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Base Flow Asymmetry Effects on the Absolute Stability of Non-uniform Density Wakes BENJAMIN EMERSON, DAVID NOBLE, TIM LIEUWEN, Georgia Institute of Technology — This work investigates the hydrodynamic stability of bluff body wakes with non-uniform mean density. Such flows are common in bluff body combustors. The absolute/convective stability characteristics of the wake are important, because vortex shedding from the bluff body participates in such processes as mixing, flame blowoff, and combustion instability. Non-uniform density is a sensitive stability parameter for wake flows. Reduction of the wake density relative to the free stream density can stabilize the flow and suppress coherent vortex shedding. Practical bluff body combustors operate at a range of flame density ratios spanning this stability limit. Recent experimental bluff body combustor work by Tuttle et al. investigates wakes with asymmetry in the base flow density profiles. This motivates a hydrodynamic stability model for non-uniform density wakes that includes base flow asymmetry. The model developed in this study investigates the effects of asymmetric base flow velocity and density profiles. It begins with a parameterization of the base flow asymmetries. Results show that base flow asymmetry influences the absolute stability of the flow, and has a strong effect on the most amplified mode shape. The investigation concludes with a comparison to the vorticity equation. Here, we elucidate the physics of the model, and comment on the limitations of such a model.

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