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An Acoustically Consistent Investigation of Combustion Instabilities in a Dump Combustor VIJAYA KRISHNA RANI, SARMA RANI, University of Alabama in Huntsville — An acoustically consistent, linear modal analysis-based analytical method is presented to predict the longitudinal and transverse combustion instabilities in a 2-D cartesian dump combustor. At first, rigorous acoustical analysis is performed. Novel, acoustically consistent jump or matching conditions are developed and applied at the duct cross-sectional interface(s), with distinct forms for the purely axial and non-axial modes. The effects of uniform and non-uniform mean flow, cross-sectional area ratio, as well as of different types of boundary conditions on the duct acoustic modes are investigated. Subsequent to the acoustic analysis, combustion instabilities of a 2-D, cartesian dump combustor are investigated. The instability analysis employs the developed acoustically consistent jump conditions, instead of the conventional mass, momentum, and energy balance-based conditions. Effects of the fluctuating heat-release source term in the acoustic wave equation are incorporated directly into the longitudinal wavenumber, obviating the need for a separate energy matching condition across the flame. A detailed investigation of the parametric space and boundary conditions affecting combustion instabilities is undertaken.

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