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CFD analysis of compressible flows in a convergent-divergent nozzle

Khan S.A.[a], Ibrahim O.M.[a], Aabid A.[a, b]

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[a] Department of Mechanical Engineering, Faculty of Engineering, International Islamic University Malaysia, PO Box 10, Kuala Lumpur, 50728, Malaysia

[b] Department of Engineering Management, College of Engineering, Prince Sultan University, PO BOX 66833, Riyadh, 11586, Saudi Arabia

Abstract

A Nozzle is a mechanical device that uses pressure energy and fluid enthalpy to increase the outflow velocity and control fluid flow direction. To obtain the nozzle duct's shock pattern, the flow inside the nozzle must be supersonic with a Mach number greater than one. Experimentally, the shock pattern is obtained for a nozzle with a Mach number 2 and nozzle pressure ratio (NPR) equivalent to 7 and below. For Mach M=2, the needed NPR is equal to 7.82 for correct expansion. When the NPR is greater

than 7.82, flow from the nozzles is under-expanded. For NPR less than 7.72 the flow from the nozzle is over-expanded. In this paper, the computational fluid mechanics (CFD) technique was used to simulate the nozzle flow based on the experimental investigation. A two-dimensional transient compressible flow of air through a supersonic nozzle was simulated using ANSYS fluent software. A time-dependent flow using the density-based implicit solver was useds to analyze the simulation results. The results illustrate that the CFD technique simulates the fluid flows and the formation of shock in a duct and gives useful information about fluid dynamics analysis .

Author keywords

ANSYS simulation; C-D nozzle ; CFD ; Compressible flow ; Mach number

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Aabid, A.; Department of Engineering Management, College of Engineering, Prince Sultan University, PO BOX 66833, Riyadh, Saudi Arabia;
email:abdul.aabid@live.iium.edu.my