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The Effects of Parasitic Combustion on Detonation Wave Propagation[1] SUPRAJ PRAKASH[2], VENKAT RAMAN[3], University of Michigan — Rotating detonation engines (RDEs) are a feasible approach to realizing pressure gain combustion. However, practical implementation of these devices requires the use of non-premixed discrete fuel-oxidizer injection. Turbulent mixing of the fuel and oxidizer streams enforces reactant stratification inside the combustor annulus. Parasitic deflagrative combustion of the freshly-injected fuel-oxidizer mixture introduces partially-burnt gases to the detonation wave and diminishes heat release. Numerical studies of full-scale RDE systems have suggested that up to 35-50% pre-burning of the fuel-oxidizer mixture is prevalent within the combustor. The primary objective of this work is to understand the interaction of the detonation wave and a spatially-inhomogeneous mixture. To this end, a high-fidelity numerical simulation approach is utilized to understand how partially-burnt mixtures affect the detonation wave structure by inducing different fractional levels of reactant mixture pre-burning with reference to the fully-burnt equilibrium state. The effect of pre-burning on detonation wave stability and characteristics are discussed to provide insight into the difference between theoretical Chapman-Jouguet detonation and the detonative combustion observed in practical combustors.

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[2]Ph.D. Student, Department of Aerospace Engineering
[3]Professor, Department of Aerospace Engineering

Supraj Prakash
University of Michigan

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