Preferential diffusion effects in LES of mild combustion with flamelet generated manifolds

Preferential diffusion effects in LES of mild combustion with Flamelet Generated Manifolds

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Preferential diffusion effects are investigated in flame stabilization of turbulent lifted flames using LES with a FGM-PDF model. The experimental test case is the Delft JHC burner in which methane based fuel has been enriched with various amounts of H2. A novel numerical model is proposed based on the Flamelet Generated Manifolds (FGM) to account for preferential diffusion effects in autoignition. Afterwards, this model is implemented in LES of the H2 enriched turbulent lifted flames. Main features of these turbulent lifted flames such as the formation of ignition kernels and stabilization mechanisms are analysed and compared with the measurements.

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Resolved flame LES of the Cambridge stratified burner using PFGM

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Large eddy simulation results are presented for the Cambridge stratified burner. The grid resolution is 100 µm, which is sufficient to resolve the progress variable field for the applied premixed flamelet generated manifolds approach without any kind of thickening, filtering or tracking of the flame. To validate the simulation, mean and rms radial profiles are compared against the available measurement data. Subsequently, an a-priori analysis of the progress variable- and velocity fields is performed to extract the related sub-filter contributions for different filter widths. In addition, JPDFs of equivalence ratio and progress variable from simulation and experiment are compared.

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Large-eddy simulation/probability density function modelling of Cambridge stratified flame

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In this study, large-eddy simulation (LES)/probability density function (PDF) method is applied to Cambridge stratified flame in order to ascertain its ability to calculate the details of the effects of the stratification. In LES, large-scale motions are explicitly computed, whereas the effects of subgrid scale (SGS) motions on the large-scales are modelled. The interactions between turbulence and chemistry are modelled by the PDF method. LES/PDF equations are solved by OpenFOAM/HPDF code which is second-order in both time and space. For detailed chemistry representation of the flame, an augmented reduced mechanism (ARM2) for methane oxidation, which involves 19 species and 15 reactions (including NO chemistry) is incorporated into LES/PDF calculations using ISAT algorithm. The results are in good agreement with the experimental data.

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Challenging modeling strategies for LES of non-adiabatic turbulent stratified combustion

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This work provides a state-of-the-art picture of a selection of computational approaches for LES of stratified flame. Five simulations, which differ by modeling approach, CFD code, combustion chemistry, numerical techniques, computational meshes and user, are presented. Each of these computational strategies is designed to capture the filtered turbulent flame propagation speed. In addition, as the models account for non-adiabatic effects on the combustion chemistry, quenching phenomena induced by heat losses are captured. Encouraging similarities between the computations and the experiments are observed. It creates some confidence that these modeling approaches are leading in the right direction.

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CP5 (6/6)

Wednesday April 22nd (16h00 – 18h00)

Effects of preheat temperatures and turbulence intensities on the disruption of the reaction zone in high Karlovitz premixed flames

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Direct numerical simulations of premixed n-heptane/air flames at Karlovitz numbers above 200 are performed using detailed chemistry. Different unburnt temperatures and turbulence intensities are used and their effects on the flame structure are investigated. As the unburnt gases are preheated, the viscosity ratio across the flame is reduced and the effective Karlovitz number at the reaction zone is increased. Both the increase in the unburnt temperature and turbulence