# Thermoacoustic FEM modeling of partly autoignition and propagation-stabilized flames

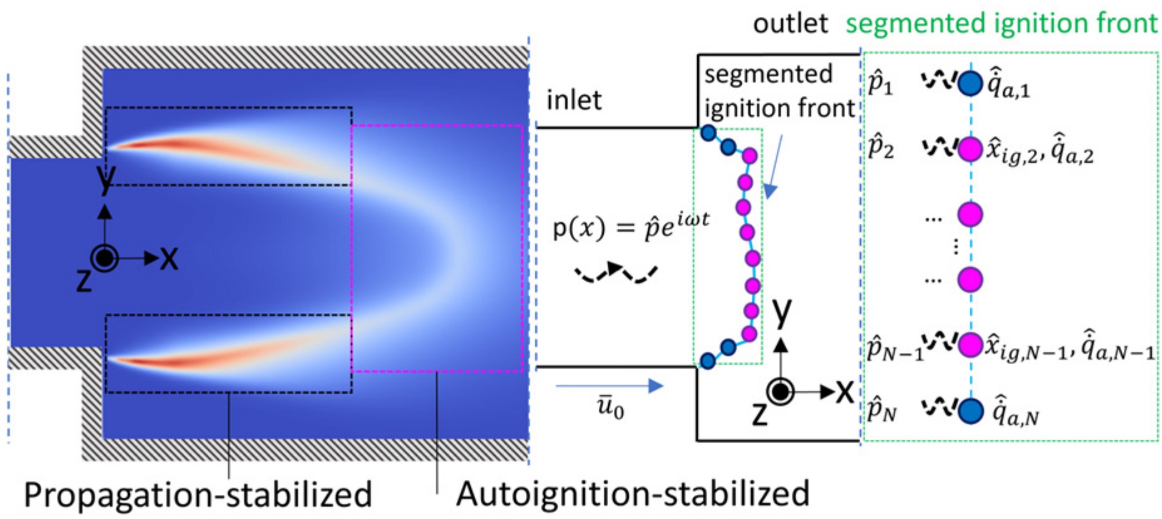
Symposium on Thermoacoustics in Combustion: Industry meets Academia (SoTiC 2025)
Sept. 8 - Sept. 11, 2025
Trondheim, Norway
Paper No.: 52


**Simon M. Heinzmann[1,2] , Nino A. Leder[1], Harish S. Gopalakrishnan[1] and Mirko R. Bothien[1,3]**

This paper describes a methodology to thermoacoustically account for different flame types in a single Finite-Elementcomputation.

To do so, the flame segmentation mechanism presented in previous studies is used to characterize the different flame zones. Differentiation is done between propagation-stabilized shear-layer flames and autoignition flames that respond to acoustic perturbations very differently. While autoignition flames mainly respond to acoustic pressure and temperature fluctuations, propagation-stabilized flames respond to acoustic velocity perturbations. Thus, flame transfer functions specific to each flame type are analytically implemented within the frequency domain Finite-Elementcomputation.

Using the novel framework, it is shown that the global FTF obtained from Computational-Fluid-Dynamics (CFD) simulations of a backward facing step reheat combustor can be reproduced accurately in the low-frequency regime for an operating point where the flame is forced in a planar manner. The investigated operating point operates on hydrogen fully premixed at lean and autoignitive conditions. The autoignition framework is validated by comparison to one-dimensional direct-numerical-simulation (DNS). The time averaged CFD heat release rate result is validated with large eddy simulation (LES) data.




This project is supported by the Clean Hydrogen Partnership and its members Hydrogen Europe and Hydrogen Europe Research (GA 101101427), and the Swiss Federal Department of Economic Affairs, Education and Research, State Secretariat for Education, Research and Innovation (SERI)