World Academy of Science, Engineering and Technology
International Journal of Aerospace and Mechanical Engineering
Vol:11, No:10, 2017

# Computational Fluid Dynamics Analysis of Convergent–Divergent Nozzle and Comparison against Theoretical and Experimental Results

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**Abstract :** This study aims to use both analytical and experimental methods of analysis to examine the accuracy of Computational Fluid Dynamics (CFD) models that can then be used for more complex analyses, accurately representing more elaborate flow phenomena such as internal shockwaves and boundary layers. The geometry used in the analytical study and CFD model is taken from the experimental rig. The analytical study is undertaken using isentropic and adiabatic relationships and the output of the analytical study, the 'shockwave location tool', is created. The results from the analytical study are then used to optimize the redesign an experimental rig for more favorable placement of pressure taps and gain a much better representation of the shockwaves occurring in the divergent section of the nozzle. The CFD model is then optimized through the selection of different parameters, e.g. turbulence models (Spalart-Almaras, Realizable k-epsilon & Standard k-omega) in order to develop an accurate, robust model. The results from the CFD model can then be directly compared to experimental and analytical results in order to gauge the accuracy of each method of analysis. The CFD model will be used to visualize the variation of various parameters such as velocity/Mach number, pressure and turbulence across the shock. The CFD results will be used to investigate the interaction between the shock wave and the boundary layer. The validated model can then be used to modify the nozzle designs which may offer better performance and ease of manufacture and may present feasible improvements to existing high-speed flow applications.

**Keywords :** CFD, nozzle, fluent, gas dynamics, shock-wave
**Conference Title :** ICAMAME 2017 : International Conference on Aerospace, Mechanical, Automotive and Materials Engineering
**Conference Location :** London, United Kingdom
**Conference Dates :** October 19-20, 2017