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Alignment Analysis of Passive Scalar Mixing in Shock Turbulence Interaction XIANGYU GAO, IVAN BERMEJO-MORENO, University of Southern California, JOHAN LARSSON, University of Maryland — The transport of passive scalar fields by an initially isotropic turbulent flow passing through a nominally planar shock wave is investigated via shock-capturing DNS for different Mach numbers (1.5 to 5), turbulence Mach numbers (0.1 to 0.4), and Taylor microscale Reynolds numbers (40, 70), with unitary Schmidt number, including both wrinkled- and broken-shock regimes. The effects of the shock-turbulence interaction on alignments between the strain-rate eigenvectors and vorticity, scalar gradient, and the mean streamwise direction are studied, aided by a novel barycentric map representation. Across the shock, the scalar gradient shows an increased alignment with the most extensive eigenvector of strain rate at the expense of a reduced alignment with the most compressive eigenvector (which still dominates) and with the intermediate eigenvector (which becomes nearly perpendicular). This trend is more obvious with larger Mach number and smaller Taylor microscale Reynolds number. Also, across the shock, the most probable alignment between the passive scalar gradient and the eigenvectors of the strain-rate tensor is found to converge towards the alignment that provides the largest scalar dissipation, which is correlated with the enhanced scalar mixing observed downstream of the shock.

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