The important problems of conducting fluid dynamics experiments with soap film tunnels （PART Ⅰ） The development of Digit

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ABSTRACT

This thesis is divided into two parts: Part Ⅰ-“ The important problems of conducting fluid dynamics experiments with soap film tunnels ” and Part Ⅱ“ The development of Digital Partical Image Velocimetry ” . The main goal for the first part of the thesis is to investigate two key problems of conducting fluid dynamics experiments with soap film tunnels. These two problems are: (1) How important is the air friction to the soap film flow? (2) What does the interference pattern in the soap film represent? The first problem was answered by two sets of experiments conducted in a horizontal soap film tunnel. The tunnel was placed in a vacuum chamber. The first set of experiments is to observe the shedding frequencies of flows over a circular cylinder, via a laser Doppler anemometer. The second set of experiments is to measure the drag coefficients experienced by a normal flat plate, via a laser Doppler anemometer and the momentum defect method. Both set of experiments were conducted with and without vacuum. The objective is to find the influence of different ambient pressure (air friction) on the soap film flow. The vacuum chamber for the horizontal soap film tunnel has been established. The second subject was to interpret the physical meaning of those color fringes with a theoretical investigation and numerical simulation. It was showed that they resembled streamlines of 2-D flows in steadily flowing soap films. Photographs of flow over a circular cylinder and step were compared with theoretical investigation and numerical simulation. Good agreement is found. The physical meaning of those color fringes is streamlines in steady flow. The main goal for the second part of the thesis is to develop the software of Digital Partical Image Velocimetry. With tests of the numerical simulation and the benchmark test flow, the software of Digital Partical Image Velocimetry yields good results.

Keywords : Soap Film Tunnel ; Two- Dimensional Flow ; Circular Cylinder ; Wake ; Interference Pattern ; Digital Partical Image Velocimetry

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