PHYSICAL STUDY OF RADIATION EFFECTS IN A STRONGLY HEATED TURBULENT JET USING DIRECT NUMERICAL SIMULATIONS

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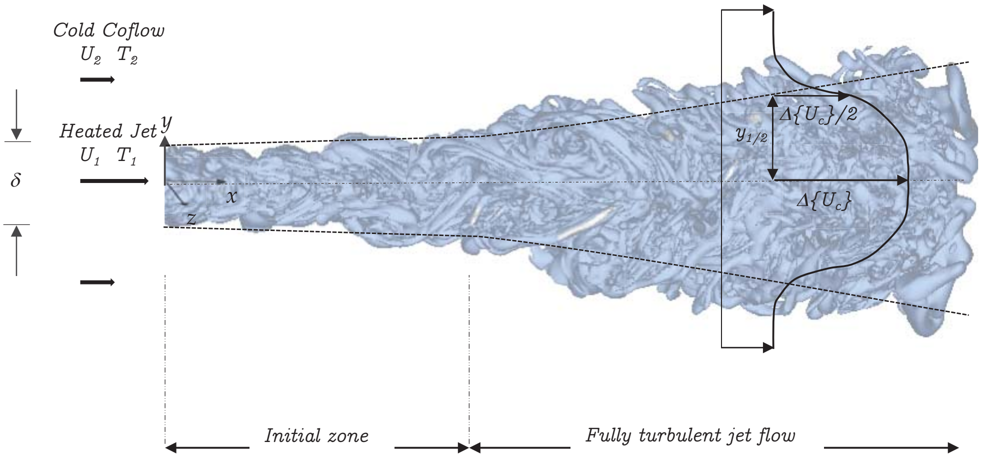
Radiation plays an important role in a broad range of thermal engineering applications comprising turbulent flows such as combustion, propulsion or environmental flows. In such applications radiation modifies the heat transport and the fluid dynamics, while turbulence fluctuations can significantly alter the radiative heat transfer. Those interactions are commonly called turbulent-radiation interactions (TRI) [1,2] which, in a broad sense, stand for the effects that turbulence causes on radiation and vice-versa.
The present work analyses the radiation effects on the turbulent structures of a heated plane jet shown in Fig. 1, in which U_1 and T_1 are the initial velocity and temperature of the jet, U_2 and T_2 correspond to the coflow velocity and temperature, ΔU_c is the centreline jet velocity corrected by U_2, δ is the jet opening width, and $y_{1/2}$ is the jet half-width.
As far as we know, the present set of simulations are the first DNS of a free shear flow to be fully coupled with a reciprocal Monte-Carlo method with spectral dependence of the optical properties to account for thermal radiation. The effects of radiation on mean temperature and velocity fields are analysed. Additionally, temperature fluctuations and Reynolds stresses for the radiative and non-radiative jets are discussed through the enthalpy variance and turbulent kinetic balances. Finally, results of the radiative power field and specific contributions of absorption and emission powers are presented.



References

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