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Shock propagation and mixing though a stratified gas[1] FABIAN CHACON, MIRKO GAMBA, University of Michigan — In this work, we investigate the characteristics of a shock wave propagating through a stratified gas. The objective is to understand the formation and evolution of the system of waves that results from the interaction, as well as the induced mixing. This work is motivated by understanding the shock-induced mixing and system of waves that arise by the interaction of a detonation wave with the fuel/air injection system in a rotating detonation engine. In these devices, one of the key limiting factors in achieving stable detonation and pressure gain is associated with the stratification induced by a non-uniform and incomplete mixing process. To investigate some of the fundamental aspects of the rapid distortion induced by a detonation wave on the non-uniform flow, we conduct a combined analytical and experimental analysis on a simplified and reduced problem. Experimentally, we consider a single row of injectors of regular spacing that generate a non-reacting turbulent non-uniform flow and are subject to an incident transverse normal shock. Different gasses and shock strengths are used to generate a range of density and velocity ratios that are comparable to what could be experienced through a detonation. Using Schlieren and PLIF imaging, the evolution of mixture fraction throughout the flowfield is investigated. The presence of instabilities and the formation of a system of reflected waves is observed and investigated. A variable property, 1-D, multi-isentropic method of characteristics model is constructed to theoretically investigate the shock propagation and interaction with the stratified flow.

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