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Reduced Order Modeling of Spray Flame Response to Harmonic Velocity Fluctuations VISHAL ACHARYA, Georgia Institute of Technology — Modern combustion systems are all susceptible to thermoacoustic combustion instabilities. To understand these instabilities, reduced order models are developed for the dynamics of the flame when subjected to various source fluctuations, such as due to velocity, mixture ratio, pressure etc. Prior research has significantly focused on modeling for gaseous premixed flame dynamics with recent research also increasing focus on gaseous non-premixed diffusion flames. However, reduced order modeling for spray flames has received no attention and thus this work presents a modeling framework for the dynamics of spray flames with a focus on the velocity coupled response. The response is characterized using the Flame Transfer Function (FTF). The paper uses the classical Burke-Schumann diffusion flame configuration as a basis with the fuel introduced in the form of a spray of liquid droplets. The space-time dynamics in the model uses the fast-chemistry limit applied to the mixture fraction equation for both the gaseous and liquid phases. These equations are coupled through evaporation of the liquid droplets and results in new control parameters such as a vaporization Damkohler number in addition to parameters pertaining to the spray and droplets themselves. Collectively, the effects of these new parameters on spray flame dynamics can be understood.

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