Dynamic pressure measurement on the rotating blade suction surface of an axial compressor

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In order to measure the static pressures distributions and inherent unsteady pressure fluctuations on the rotating blade suction surface of a single-stage axial compressor, five Kulite high response miniature pressure transducers were directly mounted in the rotating blade along a streamline at 50% span. These transducers had been static calibrated precisely. During experiment, the data acquisition system was fixed and rotated with the compressor axletree. The electrical wires of transducers were routed down along the blade surface and through the hub to connect with the data logger. Thus the data logger could directly sample and amplify the electrical signals of transducers, and transform them into digital data, then store to the memorizer while the rotor was working. After the compressor stopped, the digital data stored in the memorizer was transferred to computer through a USB data line. This means ensured the data reliability.

The blade surface static pressure distributions of experimental data were compared with the CFD numerically simulated results under 1500r/min and 2000r/min. At the same total pressure rise condition, experimental results gave a little lower values comparing to the simulations as shown in Fig.1. But overall, the trends of experimental pressure distribution were accordant with the simulations, and the experimental static pressure results were credible and approximated to the real value. Although there were no any disturb sources, because of the viscous fluid inherent characteristics, the warp of inlet fairing and the vibration of compressor, the pressure signals of the rotor blade surface were unsteady, and the unsteady pressure fluctuations could be measured successfully. As shown in Fig.2, the pressure fluctuations were periodical obviously, and the periods were almost the same with the time of compressor revolving one circle. The dominant frequency was the fundamental frequencies of the rotor revolving and its hormonics. The pressure fluctuations on blade suction surface gradually increased from inlet to outlet. But owing to the boundary layers near the blade trailing edge region, the fluctuations declined. The altitudes of unsteady pressure were also relative to rotating speed. As the rotating speed down from 2000r/min to 1000r/min, the altitudes of pressure fluctuations were weakened from about 300Pa to 85Pa.

![Fig.1 The blade surface pressure under 1500r/min](image1)

![Fig.2 The time-domain waves and frequency spectral curves of B under 1500r/min](image2)