Abstract Submitted
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Multidimensional direct numerical simulations of superknock in a thermally inhomogeneous DME/air mixture[1] MINH BAU LUONG, FRANCISCO E. HERNANDEZ PEREZ, BENGT JOHANSSON, HONG G. IM, King Abdullah Univ of Sci Tech (KAUST) — Superknock propensity in a stoichiometric dimethyl-ether (DME)/air mixture with temperature inhomogeneities at conditions relevant to internal combustion engines is investigated using multidimensional direct numerical simulations. To examine the detonation development, simulations are performed by varying the temperature fluctuations, characteristic length scale and initial mean temperature, with initial temperatures lying in the low-, intermediate-, and high-temperature chemistry regimes. The volumetric fraction of the mixture regions that is prone to detonation development, F_D, which was proposed as a metric to predict the amplitude of knock intensity in previous studies by Luong et al. (Proc. Combust. Inst. 2020; Flow Turbul. Combust. 2020), is adopted. Regardless of the initial mean temperatures, F_D serves as a reliable indicator of the subsequent detonation development that can capture the level of knock intensity. Partially, F_D shows a good correlation with the heat release fraction of the mixture regions with pressure greater than the equilibrium pressure, F_H. The detonation regimes are also well captured by the predictive nondimensional numbers, ε_p and ξ_p, that are extended from ε and ξ in the regime diagram of Bradley et al.

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