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Large Eddy Simulations of Colorless Distributed Combustion Systems HUSAM F. ABDULRAHMAN, FARHAD JABERI, Michigan State University, ASHWANI GUPTA, University of Maryland — Development of efficient and low-emission colorless distributed combustion (CDC) systems for gas turbine applications require careful examination of the role of various flow and combustion parameters. Numerical simulations of CDC in a laboratory-scale combustor have been conducted to carefully examine the effects of these parameters on the CDC. The computational model is based on a hybrid modeling approach combining large eddy simulation (LES) with the filtered mass density function (FMDF) equations, solved with high order numerical methods and complex chemical kinetics. The simulated combustor operates based on the principle of high temperature air combustion (HiTAC) and has shown to significantly reduce the NOx, and CO emissions while improving the reaction pattern factor and stability without using any flame stabilizer and with low pressure drop and noise. The focus of the current work is to investigate the mixing of air and hydrocarbon fuels and the non-premixed and premixed reactions within the combustor by the LES/FMDF with the reduced chemical kinetic mechanisms for the same flow conditions and configurations investigated experimentally. The main goal is to develop better CDC with higher mixing and efficiency, ultra-low emission levels and optimum residence time. The computational results establish the consistency and the reliability of LES/FMDF and its Lagrangian-Eulerian numerical methodology.

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