Effects of Convective Velocity on the Structure and Noise Level of Turbulent Shear Layers

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Abstract

Computational simulations have been performed to study the effects of convective Mach number on the
structure and noise level of two-dimensional turbulent shear layers. The governing equations are the
two-dimensional, compressible Euler equations with ideal gas law. Spatial derivatives are evaluated using
third-order-accurate MUSCL type of MOC schemes and time advancement is via the second-order-accurate
LU-SSOR scheme. Three convective Mach numbers (0.14, 0.51 and 0.64) are considered in the present study to
investigate their effects on the shear layer flow structure. Numerical results indicate that the growing of vortex is
delayed with increasing convective Mach number, due to compressibility effect which reduces turbulent mixing
rate and suppresses vortex roll-up and pairings. The power spectral density analysis of pressure fluctuations
indicates that the peak noise level remains relatively constant as the convective Mach number is increased.
However, the noise shifts to higher frequency with increasing convective Mach number.

Keyword：Shear layer, Convective Mach number, Vortex pairing, Power spectral density