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Large-eddy simulation for the prediction of supersonic rectangular jet noise[1] JOSEPH W. NICHOLS, FRANK E. HAM, SANJIVA K. LELE, Stanford U., JAMES E. BRIDGES, NASA Glenn Research Center — We investigate the noise from isothermal and heated under-expanded supersonic turbulent jets issuing from a rectangular nozzle of aspect ratio 4:1 using high-fidelity unstructured large-eddy simulation (LES) and acoustic projection based on the Ffowcs-Williams Hawkings (FWH) equations. The nozzle/flow interaction is directly included by simulating the flow in and around the nozzle in addition to the jet plume downstream. A grid resolution study is performed and results are shown for unstructured meshes containing up to 300 million control volumes, generated by a massively parallel code scaled to as many as 65,536 processors. Validated against laboratory measurements using a nozzle of precisely the same geometry, we find that mesh isotropy is a key factor in determining the quality of the far-field aeroacoustic predictions. The full flow fields produced by the simulation, in conjunction with particle image velocimetry (PIV) data measured from experiment, allow for a detailed examination of the interaction of large-scale coherent flow features and the resultant far-field noise, and its subsequent modification in the presence of heating.

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