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On the Development of Reduced Order Models for the Prediction of Acoustically Forced Laminar Diffusion Methane Flame Lift Off[1] LEO ALVES, UFF (Brazil), ANDRES VARGAS, ANN KARAGOZIAN, UCLA (USA) — Recent experiments involving laminar diffusion methane flames in a triple jet burner have observed periodic flame oscillations and eventual lift off when exposed to acoustical forcing at a high enough amplitude [Vargas, et al., APS DFD 2020]. POD coefficients obtained from high speed visible images of the oscillating flame first accumulate more than 90% of the energy within the first three terms at moderate amplitude excitation, before lift off, but that changes to approximately the first 10 coefficients after periodic lift off initiates. This transition is clearly observed through the strong deformation of the POD phase-portrait trajectories beyond the critical pressure amplitude. In the present work, the SINDy approach [Brunton, et al., PNAES, 2016] is employed to identify a ROM that governs the behavior of these POD coefficients. For the ROM to replicate the low amplitude flame dynamics appropriately, a special experimental data folding procedure is employed to overcome under sampling issues caused by image acquisition limitations. The quality of the ROM generated is confirmed by the fact that its solutions remain within the experimental phase-portrait trajectories over hundreds of periods. Current work is using this ROM to predict the onset of periodic flame lift off.

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