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Numerical simulations of flame acceleration and DDT in natural gas: the effects of trace propane and ethane LOGAN N. KUNKA, XIAOYI LU, Texas A&M University, CAROLYN R. KAPLAN, University of Maryland, VADIM N. GAMEZO, Naval Research Laboratory, ELAINE S. ORAN, Texas A&M University — Natural gas is primarily composed of methane, but realistic mixtures usually contain trace amounts of higher hydrocarbons. Here we summarize results of numerical simulation of flame acceleration and subsequent deflagration-to-detonation transition (DDT) in channels with obstacles for methane-air mixtures diluted with varying trace amounts of ethane and propane. The simulations were performed with a fully compressible, unsteady, reactive flow code coupled to appropriate chemical diffusion models (CDM) which describe energy release, the diffusion processes, and the conversion of fuel to product. Various aspects of flame acceleration and DDT phenomena are examined, including the run-up distance to DDT and the detonation cell structure, a property characteristic of the reactive gas. Numerical simulation results show that the distance to DDT is only slightly reduced with the added hydrocarbons. The detonation cell size, however, does decrease significantly making the propagating detonation more robust and harder to extinguish.

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