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Large Eddy Simulation Analysis of Turbulent Combustion in a Jet-Engine Combustor[1] DONGHYUN YOU, FRANK HAM, PARVIZ MOIN, Center for Turbulence Research — Large-eddy simulation is performed to understand turbulent mixing, cooling, and combustion dynamics in a jet-engine combustor. An LES technique conserving discrete mass, momentum, and kinetic energy on arbitrary shaped unstructured grids is coupled with a Lagrangian particle tracking method for liquid fuel atomization and evaporation, and a presumed probability density function approach for turbulent combustion. A systematic analysis of the mean and turbulent flow fields is carried out to elucidate dynamics of important flow structures and mechanisms for turbulent mixing and cooling. The present LES is found to predict flow splits through the injector swirler and inner and outer dilution shrouds that are in excellent agreement with experimental measurements. The mean temperature, temperature profile, and NO mole fraction at the exit of the combustor are also found to be in favorable agreement with experimental data. The dilution jets produce significant magnitudes of the derivatives of the mean radial and circumferential velocity components, thereby dominating turbulent kinetic energy production. Combustor exit flow consists of fine-scale velocity fluctuations and intermittent large-scale high temperature flow structures.

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Donghyun You
Center for Turbulence Research

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