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Dynamic and Thermal Characteristics of Three-Dimensional Turbulent Offset Jet

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Abstract : Studying the flow characteristics of a turbulent offset jet is an important topic among researchers across the world because of its various engineering applications. Some of the common examples include: injection and carburetor systems, entrainment and mixing process in gas turbine and boiler combustion chambers, Thrust-augmenting ejectors for V/STOL aircrafts and HVAC systems, environmental dischargers, film cooling and many others. An offset jet is formed when a jet discharges into a medium above a horizontal solid wall parallel to the axis of the jet exit but which is offset by a certain distance. The structure of a turbulent offset-jet can be described by three main regions. Close to the nozzle exit, an offset jet possesses characteristic features similar to those of free jets. Then, the entrainment of fluid between the jet, the offset wall and the bottom wall creates a low pressure zone, forcing the jet to deflect towards the wall and eventually attaches to it at the impingement point. This is referred to as the Coanda effect. Further downstream after the reattachment point, the offset jet has the characteristics of a wall jet flow. Therefore, the offset jet has characteristics of free, impingement and wall jets, and it is relatively more complex compared to these types of flows. The present study examines the dynamic and thermal evolution of a 3D turbulent offset jet with different offset height ratio (the ratio of the distance from the jet exit to the impingement bottom wall and the jet nozzle diameter). To achieve this purpose a numerical study was conducted to investigate a three-dimensional offset jet flow through the resolution of the different governing Navier–Stokes' equations by means of the finite volume method and the RSM second-order turbulent closure model. A detailed discussion has been provided on the flow and thermal characteristics in the form of streamlines, mean velocity vector, pressure field and Reynolds stresses.

Keywords : offset jet, offset ratio, numerical simulation, RSM
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