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Flow control of a centrifugal fan in a commercial air conditioner¹

JYU KIM, KYEONGTAE BANG, HAECHEON CHOI, Seoul National University, EUNG RYEOL SEO, YONGHUN KANG, Samsung Electronics — Air-conditioning fans require a low noise level to provide user comfort and quietness. The aerodynamic noise sources are generated by highly unsteady, turbulent structures near the fan blade. In this study, we investigate the flow characteristics of a centrifugal fan in an air-conditioner indoor unit and suggest control ideas to develop a low noise fan. The experiment is conducted at the operation condition where the Reynolds number is 163000 based on the blade tip velocity and chord length. Intermittent separation occurs at the blade leading edge and thus flow significantly fluctuates there, whereas vortex shedding occurs at the blade trailing edge. Furthermore, the discharge flow observed in the axial plane near the shroud shows low-frequency intermittent behaviors, resulting in high Reynolds stresses. To control these flow structures, we modify the shapes of the blade leading edge and shroud of the centrifugal fan and obtain noise reduction. The flow characteristics of the base and modified fans will be discussed.

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