Professur für
Thermofluiddynamik

Master thesis / Semester thesis

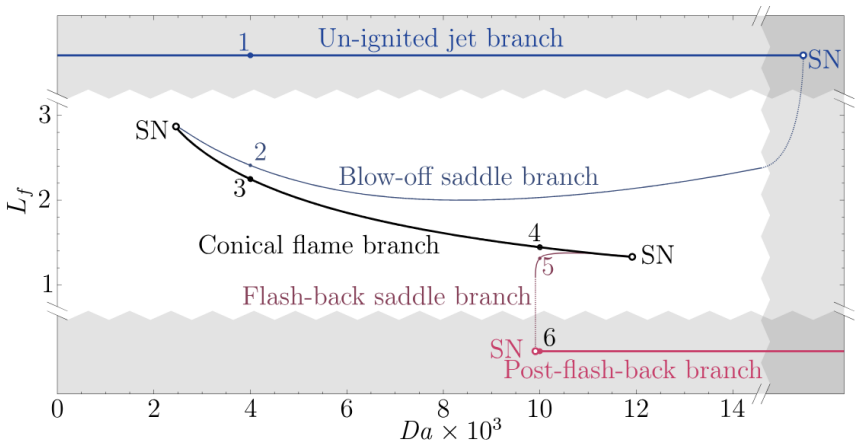
Start: As soon as possible

Add published: 24.08.2026

☒ theoretical
☒ numerical

Implementation of a branch tracing algorithm for reacting flow systems

Thermoacoustic instabilities are a highly unwanted phenomenon, reducing performance and safe operation of combustion systems.
To gain insight into the instability mechanisms of a combustion systems, one can linearize the governing reacting flow equitations about their steady fixed point to analyse the system modes. Very often, we are interested in the influence of a system parameter on stability. In this case, it becomes crucial to follow the branch of steady solutions in a computationally efficient manner as the relevant system parameter changes.



Bifurcation diagram for flash back and blow-off of a conical flame [2].

To this end, the goal of the proposed project is to implement a branch tracing algorithm [1] in an in-house flow solver. If you are interested in computational fluid dynamics and numerical methods, we are looking forward to you joining our team for a project. Details of the project can be adapted and discussed according to personal preferences and interests.

[1] Christopher M. Douglas and Pierre Jolivet. ff-bifbox: A scalable, open-source toolbox for bifurcation analysis of nonlinear PDEs, September 2025. arXiv:2509.18429 [math].

[2] Christopher M. Douglas, Wolfgang Polifke, and Lutz Lesshafft. Flash-back, blow-off, and symmetry breaking of premixed conical flames. *Combust. Flame*, 258, 2023.

Requirements:
Computational fluid dynamics
Interest in non-linear dynamics
Programming in python or similar
Working in linux

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