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Numerical Analysis of the Acoustic Field of Tip-Clearance Flow S.M. ALAVI MOGHADAM, Research Scientist, M. MEINKE TEAM[1], W. SCHRÖDER TEAM[2] — Numerical simulations of the acoustic field generated by a shrouded axial fan are studied by a hybrid fluid-dynamics-acoustics method. In a first step, large-eddy simulations are performed to investigate the dynamics of tip clearance flow for various tip gap sizes and to determine the acoustic sources. The simulations are performed for a single blade out of five blades with periodic boundary conditions in the circumferential direction on a multi-block structured mesh with 1.4×10^8 grid points. The turbulent flow is simulated at a Reynolds number of 9.36×10^5 at undisturbed inflow condition and the results are compared with experimental data. The diameter and strength of the tip vortex increase with the tip gap size, while simultaneously the efficiency of the fan decreases. In a second step, the acoustic field on the near field is determined by solving the acoustic perturbation equations (APE) on a mesh for a single blade consisting of approx. 9.8×10^8 grid points. The overall agreement of the pressure spectrum and its directivity with measurements confirm the correct identification of the sound sources and accurate prediction of the acoustic duct propagation. The results show that the longer the tip gap size the higher the broadband noise level.

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