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Response surface analysis of nozzle parameters at supersonic flow through microjets

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AUSTRALIAN JOURNAL OF MECHANICAL ENGINEERING

DOI: 10.1080/14484846.2021.1938954

Early Access: JUN 2021

Document Type: Article; Early Access

Abstract

Base pressure is a crucial component in the measurement of flow parameters in a high-speed aerodynamic flow. In this paper, the microjets impact as a control mechanism is experimentally tested for the nozzles with abrupt expansion at supersonic Mach in an axisymmetric conduit. The flow regulation mechanism is placed at a 90-degree interval in the shape of an orifice of 0.5 mm in radius along the nozzle's exit diameter, which generates jets at sonic Mach numbers. The flow constraints studied are inertia level (Mach number), expansion level (NPR), and the geometric parameters considered are the pipe's length (L/D). These three relevant parameters were selected for design of experiments (DOE). In the management of base pressure, this analysis's primary objective is to evaluate the parameters influencing the flow. The experiments were carried out in two ways: without and with microjets. For the DOE, an L-27 orthogonal series, polynomial expression, analysis of variance, and predicted plots were carried out to test the experimental findings. The established prototypes are statistically appropriate and achieved when making precise projections for all the cases. According to the present results, the L/D ratio for a given parameter is the most critical parameter influencing the maximum increase or decrease in the base pressure.

Keywords

Author Keywords: [Design of experiments](#); [high-speed flows](#); [CD nozzle](#); [base pressure](#); [RSM](#)

Keywords Plus: [SUDDENLY EXPANDED FLOWS](#); [ACTIVE CONTROL](#)

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Categories/Classification

Research Areas: Engineering

Funding

Funding agency	Grant number
Structures and Materials (S&M) Research Lab of Prince Sultan University	

Close funding text

The authors Abdul Aabid and Muneer Baig wish to acknowledge the support of the Structures and Materials (S&M) Research Lab of Prince Sultan University.

+ [See more data fields](#)

Journal information

AUSTRALIAN JOURNAL OF MECHANICAL ENGINEERING

ISSN: 1448-4846

eISSN: 2204-2253

Current Publisher: TAYLOR & FRANCIS LTD, 2-4 PARK SQUARE, MILTON PARK, ABINGDON OX14 4RN, OXON, ENGLAND

Research Areas: Engineering

Web of Science Categories: Engineering, Mechanical

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