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Large-Eddy Simulation of an over-expanded planar nozzle BRITTON OLSON, SANJIVA LELE, Stanford University — Large-eddy simulation (LES) of an over-expanded planar nozzle is performed to elucidate the complex interaction between the turbulent boundary layer, the internal shock wave and the separated shear layer downstream of the shock. This numerical simulation seeks to model one the experiments of Papamoschou et.al. and shed light on the underlying physics of the shock-boundary layer interaction and the Free-Shock Separation (FSS) which is present in over-expanded supersonic nozzles. Simulation results compare well with those obtained from the experiment despite the modeling approximations. The LES captures the unsteady fluctuation of the shock wave as it interacts with the incoming turbulent boundary layer and the separated shear layer downstream. The richness of the simulation data allow for a more in-depth exploration of the underlying physics and have informed development of a reduced order model for approximating the large-scale dynamics of the complex system.

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