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Numerical Simulation of Supersonic Gas Jet Flows and Acoustics Fields

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Abstract : The source of the jet noise is generated by rocket exhaust plume during rocket engine testing. A domain decomposition approach is applied to the jet noise prediction in this paper. The aerodynamic noise coupling is based on the splitting into acoustic sources generation and sound propagation in separate physical domains. Large Eddy Simulation (LES) is used to simulate the supersonic jet flow. Based on the simulation results of the flow-fields, the jet noise distribution of the sound pressure level is obtained by applying the Ffowcs Williams-Hawkings (FW-H) acoustics equation and Fourier transform. The calculation results show that the complex structures of expansion waves, compression waves and the turbulent boundary layer could occur due to the strong interaction between the gas jet and the ambient air. In addition, the jet core region, the shock cell and the sound pressure level of the gas jet increase with the nozzle size increasing. Importantly, the numerical simulation results of the far-field sound are in good agreement with the experimental measurements in directivity.

Keywords : supersonic gas jet, Large Eddy Simulation(LES), acoustic noise, Ffowcs Williams-Hawkings(FW-H) equations, nozzle size

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