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A bulk viscosity approach for shock capturing on unstructured grids[1] MOHAMMAD SHOEYBI, NILS JOHAN LARSSON, FRANK HAM, PARVIZ MOIN, Stanford University — The bulk viscosity approach for shock capturing (Cook and Cabot, JCP, 2005) augments the bulk part of the viscous stress tensor. The intention is to capture shock waves without dissipating turbulent structures. The present work extends and modifies this method for unstructured grids. We propose a method that properly scales the bulk viscosity with the grid spacing normal to the shock for unstructured grid for which the shock is not necessarily aligned with the grid. The magnitude of the strain rate tensor used in the original formulation is replaced with the dilatation, which appears to be more appropriate in the vortical turbulent flow regions (Mani et al., 2008). The original form of the model is found to have an impact on dilatational motions away form the shock wave, which is eliminated by a proposed localization of the bulk viscosity. Finally, to allow for grid adaptation around shock waves, an explicit/implicit time advancement scheme has been developed that adaptively identifies the stiff regions. The full method has been verified with several test cases, including 2D shock-vorticity entropy interaction, homogenous isotropic turbulence, and turbulent flow over a cylinder.

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Mohammad Shoeybi
Stanford University

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