66th International Astronautical Congress 2015

MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Fluid and Materials Sciences (2)

Author: Mr. Qiancheng Wang
National University of Defense Technology, China, wqc1235@163.com

CHARACTERISTICS OF THE SUPERSONIC FLOW DOMINATED BY LARGE-SCALE STREAMWISE VORTICES

Abstract

The characteristics of the large scale supersonic streamwise vortices induced by a rectangular lobed mixer are experimentally and numerically investigated. Instantaneous visualization results and velocity distribution of the flow field are acquired through the Nanoparticle-based Planar Laser Scattering method and Particle Image Velocimetry, illustrating the coexistence of large scale streamwise and Kelvin-Helmholtz vortices downstream of the trailing edge. The numerical result reveals that large scale streamwise vortices dominate the flow, which greatly distort the K-H vortex tubes, while the motions of the streamwise vortices are not notably affected in return. In spite of that, the significant effect of the K-H instability on the fine structures of the streamwise vortices in the form of orderly distributed vortex clusters should not be neglected. The small scale vortices introduced in the corner regions upstream of the trailing edge contribute a lot to the formation of three large scale streamwise vortices downstream. Helical structures noted on the weakest streamwise vortex indicates that weaker vortex is more vulnerable to the K-H instability. The interaction of the adjacent streamwise vortices will affect the motion of the streamwise vortices.