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Hairpin-Shape Vortices in the Round Jet

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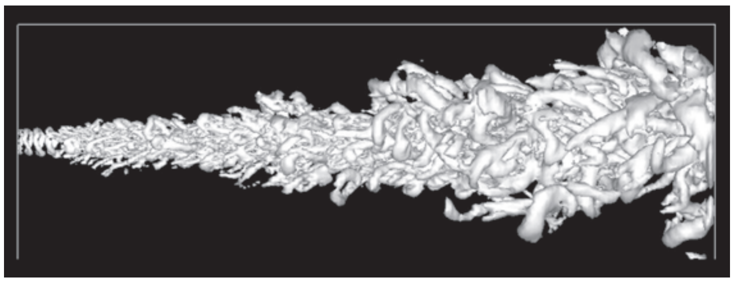

Fig. 1. Iso-surface of Laplacian for pressure

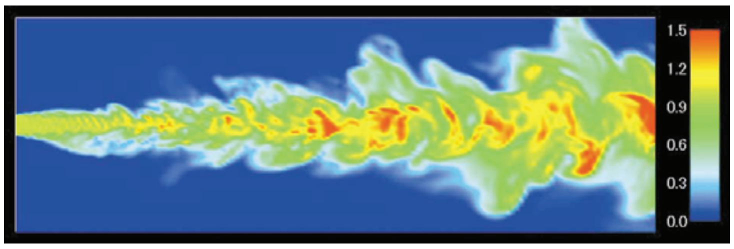

Fig. 2. Contour of temperature normalized by mean center value

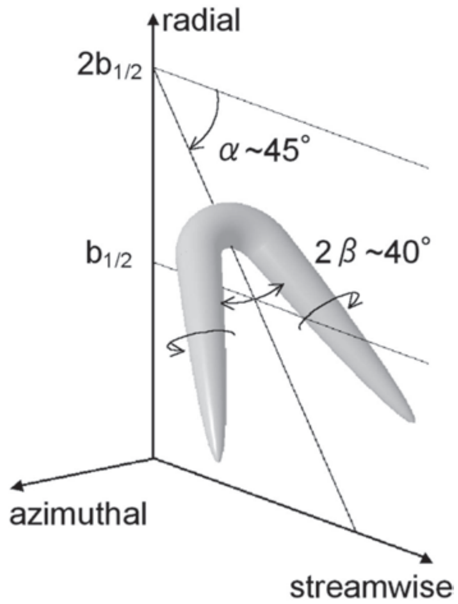

Fig. 3. Hairpin-shape vortex

Direct numerical simulation was performed for non-isothermal air jet at the Reynolds number equal to 1200. Simulated is a cylindrical domain extending 30 nozzle diameter. In the developed stage of the jet away from the nozzle exit, careful observer should notice existence of orderly structures, i.e., hairpin-shape vortex (Fig. 1) and wavy pattern of temperature variation (Fig. 2). One to one correspondence between vortical structure and temperature variation indicates that hairpin-shape vortex is a key to control the scalar mixing. From the PDF analysis of three orthogonal vorticity components, it was suggested that hairpin-shape vortices are inclined to lie in the flow field as suggested in Fig. 3.