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Understanding Non-linear Flame Response Triggering through High-Order Analysis VISHAL ACHARYA, Georgia Institute of Technology — During combustion instabilities, the amplitude of excitation grows due to a self-excited feedback loop between exciting disturbances and flame response. However, as amplitude increases, non-linear processes lead to unique behaviors in the amplitude dependent flame response that are either monotonic with excitation amplitude or non-monotonic. Monotonic flame response trends include those which increase linearly and then saturate or those that have no linear slope (i.e. linear flame response is zero) but increase to non-zero values for higher excitation amplitudes and then saturate. In the latter cases, the flame response curve exhibits inflection points that result in 3 intersection points between the flame response curve and the linear damping curve. In this case, both the zero amplitude and finite amplitude intersection points are stable and thus result in bi-stable behavior, hysteresis and triggering. This results in the destabilization of an otherwise stable system through a disturbance that is large enough. In order to understand such flame response behaviors, this work explores the relationship between higher order terms of non-linearity (upto fifth order) in order to better understand the mechanism by which the higher order flame response saturation occurs. Finally, we apply this analysis to a model premixed flame to explore the relationship between different control parameters that causes bi-stable behavior.

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