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Three-dimensional Flow Structure around an Axial Fan

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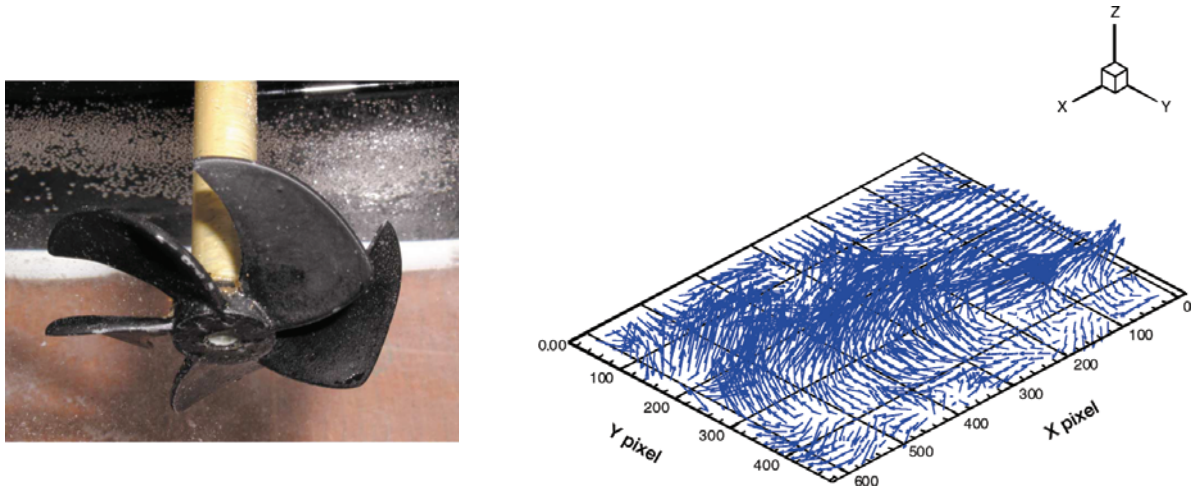

Fig.1. Axial-fan model and instantaneous velocity vectors measured by stereoscopic PIV

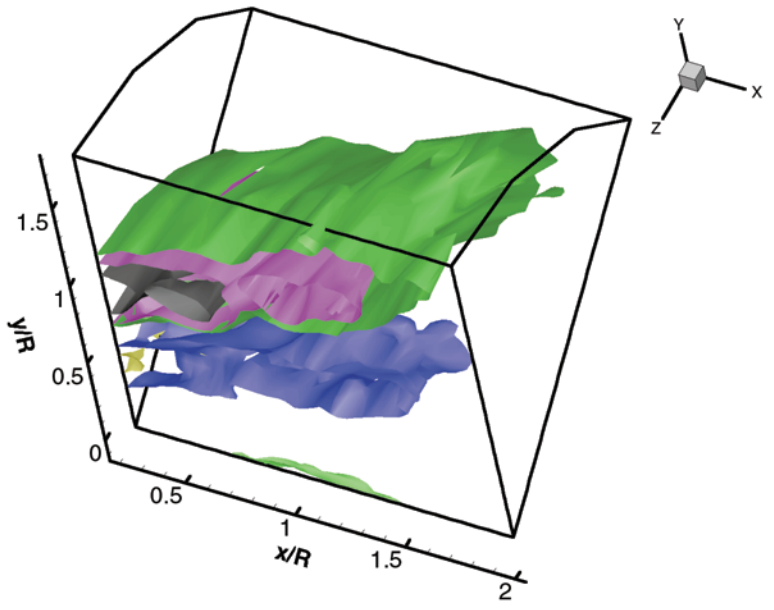

Fig.2. Three-dimensional iso-vorticity structure of spanwise vorticity ω_z

The stereoscopic PIV (particle image velocimetry) measurements were carried for an axial-fan to understand the three-dimensional (3-D) flow structure around the fan. The fan model has five forward-swept blades and its tip diameter is 50 mm. Figure. 1 shows the axial-fan tested and a typical 3-D reconstructed instantaneous velocity field measured in an axial plane just behind the axial-fan. During experiments, the fan is rotating at 180rpm. 500 instantaneous velocity fields were measured and they were ensemble averaged to obtain the phase-averaged mean flow structure.

By combining the vorticity contours measured at four consecutive phases, iso-vorticity contours having the same spanwise vorticity (ω_z) were derived. The contour plot of equi-spanwise vorticity surface is depicted in Fig. 2. It shows the quasi 3-D distribution of positive tip vortices shed from the blade tip, trailing vortices and negative vortices induced from the pressure side of fan blade. The positive tip vortices and negative vortices interact strongly in the region of $0.6<y/R<0.8$.