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Numerical Investigation of Shock Wave Propagation in Ducts with Grooves

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The pressure attenuation of moving shocks when they propagate in ducts is of great importance in a wide variety of applications, such as health, safety, and transportation. The objective of this research is to investigate the propagation of shock waves in ducts with roughness. The roughness is added in the form of grooves as in an existing experiment. Straight and branching ducts are considered in order to better understand the mechanisms causing attenuation of the shock and the physics behind the evolution of the complex wave patterns resulting from diffraction and reflection of the primary moving shock. A finite volume numerical method is used and further validated for several test cases relevant to this study. The computed results are compared with experimental measurements in ducts with grooves. Good agreement between high resolution simulations and experiment is obtained for the shock speeds and complex wave patterns created by the grooves. Time histories of pressure at various locations, and shock strengths are presented and compared with measurements. Different groove geometries have been tested in the numerical simulation in order to identify the shape that will better diminish shock strength. Animations of the computed results are shown to reveal salient features of the unsteady flowfield.

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