Numerical Simulation of Detonation Flows on the Basis of TVD-scheme

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The mathematical model corresponding to the simplified model of two-phase chemical reaction, including the induction period and the subsequent reaction period was used for numerical simulation of detonation in gas mix oxygen-hydrogen. Gas was assumed non viscous. We can divide numerical algorithm construction into three main stages: time discretisation, spatial discretisation and grid construction. Two types of time discretisation were used. The first method consists of splitting the explicit time step operator in the symmetric consequence of operators in directions (this method preserves 2-nd order of time accuracy if operators in directions were of 2-nd order accuracy). The other way of time discretisation is the Runge-Kutta method. The multi-step Runge-Kutta operator of m-order gives m - order accuracy for time. Using Runge Kutta procedure makes the separate multi-step solution of system of kinetic equations by, for example, the Gir procedure or similar methods unnatural. For spatial discretisation, two finite volume methods were used, namely, TVD schemes - Harten scheme and Chacravarthy-Osher scheme. Only the problems with axial symmetry were considered, so the two-dimensional calculation grids were used . Calculation grids were generated by Thompson - type algorithm, based on solving the system of two Poisson equations. The two-step simplified model of reacting gas mix was used for simulation of detonation and deflagration flows. At the first stage the system of equations for gas dynamics and kinetics unknowns was solved as a whole. On the second stage of investigation gas dynamics system and two kinetic equations were solved separately, on the basis of mentioned TVD schemes . This approach makes it possible to solve the full system of kinetic equations separately with gas dynamic system.
The flows in channels with obstacles and the flow in chamber of pulsing detonation engine were numerically simulated as tests for the algorithm. The results of calculations are qualitatively similar to experimental ones and some results of the other authors.