PIV 기법을 이용한 마하 2.0 초음속 노즐의 과대팽창 충격파구조에 대한 연구

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ABSTRACT

Two dimensional velocity distributions outside a Mach 2.0 supersonic nozzle have been investigated using digital particle image velocimetry (PIV). Mean velocities, turbulence intensities, vorticity field and volume dilatation field are obtained from 300 instantaneous PIV images using 0.33 μm TiO_2 particle. The seeding particle of larger size, 1.4 μm TiO_2, is also used for the experimental measurements of velocity lag downstream of shock waves according to particle sizes. The results have been compared and analyzed with schlieren photographs and computational fluid dynamics (CFD) results for the velocity distribution, the locations of shock waves and over-expanded shock structure. It was shown that the locations of normal shock and shock waves can be resolved by the axial or radial velocities, and the velocity lag is more significantly increased due to particle inertia as a particle size increases. And it was also found that over-expanded shock structures can be predicted by volume dilatation fields, and streamwise turbulence intensities are influenced significantly by normal shock waves.