Abstract Submitted
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A nonlinear framework for the prediction of thermoacoustic oscillations ALESSANDRO ORCHINI, MATTHEW JUNIPER, Univ of Cambridge — Thermoacoustic oscillations may occur in afterburners and gas turbines because of the interaction of unsteady heat release and acoustic waves. These oscillations lead to structural damage and deteriorate system efficiency. We present a low-order thermoacoustic model for premixed flames that exploits the fact that the main nonlinearity of this instability is due to the unsteady heat release. We describe the flame dynamics using the G-equation model, and some of the features of a Low Order ThermoAcoustic Network (LOTAN) to describe, in an efficient way, the system's acoustics. The advantage of the latter approach, with respect to the more diffused Galerkin decomposition of the acoustic equations, is that mean flow effects, temperature variations, and cross sectional area changes of the combustion chamber can be easily included. With the resulting nonlinear network, we can analyze the stability of thermoacoustic systems both in the frequency and time domain, and determine the frequency, amplitude and stability of limit cycle oscillations. In the time domain, we can also predict the location of Neimark-Sacker bifurcations, which lead to quasi-periodic oscillations and more elaborate dynamical behavior. Numerical continuation is proved to be an efficient tool to achieve this goal.

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