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**Solution of variable-density edge flames by a homotopy method** KAI-PIN LIAO, MOSHE MATALON, CARLOS PANTANO, University of Illinois at Urbana-Champaign — The edge flame is a fundamental flame structure essential to the description of flame hole dynamics in turbulent nonpremixed combustion and the stabilization of lifted jet flames. The edge flame propagation velocity is a solution to a nonlinear eigenvalue problem based on the variable-density reactive Navier-Stokes equations. This problem is remarkably difficult to solve as a boundary-value problem due to the two-dimensionality of edge flames and the nonlinear nature of the equations. In this talk we present a novel algorithm to solve for the steady state solution of the system using a homotopy method that maps continuously the easy-to-find constant-density solution into the variable-density flow. The flow and the combustion fields are segregated within an outer Picard iteration embedding a Newton method, which is solved sequentially using GMRES with proper multigrid preconditioners. This efficient algorithm enables the parametric study of the effects of thermal expansion, differential diffusion, heat release, and strain rate on edge flame structure and propagation velocity for variable-density flows. Furthermore, a discussion of admissible boundary conditions for this problem will be presented.

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