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Experimental and numerical investigation of flame acceleration in natural gas – air mixture

S. M. Frolov, V. S. Ivanov, A. E. Mailkov, V. A. Smetanyuk

N. N. Semenov Institute of Chemical Physics, 4 Kosigin Street, Moscow 119991, Russia

Realistic estimates of performances of pulse detonation burners and propulsion units, as compared to those obtained with the presumption of direct detonation initiation require the availability of a computationally efficient algorithm for multidimensional numerical simulation of DDT. Such an algorithm based on the coupled Flame Tracking – Particle (FTP) method has been recently developed by the authors. The method allows simulating both frontal and volumetric combustion in a compressible flow, in particular, flame acceleration in a channel of complex geometry followed by preflame autoignition and DDT. The coupled FTP method has been implemented into the standard Computational Fluid Dynamics (CFD) code solving the Reynolds-Averaged Navier–Stokes equations by the control-volume technique. The method has been thoroughly validated against experimental data on flame acceleration in smooth-walled and obstructed channels with one closed and one open end. Presented in this communication are the results of code performance validation against authors' experiments on flame acceleration in a complex-geometry duct 70 mm in diameter filled with stoichiometric natural gas (methane content 98.6%) – air mixture.