

[Free Full Text from Publisher](#)
[Look Up Full Text](#)


1 of 1

Modelling of Suddenly Expanded Flow Process in Supersonic Mach Regime using Design of Experiments and Response Surface Methodology

By: [Quadros, JD](#) (Quadros, Jaimon D.)^[1]; [Khan, SA](#) (Khan, S. A.)^[2]; [Antony, AJ](#) (Antony, A. J.)^[3]

JOURNAL OF COMPUTATIONAL APPLIED MECHANICS

Volume: 49 Issue: 1 Pages: 149-160

DOI: 10.22059/jcamech.2018.248043.221

Published: JUN 2018

Document Type: Article

Abstract

The present work is an attempt to model, analyze, and control the flow at the base of an abruptly expanded circular duct by using design of experiments (DOE) and response surface methodology (RSM). Tiny-jets in the form of orifice were positioned at an interval of 900, 6.5 mm from the primary axis of the main jet of the nozzle. Experiments were conducted to measure two responses namely, base pressure without the use of micro jets or active control (WoC) and base pressure with the use of micro jets or active control (WC). Mach number (M), nozzle pressure ratio (NPR), area ratio (AR) and length to diameter ratio (L/D) were considered as the input variables (parameters), which control the outputs (i.e. base pressure). Non-linear regression models based on central composite design (CCD) and Box-Behnken design (BBD) have been developed in order to facilitate the input-output relationships. Moreover, the significance of main, square and interaction terms of the developed models have been tested by performing analysis of variance (ANOVA). The ANOVA and significance test results and their respective correlation coefficient values indicate that both the CCD and BBD regression models are statistically adequate for both the base pressure responses of without control and with control respectively. The performances of the nonlinear models have been validated for accuracy prediction by use of 15 test cases. The performance of BBD model is found to be better in forecasting base pressure for both cases of without control and with control when compared to the CCD model.

Keywords

Author Keywords: base pressure; Mach number; area ratio; length to diameter ratio; nozzle pressure ratio; central composite design; Box-Behnken design

KeyWords Plus: MICRO-JETS; EXPANSION FLOWS; DRAG REDUCTION; ACTIVE CONTROL; SEPARATION; NOZZLES


Author Information

Reprint Address: Quadros, JD (reprint author)

Birla Inst Technol, Dept Mech Engr, RAK Campus, Ras Al Khaymah, U Arab Emirates.

Addresses:

[1] Birla Inst Technol, Dept Mech Engr, RAK Campus, Ras Al Khaymah, U Arab Emirates

 [2] IIUM, Dept Mech Engr, Kuala Lumpur, Malaysia

[3] Bearys Inst Technol, Dept Mech Engr, Mangalore, India

E-mail Addresses: jaimonq@gmail.com

Citation Network

In Web of Science Core Collection

0

Times Cited



Create Citation Alert

25

Cited References

[View Related Records](#)

Use in Web of Science

Web of Science Usage Count

0

Last 180 Days

0

Since 2013

[Learn more](#)

This record is from:

Web of Science Core Collection
- Emerging Sources Citation Index

Suggest a correction

If you would like to improve the quality of the data in this record, please [suggest a correction](#).

Publisher

UNIV TEHRAN, DANISHGAH-I TIHRAN, UNIV TEHRAN, DANISHGAH-I TIHRAN, TEHRAN, 00000, IRAN

Categories / Classification**Research Areas:** Mechanics**Web of Science Categories:** Mechanics[See more data fields](#)

◀ 1 of 1 ▶

Cited References: 25**Showing 25 of 25** [View All in Cited References page](#)*(from Web of Science Core Collection)*

1. **Control of Base Pressure with Micro Jets for Area Ratio 2.4**

By: Ashfaq, S.; Khan, S. A.; Rathakrishnan, E.

International Review of Mechanical Engineering (IREME) Volume: 8 Issue: 1 Pages: 1-10 Published: 2014

Times Cited: 3
2. **An experimental investigation of base flows at supersonic speeds**

By: Badrinarayanan, M.

The Aeronautical Journal Volume: 65 Issue: 607 Pages: 475-482 Published: 1961

Times Cited: 1
3. **Control of Base Flows with Micro Jets**

By: Baig, Maughal Ahmed Ali; Al-Mufadi, Fahad; Khan, Sher Afghan; et al.

INTERNATIONAL JOURNAL OF TURBO & JET-ENGINES Volume: 28 Issue: 1 Pages: 59-69 Published: APR 2011

Times Cited: 5
4. **Drag reduction of passenger car using add-on devices**

By: Bansal, R.; Sharma, R.

Journal of Aerodynamics Volume: 2014 Published: 2014

Times Cited: 1
5. Title: [not available]

By: Cantwell, B. J.

Fundamentals of Compressible Flow, AA210 Published: 1996

Publisher: Department of Aeronautics and Astronautics, Stanford University, California, USA

Times Cited: 2
6. **Numerical analysis of axisymmetric and planar sudden expansion flows for laminar regime**

By: Dagtekin, Ihsan; Unsal, Mazhar

INTERNATIONAL JOURNAL FOR NUMERICAL METHODS IN FLUIDS Volume: 65 Issue: 9 Pages: 1133-1144 Published: MAR 30 2011

Times Cited: 18
7. **Bifurcation phenomena in incompressible sudden expansion flows**

By: Drikakis, D

PHYSICS OF FLUIDS Volume: 9 Issue: 1 Pages: 76-87 Published: JAN 1997

Times Cited: 119
8. Title: [not available]

By: Genick, B. M.

Gas Dynamics Tables, Version 1.3 Published: 2007

2007

Times Cited: 1
9. **Control of suddenly expanded flow**

Times Cited: 7