A critical review of supersonic flow control for high-speed applications

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Abstract

In high-speed fluid dynamics, base pressure controls find many engineering applications, such as in the automobile and defense industries. Several studies have been reported on flow control with sudden expansion duct. Passive control was found to be more beneficial in the last four decades and is used in devices such as cavities, ribs, aerospikes, etc., but these need additional control mechanics and objects to control the flow. Therefore, in the last two decades, the active control method has been used via a microjet controller at the base region of the suddenly expanded duct of the convergent–divergent (CD) nozzle to control the flow, which was found to be a cost-efficient and energy-saving method. Hence, in this paper, a systemic literature review is conducted to investigate the research gap by reviewing the exhaustive work on the active control of high-speed aerodynamic flows from the nozzle as the major focus. Additionally, a basic idea about the nozzle and its configuration is discussed, and the passive control method for the control of jet and noise are represented in order to investigate the existing contributions in supersonic speed applications. A critical review of the last two decades considering the challenges and limitations in this field is expressed. As a result, some major and minor gaps are introduced, and we plot the research trends in this field. As a result, this review can serve as guidance and an opportunity for scholars who want to use an active control approach via microjets for supersonic flow problems. © 2021 by the authors. License MDPI, Basel, Switzerland.

Author keywords
CD nozzle; CFD; De Laval nozzle; DOE; Flow control; Microjet; Supersonic flow

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