Response surface analysis of nozzle parameters at supersonic flow through microjets

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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

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