Supersonic Cavity Flows and Their Control

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Abstract

A detailed experimental study of supersonic flow, Mach 2, over a three dimensional cavity was conducted using shadowgraph visualization, unsteady surface pressure measurements and particle image velocimetry. A large recirculation zone and high speed reverse flow was revealed in the cavity. Large-scale structures in the cavity mixing layer and visible disturbances inside the cavity were clearly observed. In this study, supersonic microjets are used at the leading edge to suppress flow unsteadiness within the cavity. With a minimal mass flux, the activation of microjets led to reductions of up to 20 dB in the amplitudes of cavity tones with reductions of more than 9 dB in the overall noise levels. The microjet injection also modified the cavity mixing layer and resulted in a significant reduction in the flow unsteadiness inside the cavity.

Introduction

Cavity flow has been the subject of research since the 1950s.[1] Although geometrically simple, the fluid dynamics in such flows are rather complicated and much of the flow physics governing cavity behavior remains unclear. Due to the additional complexity and measurement challenges inherent in supersonic flows, to-date very limited data is available for

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