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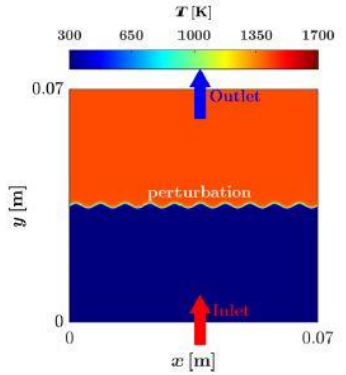
Numerical Investigation of Thermo-Diffusive Unstable Hydrogen Premixed Flame using Detailed Chemistry

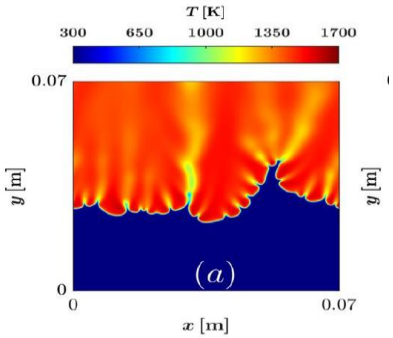
The combustion of lean hydrogen premixed flames in turbine burners is promising because it is characterized by low emissions and high efficiency. However, the reacting flow induced by burning hydrogen presents significant technical and engineering challenges. As the hydrogen/air mixture approaches the lean flammability limit, the resulting combustion is subject to thermo-diffusive instabilities which might lead ultimately to unstable combustion, flashback, blow-off, and noise.

Currently, we plan to perform the Direct Numerical Simulation (DNS) for the thermo-Diffusive unstable hydrogen premixed flame using detailed chemistry in the OpenFOAM, which further will be assessed using model reduction technique called Reaction-Diffusion Manifold (REDIM).

To access the model-reduction for this kind of flame, a detailed investigation of the flame structure using detailed chemistry is needed. Furthermore, the sensitivity of different parameters on the flame structure, for an example, type of setup including boundary condition, operating pressure, chemical mechanism, etc., needs to be investigated.



Numerical setup for the flame (Wen et al., 2023)



Instantaneous temperature distribution field(Wen et al., 2023)

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