Professur für Thermofluiddynamik

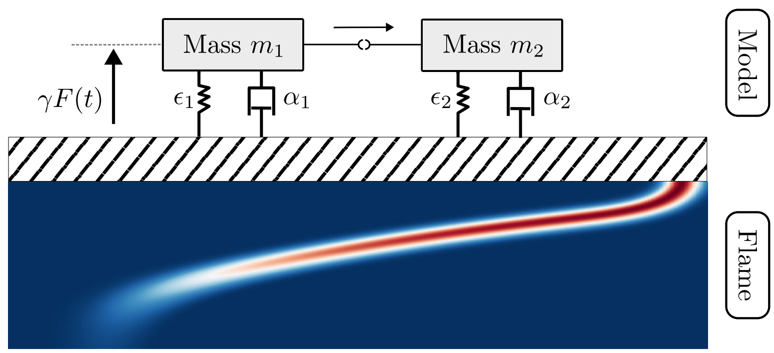
Bachelor Thesis

Start: As soon as possible

Add published: 28.10.2024

☒ theoretical
☒ numerical
☐ experimental
☐ constructional

Derivation of an Analytical Expression for the Flame Describing Function using a Physics-Inspired Modeling Approach



Thermoacoustic instabilities are a highly unwanted phenomenon caused by the constructive feedback of acoustic oscillations with the flame's fluctuating heat release in combustion chambers. These instabilities reduce performance and make safe operation of combustion systems very difficult.

One low order approach to model the flame is to represent it by a physics inspired dynamical surrogate model. For this purpose, a relatively simple mass-spring-damper system was developed within the professorship and already demonstrated to qualitatively model the flame in the linear and quantitatively in the nonlinear regime.

In this thesis, the student is tasked with using perturbation theory to linearize the underlying ODEs, allowing us to use powerful analysis tools, otherwise only applicable to linear models. The obtained equation will be compared to reference data obtained from numerical simulations. The student will incorporate the newly derived analytical expression into an already existing optimization framework and evaluate its performance.

Requirements:

Good coding knowledge (preferably Python)
Interest in non-linear dynamics and analytical work
High motivation to learn new concepts

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