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HIGH RESOLUTION NUMERICAL SIMULATION ON DYNAMICS OF INTAKE SHOCK MOTION

Abstract

Abstract: Intake is the main component of supersonic propulsion systems, the performance of propulsion systems is directly relevant to the intake dynamics. The terminal shock position is affected by perturbations propagating upstream from the combustor and nozzle and from disturbances in the free stream during the operation of the air breathing engine. These may result in the inlet buzz or unstart, extinguish in the combustor, which are undesirable. In order to improve the economics and safety of the air breathing engine, it is essential to control the shock position capable of operation closer to the stability boundary to decrease the pressure loss and capable of keeping shock position to the desired state during large disturbance. It's important to develop the mathematical model of intake, which is the basis of the shock control systems. This paper presents the high accuracy simulation of the nonlinear dynamics of shock motion, based on the one-dimensional unsteady flow governing equations. The high order weighted essentially non-oscillatory schemes (WENO) is implemented to accurately capture the shock. Furthermore, the dynamics of shock position and the shock observation have been obtained, under disturbances in back pressure and free stream. In order to attain low order model for controlling the shock position, the model identification of the data in time domain is applied. The results show that the dynamics of the low order model are consistent to the nonlinear simulation results during small disturbance, which are useful to design the shock position controller. Keywords: Terminal Shock; Dynamics; WENO; Model Identification