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A novel numerical approach and stability analysis of thermo-acoustic phenomenon in the Rijke tube problem TARANEH SAYADI, Laboratoire d'Hydrodynamique, Ecole Polytechnique, VINCENT LE CHENADEC, EM2C Laboratory, Ecole Centrale Paris, PETER SCHMID, Laboratoire d'Hydrodynamique, Ecole Polytechnique, FRANCK RICHECOEUR, MARC MASSOT, EM2C Laboratory, Ecole Centrale Paris — The modeling of thermo-acoustic coupling in reactive flows represents a challenging task. In this study, we focus on the Rijke tube problem, which includes relevant features such as a compact acoustic source, an empirical modeling of the heat source, and non-linearities. This thermo-acoustic system features a complex dynamical behavior, which renders the characterization of the different encountered flow regimes difficult. In order to synthesize accurate time series, we tackle this problem from a numerical point-of-view, and start by proposing a dedicated solver designed for dealing with the underlying stiffness, in particular, the retarded time and the discontinuity at the location of the heat source. Convergence and parametric studies are carried out to assess the accuracy of the discretization, hence laying a foundation for a stability analysis of the semi-discrete system. This stability analysis is performed by means of the projection method proposed by Jarlebring [1], which alleviates the linearization of the retarded term, and is used to validate the numerical results. Finally, the focus is set on the application of the dynamic mode decomposition [2] technique to study bifurcations.

[1] Jarlebring, E., Thesis, 2008
[2] Schmid P., JFM, 2010

Taraneh Sayadi
Laboratoire d'Hydrodynamique, Ecole Polytechnique

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