TENTH AUSTRALASIAN FLUID MECHANICS
CONFERENCE - UNIVERSITY OF MELBOURNE
11-15 DECEMBER 1989

STREAMLINES, VORTICITY LINES, AND VORTICES

Leslie A. YATES[1] and Gary T. CHAPMAN[2]

[1]Eloret Institute
NASA-Ames Research Center, Moffett Field, CA 94035, USA

[2]University of California at Berkeley
Berkeley, CA 94720, USA

ABSTRACT

Vortices are studied using both computational flow fields and theoretical observations based on the properties of vector fields, the Navier-Stokes equations, and hypotheses inferred from the computational studies. The vortex core, as defined by Levy, Seginer, and Degani (AIAA Paper 88-2598), is determined by extrema in the helicity and by streamlines of minimum curvature. However, extrema in the helicity and the streamline of minimum curvature do not necessarily coincide, nor is a vortex core defined by extrema in the helicity necessarily a streamline. For example, in one computational case, that of a vortex passing through a shock, the vortex core was composed of at least two streamlines. Before the shock, a single streamline coincided with the extrema in the helicity. After the shock, a second streamline coincided with the extrema, and the streamline that initially followed the core spiraled about this second streamline. Nevertheless, in most cases it appears that vortex cores defined by extrema in helicity do coincide with streamlines, and that in the vortical region of the fluid flow, these streamlines have the minimum curvature. The conditions necessary for coincidence of streamlines with the defined vortex cores are examined as well as the condition necessary for minimum curvature. Also, the positions relative to the vortex core of extrema in the pressure, density, velocity magnitude and vorticity magnitude are determined, and they generally coincide with the vortex core.