ON THE INITIAL TRANSITION OF FLOW OVER A CIRCULAR CYLINDER FROM SUB-CRITICAL TO CRITICAL REGIMES

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This paper reports on an experimental finding concerning two states bi-stably existed at a fixed speed of flow over a circular cylinder in the pre-critical regime. The characteristics of the two states, named States A and B, respectively, were studied with pressure measurements and thermal tuft sensors on the circular cylinder, and hot-wire velocity measurements in the near wake region. While State B is identified as the sub-critical state, State A indicates the initial transition towards the critical regime. Using the present data analysis techniques, the flow characteristics of the two states can be clearly differentiated, in terms of their Strouhal numbers, steadiness of the vortex shedding frequency and base pressure coefficients. Physically, State A corresponds to two separation bubbles situated symmetrically on the two sides of the circular cylinder. Comparing the results obtained at two Reynolds numbers of State A, which are differed by 6% only, shows that the separation bubbles were situated at different locations. This indicates that the flow phenomenon is very sensitive to Reynolds number.

Key words: pre-critical regime, circular cylinder, Wavelet transformation, Hilbert-Huang transformation, thermal tuft sensor.