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Large-eddy simulations of particle-laden turbulent swirling flows

MARCEL ILIE, University of Central Florida — In many combustion devices, a swirling flow is used to stabilize the flame through a recirculation zone. Swirling flows, however, are prone to instabilities which can trigger combustion oscillations and deteriorate the performance of the combustor. The presence of fine particles makes swirling flows of particular interest from a combustor efficiency point of view. Depending on the strength of swirl, a number of recirculation zones and central vortex breakdown regions are identified in many swirl-stabilized flames. In general these characteristics make swirling flows and flames to exhibit highly three-dimensional, large-scale turbulent structures with complex turbulent shear flow regions. The present research concerns the influence of swirl characteristics on the particle dispersion and total deposition. A Lagrangian particle tracking algorithm using large-eddy simulation is proposed. The influence of particle characteristics such size, density and shape on the particle dispersion and total deposition is subject of investigation as well. The present research shows that the total particle deposition increases with size and density. It was also observed that particles of ellipsoidal shape are more prone to deposition.

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