Analysis and Control of Turbulent Flow Phenomena

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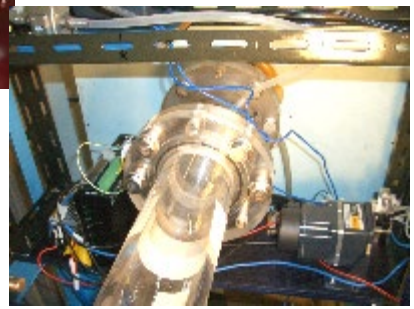
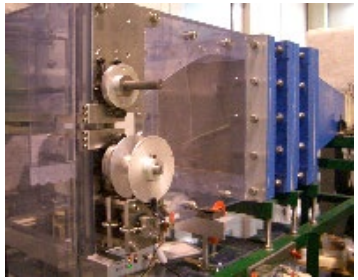
(a) A line of roughness elements



(b)Jet injection section in pipe



(c) Mixing layer exit oscillation plates

Fig. 1 Apparatuses in present investigation

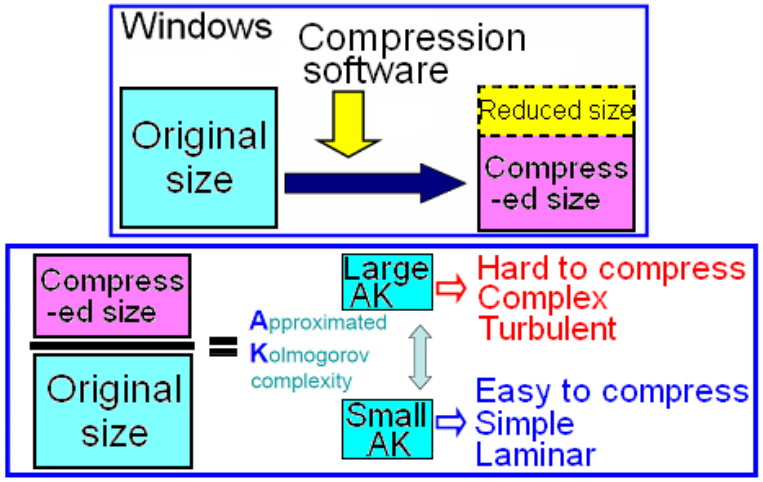


Fig. 2 Schematic diagram of K-complexity analysis

Content:

In fluid flows, although a turbulent flow and laminar-turbulent transition are often seen in a nature or industrial apparatus, it is hard to say that the details have been clear. Therefore, in our research, especially the laminar-turbulent transition is observed. In the laminar flow, forced transition is generated and the mechanism of transition progress is investigated experimentally.

Main experimental apparatuses are shown in Fig. 1. In (a), from a line of three-dimensional roughness elements in a flat-plate laminar boundary layer a wedge-shaped turbulent region is formed downstream from each roughness elements. In (b), an intermittent jet is periodically ejected in a circular pipe radially, then an isolated turbulent patch is generated within a laminar boundary layer and moves downstream. In (c), oscillating plates at the exit of a rectangular nozzle promote the transition of a mixing layer between the jet and surrounding quiescent air.

Moreover, the new measure which shows the transition process quantitatively is developed based on the Kolmogorov complexity and Shannon entropy analysis. Figure 2 shows the schematic diagram of the Kolmogorov complexity analysis.

Keywords : turbulent flow,
laminar-turbulent transition,
boundary layer, complexity analysis

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