Paper 34.3

Spatio-temporal reconstruction of the unsteady wake of axi-symmetric bluff bodies via time-recording DPIV

BY
CHRISTOPH BRÜCKER
Aerodynamisches Institut der RWTH Aachen
Wüllnerstr. Zw. 5 u. 7,
D-52062 Aachen, Germany
E-mail: bruecker@aia.rwth-aachen.de

ABSTRACT

The present study was undertaken with the objective of a more detailed quantitative analysis of the evolution of the flow field in the wake of axisymmetric bluff bodies like spheroids or bubbles. With the measurement technique described here, we could confirm that the form of the flow field predicted by Schwarz et al. also arises for a solid sphere which is a more close approximation to the shape of a bubble. The figure below shows the spatio-temporal reconstruction of the streamwise vorticity in the wake of a sphere for three different Reynolds-numbers. The sphere was placed in the test section of the water tank and the secondary flow in the wake was measured in a horizontal plane three diameters downstream of the sphere. The flow field and streamwise vorticity distribution in the plane was obtained by chronological DPIV recordings. A three-dimensional data cube was created from the temporal evolution of the planar vorticity distribution by stacking the results of continuous successive moments in the vertical direction. The spatio-temporal reconstruction of the vortex structures is displayed by means of surfaces of constant streamwise vorticity within the three-dimensional data cube. For *Re* = 280 the wake is continuous and consists clearly of a pair of streamwise vortices. A slight waviness in the size and strength of the vortices can be seen. For *Re* = 400 hairpin-vortices are periodically shed in the wake. The reconstructed streamwise structures in the figure represent the legs of the hairpin vortices. Note that the measurement results demonstrate a chain of oppositely oriented hairpin-vortices with alternate circulation as also observed by Johnson & Patel. Finally, in the case when *Re* = 700 the wake structure allows us to recognize phases, in which – besides an irregular orientation of the hairpin-vortices - the shedding is partly suppressed and the structure is twisted as a whole into a double-helical vortex structure. Such a phase is shown at the right-hand side. One can see the beginning and end of this phase by means of the open legs at the top and bottom end of the structure, which mark the generation of the shed hairpin with opposite circulation.