

PRELIMINARY RESULTS OF CALCULATIONS OF PREMIXED METHANE COMBUSTION IN A BURNER WITH PILOT FLAME STABILIZATION

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Abstract: The article presents the results of numerical simulation of the Meares and Masri (2014) and Barlow *et al.* (2015) experiment with methane mixing and combustion in a subsonic jet stabilized by a pilot flame. The interesting feature of the problem is the large spread of the mixture equivalence ratio: the mixture is fuel-rich at the beginning of the jet and gradually approaches the stoichiometric composition further downstream. The calculations were performed using the EPaSR (Extended Partially Stirred Reactor) model to account for the effect of turbulence on the mean reaction rates. The possibility of simulating a pilot flame with a perforated wall in an axisymmetric formulation with holes replaced by annular slots while maintaining the area ratio is investigated. The problem of determining the characteristic chemical time scale in the case of large gradients of mixture equivalence ratio is revealed. The mean temperature and velocity profiles obtained in the RANS (Reynolds-Averaged Navier–Stokes) formulation are compared not only with the experiment but also with the DNS (Direct Numerical Simulation) calculation by Zirwes *et al.* (2020).

Keywords: jet flow; premixed combustion; turbulence–combustion interaction

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Figure Captions

Figure 1 Burner schematic from [2]

Figure 2 Computational domain (a) and grid (b)

Figure 3 Temperature field in the pilot flame

Figure 4 Temperature field near the burner obtained in the axisymmetric RANS calculation

Figure 5 Temperature profiles: 1 — experimental data [1]; 2 — DNS simulation [3]; 3 — RANS calculation with EPaSR model; (a) $x/D = 1$; (b) 5; (c) 10; and (d) $x/D = 15$

Figure 6 Longitudinal velocity profiles: 1 — experimental data [1]; 2 — DNS simulation [3]; 3 — RANS calculation with EPaSR model; (a) $x/D = 1$; (b) 5; and (c) $x/D = 10$

Figure 7 The fields of thin-structures volume fraction (a) and mixture equivalence ratio (b) obtained in RANS calculations with EPaSR model

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