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Differential Reynolds stress closure modeling of compressible shear flows CARLOS GOMEZ, SHARATH GIRIMAJI, Texas A&M University — The most important difference between turbulence in high and low Mach number flows stems from the changing role and action of pressure at different speed regimes. In the rapidly distorted turbulence regime, this effect is well captured by rapid distortion theory (RDT) which shows that gradient Mach number characterizes the role/action of pressure very accurately. Thus motivated, we develop a new rapid pressure-strain correlation model for high-speed compressible shear flows in which the closure coefficients are functions of the local gradient Mach number. The functional dependence of the model coefficients on the Mach number is obtained by comparison against RDT data. This closure naturally leads to a pressure-dilatation closure model. Further analysis reveals that a modification of the dissipation equation is also mandatory to accommodate the pressure-dilatation closure physics. Full differential Reynolds stress closure calculations of plane supersonic mixing layers are performed and comparison with the experimental data of Goebel and Dutton shows that the model exhibits good overall agreement without any further model calibration.

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