Abstract Submitted
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Modeling and analysis of thermoacoustic instabilities in an annular combustor SANDEEP MURTHY, TARANEH SAYADI, VINCENT LE CHENADEC, University of Illinois, Urbana-Champaign, PETER SCHMID, Department of Mathematics, Imperial College London — A simplified model is introduced to study thermo-acoustic instabilities in axisymmetric combustion chambers. Such instabilities can be triggered when correlations between heat-release and pressure oscillations exist, leading to undesirable effects. Gas turbine designs typically consist of a periodic assembly of N identical units; as evidenced by documented studies, the coupling across sectors may give rise to unstable modes, which are the highlight of this study. In the proposed model, the governing equations are linearized in the acoustic limit, with each burner modeled as a one-dimensional system, featuring acoustic damping and a compact heat source. The coupling between the burners is accounted for by solving the two-dimensional wave equation over an annular region, perpendicular to the burners, representing the chamber's geometry. The discretization of these equations results in a set of coupled delay-differential equations, that depends on a finite set of parameters. The system's periodicity is leveraged using a recently developed root-of-unity formalism (Schmid et al, 2015). This results in a linear system, which is then subjected to modal and non-modal analysis to explore the influence of the coupled behavior of the burners on the system's stability and receptivity.

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