Document details

Journal of Applied Fluid Mechanics Open Access
Volume 13, Issue 2, 2019, Pages 499-511

Prediction of base pressure in a suddenly expanded flow process at supersonic mach number regimes using ANN and CFD (Article) (Open Access)

Quadros, J.D.[a], Khan, S.A.[b]

[a]Department of Mechanical Engineering, Birla Institute of Technology, Off-shore campus, Ras Al Khaimah, United Arab Emirates
[b]Department of Mechanical Engineering, International Islamic University Malaysia, Kuala Lampur, Malaysia

Abstract

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Sudden expansion of flow in supersonic flow regime has gained relevance in the recent pasts for a wide run of applications. A number of kinematic as well as geometric parameters have been significantly found to impact the base pressure created within the suddenly expanded stream. The current research intends to create a predictive model for base pressure that is established in the abruptly extended stream. The artificial neural network (ANN) approach is being utilized for this purpose. The database utilized for training the network was assembled utilizing computational fluid dynamics (CFD). This was done by the design of experiments based L_{27} Orthogonal array. The three input parameters were Mach number (M), nozzle pressure ratio (NPR) and area ratio (AR) and base pressure was the output parameter. The CFD numerical demonstrate was approved by an experimental test rig that developed results for base pressure, and used a nozzle and sudden extended axissymmetric duct to do so. The ANN architecture comprised of three layers with eight neurons in the hidden layer. The algorithm for optimization was Levenberg-Marquardt. The ANN was able to successfully predict the base pressure with a regression coefficient R^2 of less than 0.99 and RMSE=0.0032. The importance of input parameters influencing base pressure was estimated by using the ANN weight coefficients. Mach number obtained a relative importance of 47.16% claiming to be the most dominating factor. © Isfahan University of Technology.

SciVal Topic Prominence

Topic: Base Pressure | Mach Number | Convergent-divergent Nozzles

Prominence percentile: 85.885

Author keywords

Artificial Neural Network (ANN) | Base pressure | Computational Fluid Dynamics (CFD) | Mach number

ISSN: 17353572
Source Type: Journal
Original language: English
DOI: 10.29252/jafm.13.02.30049
Document Type: Article
Publisher: Isfahan University of Technology

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