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An Efficient Computational Approach for Aerodynamical Sound Predictions

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Abstract

This work will mention about an aerodynamical sound prediction technique based on the computational fluid dynamics. The source of aerodynamical sound is flow field itself, so dynamics of sound wave is coupling with flow dynamics. Therefore, sound waves and flow fields should be analyzed simultaneously by the accurate unsteady computations to solve sound power distribution. That approach for aerodynamical sound evaluation is called as the ‘direct computation’. However, such direct computations by the CFD (computational fluid dynamics) approach often requires huge computation costs caused by difference of characteristic speed between sound wave motion and variations of flow fields, and its unsteady computational approach.

On the other hand, more small cost ways could be considered. These were based on the numerical modeling of direct relationships between sound energy and flow properties. In these approaches, the flow field can be separated from sound wave dynamics, and computation cost will be remarkable reduced compare with direct computation. Such small cost sound prediction technique will be strongly contributed to more efficient computer aided design of low noise aerodynamical turbo machines.

Present work proposes a small cost, efficient approach to predict aerodynamical sounds. A new numerical model for evaluation of sound power distribution use with the turbulence energy and the vorticity distributions which can be computed by only steady state CFD computations. And the proposed model is applied to noise level prediction of cooling fans. The variation of noise level of ten different types of fan blade shape, are predicted and compared with experimental observations. Present model can provide more accurate results compare with existing similar previous model.

Keywords*:* Computational Fluid Dynamics, Aerodynamical Sound, Flow Noise, Low Noise Design