

SIMULATION OF A TURBULENT WALL JET IN A PRECURSOR FLOW

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This paper describes a numerical simulation of a planar, $M=1.7$ shock interacting with thermal layer on dusty wall. For the problem considered, a precursor shock structure with an embedded wall jet is formed. The dust/air mixture on the wall was modeled as a dense gas, thereby focusing on how the dust mass influences the dynamics of the flow. The flow field was calculated by means of high-order Godunov scheme that solves the non-steady equations of gasdynamics. An adaptive mesh technique was used to follow the details of the precursor region. Flow visualization showed that the free shear layer on top of the jet became unstable and rolled up into positive rotational structures. In addition, the velocity field induced by these structures caused the wall shear layer to become unstable and roll up into negative rotational structures that entrained dust from the fluidized bed. Vortex structures from the two shear layers paired, thus forming a chaotic flow which destroyed the coherence of the jet. Similarity coordinates were used to analyze this chaotic flow, thereby determining the mean-flow profiles and r.m.s. fluctuations in the jet and wall boundary layer. These calculations are a uniquely valuable tool for studying such complicated flows, for example, they may be used to determine boundary layer profiles, growth rates and scaling rules, without resorting to turbulence modeling.