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The flame anchoring mechanism and associated flow structure in bluff-body stabilized lean premixed flames DAN MICHAELS, SANTOSH SHANBHOGUE, AHMED GHONIEM, Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, MA, USA — We present numerical analysis of a lean premixed flame anchoring on a heat conducting bluff-body. Different mixtures of CH_4/H_2/air are analyzed in order to systematically vary the burning velocity, adiabatic flame temperature and extinction strain rate. The study was motivated by our experimental measurements in a step combustor which showed that both the recirculation zone length and stability map under acoustically coupled conditions for different fuels and thermodynamic conditions collapse using the extinction strain rate. The model fully resolves unsteady two-dimensional flow with detailed chemistry and species transport, and without artificial flame anchoring boundary conditions. The model includes a low Mach number operator-split projection algorithm, coupled with a block-structured adaptive mesh refinement and an immersed boundary method for the solid body. Calculations reveal that the recirculation zone length correlates with the flame extinction strain rate, consistent with the experimental evidence. It is found that in the vicinity of the bluff body the flame is highly stretched and its leading edge location is controlled by the reactants combustion characteristics under high strain. Moreover, the flame surface location relative to the shear layer influences the vorticity thus impacting the velocity field and the recirculation zone. The study sheds light on the experimentally observed collapse of the combustor dynamics using the reactants extinction strain rate.

Dan Michaels
Department of Mechanical Engineering,
Massachusetts Institute of Technology, Cambridge, MA, USA

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