

肥皂膜水洞之研製暨其應用於二維正交平板流之研究

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摘要

A new experimental approach to study two-dimensional flow phenomena is introduced which uses a novel device capable of producing purely two-dimensional flows. In this technique, a suspended soap film is set in motion in a long frame using a planar water jet as a pulling mechanism. This device can generate a variety of two-dimensional flows for quantitative studies via laser Doppler velocimetry (LDV). The experiment which is conducted in this soap film tunnel is to investigate two-dimensional flow about a normal flat plate. It is aimed to understand the difference of time-averaged drag coefficients between previous experimental studies ($C_d=2.0$) and computational results ($C_d=3.2$). This inconsistency has been discussed for years and there is still no definite conclusion. Momentum defect method is used to obtain the drag coefficient, in which the wake velocity profiles are depicted by LDV. Flow visualization is also emphasized to help understand the unsteady nature embedded in this type of flows. The small thickness variation of the soap film results in interference patterns, thus providing an excellent means for flow visualization. The drag coefficient of a normal flat plate we obtain ($C_d=2.0$) is the same as the mean value of the previous experimental results. This thesis is divided into two parts. In Part I, the development of the continuous soap film tunnel is discussed in details and the experimental results of the two-dimensional flow about a normal flat plate are presented in Part II.

關鍵詞：肥皂膜水洞；二維流；平板；機械工程；工程

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