Journal of Visualization, Vol. 4, No. 2 (2001) 119

5. The Structure of a Separated Shear Layer from a Blunt Leading Edge under Forcing

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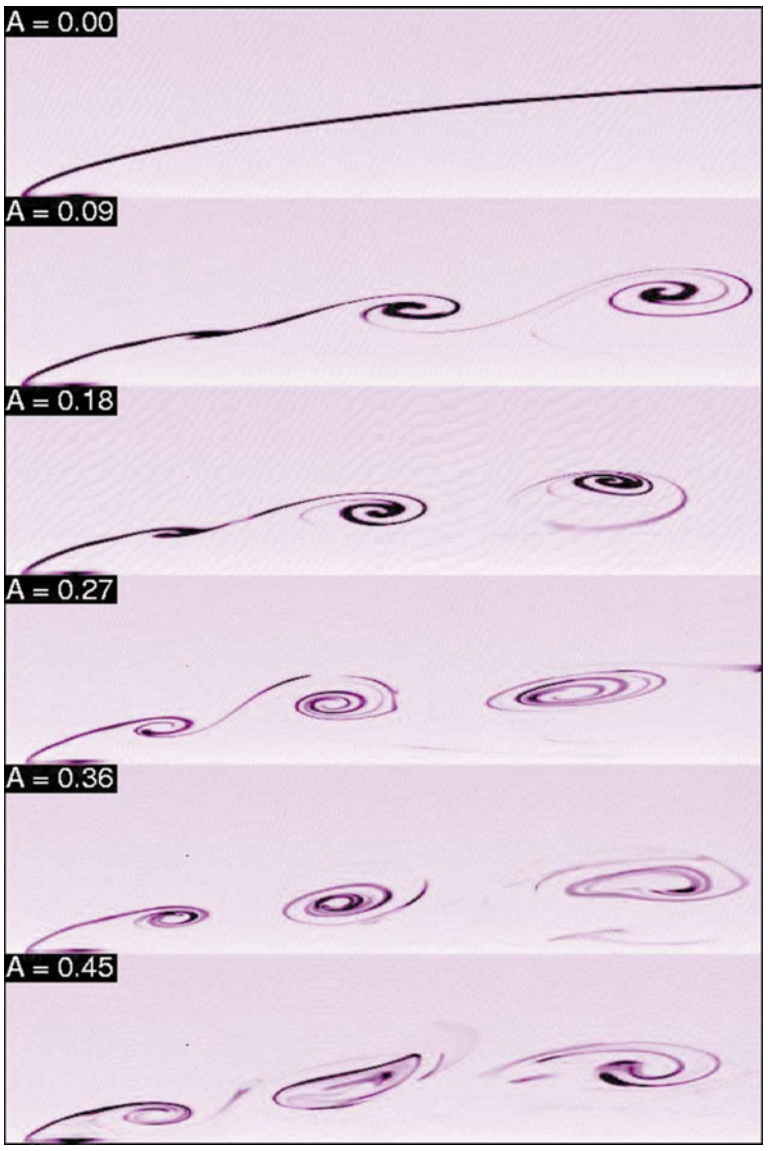

The development of a separated shear layer from a blunt leading edge normal to the flow was visualized with a fluorescing dye. A flat plate of width 25 mm and size 500 mm by 500 mm was placed in a water tunnel. A slit of 0.5 mm width and 100 mm length at the center of the leading edge was used to force the shear layer. The slit was 4 mm to one side of the center line. A scotch yoke mechanism connected to an hydraulic cylinder was used for imposing harmonic disturbances on the shear layer through the slit. The fluorescing dye was injected through an orifice of 0.5 mm diameter and displaced 5 mm from the slit. A laser sheet with a pulse duration of 6 ns and 2 mm thickness located transverse to the plate was used for illumination. The flow velocity was 35 mm/s and the Reynolds number was 1000.

The sequence of six images in the photograph show the development of the shear layer for different amplitudes of excitation normalized by the flow velocity A. The flow is from left to right. The separation corner is at the lower left corner of the image which depicts an area of 20 mm by 58 mm. The first image shows the shear layer without forcing and the remaining images show the effect of forcing at 1 Hz at various amplitudes. Strong non-linear development of vortical structures that penetrate the separated region can be clearly seen in the forced cases. The effect of these structures on the mass, momentum and heat transfers can be exploited to control the flow.