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Strong shock and turbulence interactions w/ or w/o thermochemical non-equilibrium effects[1] XIAOWEN WANG, PRADEEP S. RAWAT, XIAOLIN ZHONG, University of California, Los Angeles — The underlying physics in shock and turbulence interaction is essential for a better understanding of many natural processes as well as scientific and engineering applications. One of the fundamental building blocks in these complex processes and applications is the canonical problem of isotropic turbulence and normal shock. Unfortunately, even this fundamental problem is not well understood for strong shocks. We have conducted extensive DNS studies on strong shock and turbulence interaction for perfect gas flow with mean Mach numbers ranging from 2 to 30. The results show some new trends in turbulent statistics as mean Mach number is increased. However, gas temperature increases dramatically after strong shocks so that numerical simulations based on perfect gas flow may not be enough. The effects of thermochemical non-equilibrium flow including internal energy excitations, translation-vibration energy relaxation, and chemical reactions among different species need to be considered. We have developed a new high-order shock-fitting solver based on the 5-species air chemistry and recently thermal non-equilibrium models. The code package has been tested and applied to DNS of strong shock and turbulence interactions with thermochemical non-equilibrium effects.

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