PIV ANALYSIS OF MODE BIFURCATION IN TAYLOR VORTEX FLOW

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ABSTRACT: Since the classical investigation of the Taylor vortex by G. I. Taylor in 1923, many researchers have studied the Taylor vortex as one of the most important vortex types in flow. In this study, the inner cylinder is rotating, while the outer cylinder, which is concentric with the inner cylinder, is stationary. The phenomenon is visualized experimentally as a three-dimensional problem. In addition, the measurement of the velocity distribution is carried out by the PIV method. The radius of the inner cylinder (rin) is 20 mm, and that of the outer cylinder (rout) is 30 mm. The gap between the inner and outer cylinders (d = rout - rin) is 10 mm. In this study, Re = 650-1200 is assumed. A pulley is attached to the belt wheel places at the bottom center of the apparatus in order to rotate the inner cylinder. In the upper part of the apparatus, movable ends are fixed to the upper and lower sides of the cylinder to change the aspect ratio. The aspect ratio Γ is defined as the ratio of cylinder height to gap distance. A servo motor to rotate the inner cylinder, a servo- motor control device, a servo amplifier for rotation speed control, and a YAG laser light source are installed in the apparatus. For the visualization of Taylor vortex flow, aluminum powder composed of scale like fine particles is used. The size of the aluminum particles is uniform at 20 micro meters. As tracer particles used in the PIV method, fluorescent particles with a size of 48 micro meters were used. The governing equations are Navier-Stokes equations with cylindrical coordinates (r, theta, z) and the equations of continuity. Each physical value is nondimensionalized using the angular velocity of the inner cylinder as the representative velocity, and the radius difference between the inner and outer cylinders as the representative length. Discretization of the governing equations is based on the MAC method. The results of EFD and CFD are compared. The mode bifurcation is observed, and the flow structure is investigated.

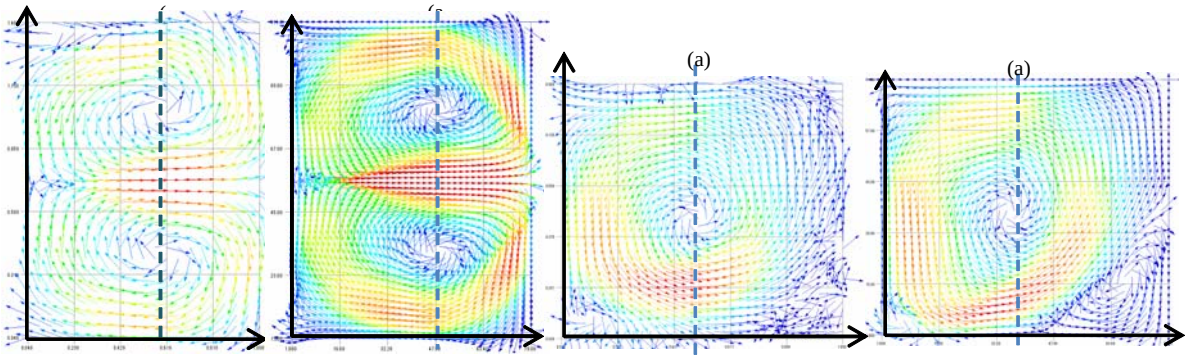

Fig. 1 Comparison of PIV and CFD results.