.D degrees in Aerospace Science from the University of Michigan, Ann Arbor.