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Hydrodynamic Stability Analysis of Multi-jet Effects in Swirling Jet Combustors BENJAMIN EMERSON, TIM LIEUWEN, Georgia Inst of Tech — Many practical combustion devices use multiple swirling jets to stabilize flames. However, much of the understanding of swirling jet dynamics has been generated from experimental and computational studies of single reacting, swirling jets. A smaller body of literature has begun to explore the effects of multi-jet systems and the role of jet-jet interactions on the macro-system dynamics. This work uses local temporal and spatio-temporal stability analyses to isolate the hydrodynamic interactions of multiple reacting, swirling jets, characterized by jet diameter, D, and spacing, L. The results first identify the familiar helical modes in the single jet. Comparison to the multi-jet configuration reveals these same familiar modes simultaneously oscillating in each of the jets. Jet-jet interaction is mostly limited to a spatial synchronization of each jet's oscillations at the jet spacing values analyzed here (L/D=3.5). The presence of multiple jets vs a single jet has little influence on the temporal and absolute growth rates. The biggest difference between the single and multi-jet configurations is the presence of nearly degenerate pairs of hydrodynamic modes in the multi-jet case, with one mode dominated by oscillations in the inner jet, and the other in the outer jets. The close similarity between the single and multi-jet hydrodynamics lends insight into experiments from our group (Aguilar, M., Malanoski, M., Adhitya, G., Emerson, B., Acharya, V., Noble, D. and Lieuwen, T., 2015. J. Engr. Gas Turbines and Power, 137(9); Smith T., Emerson B., Chterev, I., Noble D., Lieuwen T., 2016. ASME Paper GT2016-57755).

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