

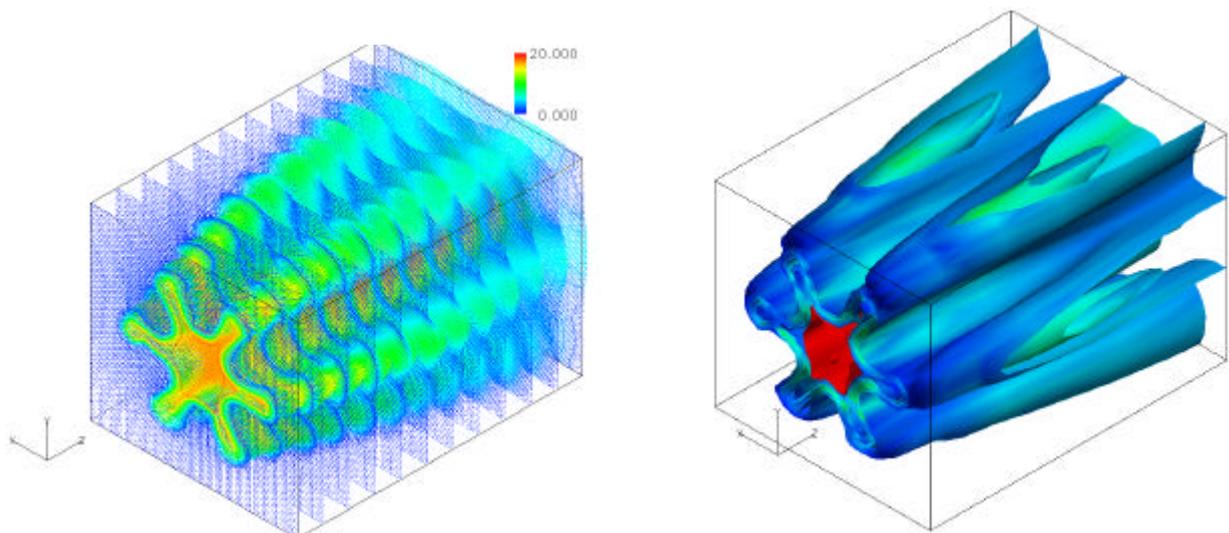
Stereoscopic PIV Measurement of a Lobed Jet Mixing Flow

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ABSTRACT

In a continuing effort to study the mixing enhancement by large scale streamwise vortices generated by a lobed nozzle, a high-resolution stereoscopic PIV system was used in the present study to conduct three-dimensional measurements of air jet flows exhausted from a lobed nozzle and a conventional circular nozzle. The three-dimensional instantaneous and ensemble averaged velocity fields, instantaneous and mean streamwise vorticity distributions and turbulent kinetic energy distributions of the stereoscopic PIV measurement results were used to analysis the characteristics of the mixing process in the lobed jet mixing flow compared with the conventional circular jet flow. The existence of the large-scale streamwise vortices in the lobed jet mixing flow is revealed clearly from the stereoscopic PIV measurement results. The large scale streamwise vortices generated by the corrugated trailing edge of the lobed nozzle were found to break into smaller, but not weaker streamwise vortices gradually as their travelling downstream. It is proposed to be the reason why a lobed nozzle can enhancement both the large-scale mixing and small scale mixing reported by other researchers. The overall effect of the lobed nozzle on the mixing process in the lobed jet mixing flow was evaluated by the mean streamwise vorticity distributions. It was found that mean streamwise vortices in the lobed jet mixing flow grew up and expanded radically at the first one and half diameters, then broke down into smaller and weaker vortices in the farther downstream. The strength of the mean streamwise vortices was also found to decay very rapidly at the first one and half diameters. After the broken down of the mean streamwise vortices, the decay was found to turn to be with a more medium rate at further downstream. The averaged turbulent kinetic energy profile indicated that most of the intensive mixing between the core jet flow and ambient flow due to the special geometry of the lobed nozzle occurred at the first two diameters, which is correspond to the upstream region of the mean streamwise vortices broken down.

Keyword: Stereoscopic PIV technique, Jet Mixing Flow, Mixing Enhancement, Lobed Nozzle



a. ensemble averaged velocity vectors
b. velocity iso-surface
Figure 18. Reconstructed three-dimensional flow field (first three diameters) of the lobed jet mixing flow based on the stereoscopic PIV measurement results