

# Ignition Delay Time and Flame Speed Validation of TPRF-E Mechanism Using OpenFoam

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## Abstract

This case study focuses on the numerical validation of a petrol surrogate using zero-dimensional (0D) ignition delay time (IDT) and one-dimensional (1D) laminar flame speed tests within the open-source CFD software OpenFOAM. Following a comprehensive literature review, the reduced KAUST TPRF-E[1] chemical mechanism comprising 67 species and 325 reactions, and accounting for ethanol was selected to accurately represent the fuel blend. The 0D simulations were conducted using the `chemFoam` solver to determine the IDT at an equivalence ratio of  $\phi=1$  across pressures of 10, 30, and 50 atm. Subsequently, 1D flame speed simulations were executed using the `reactingFoam` solver within a 1D domain at a set equivalence ratio, with the resulting flame speeds post-processed in ParaView. The numerical results were benchmarked and plotted against established experimental data for both IDT[2] and laminar flame speed[3]. This comparison assesses the accuracy of the KAUST TPRF-E mechanism and evaluates the reliability of the OpenFOAM numerical setup for predictive combustion modeling.

**Keywords:** Petrol surrogate; TPRF-E model; OpenFOAM; `chemFoam`; `reactingFoam`;

## References

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