SUBGRID MODEL FOR SIMULATING TURBULENT COMBUSTION, PREFLAME AUTOIGNITION AND POLLUTANT FORMATION

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A coupled Flame Tracking – Particle method for simulating turbulent combustion, preflame autoignition, and pollutant (NOx, soot, etc.) formation has been developed. The Flame Tracking technique implies continuous tracing of the mean flame surface and application of the laminar/turbulent flame velocity concepts. The Particle method is based on the joint velocity – scalar probability density function approach for simulating reactive mixture autoignition in the preflame zone and pollutant formation in combustion products. The coupled algorithm is supplemented with the database of tabulated laminar flame velocities and pollutant concentrations in the flame as well as reaction rates of preflame fuel oxidation in the wide range of initial temperature, pressure, and equivalence ratio for premixed hydrogen – air and hydrocarbon – air compositions. The look-up tables contain information on flammability limits to identify the conditions of flame quenching. Several 2D computational examples are presented for combustion of propane and hydrogen in confined and partly confined geometries. A possibility of preflame autoignition in multiple hot spots has been demonstrated. Autoignition was shown to occur in several spots ahead of the propagating flame with further traversing the preflame zone anisotropically and nonuniformly. The developed methodology can be readily applied for studies of combustion phenomena in high-speed reactive flows.

ПОДСЕТОЧНАЯ МОДЕЛЬ ДЛЯ РАСЧЕТА ТУРБУЛЕНТНОГО ГОРЕНИЯ, ПРЕДПЛАМЕННОГО САМОВОСПЛАМЕНЕНИЯ И ОБРАЗОВАНИЯ ВРЕДНЫХ ВЕЩЕСТВ (ПЛЕНАРНАЯ ЛЕКЦИЯ)