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The noise of radial fans with Forward-Curved (FC) blades, which are used in the automotive industry as well as HVAC applications, is associated with a dominant tonal noise that stems from the interaction between the unsteady flow leaving the impeller passages and the volute tongue (cut-off). Reducing the tonal noise in FC fans is a challenging task, considering the fact that the optimum operation of this type of fan is completely dependent on employing a properly designed scroll-housing.

Performing CFD simulations not only helps us to understand the flow characteristics of this type of fan, but also gives us real insight into the contribution of different parts in the noise radiated from the fan and therefore provides a good basis for modifying the design of the fan.

In this study, Computational Fluid Dynamics and Aeroacoustics simulations are performed to investigate different design modifications that can be made on the impeller as well as the volute geometries to reduce the tonal noise of the fan. Detached Eddy Simulation (DES) and unstructured polyhedral mesh are employed to predict and verify the noise reduction potency of different modifications. Several impeller designs are numerically tested in this study; it is noted that changing the number and the outlet angle of the blades affects the performance and the noise characteristics of the fan. Furthermore, CFD simulations are performed to examine several volute cut-off configurations to reduce the tonal noise of the fan. It is shown that it is possible to effectively reduce the tonal noise by splitting the volute tongue into different portions. Due to the counter effects (phase-shift) generated between different portions of the stepped tongue, the tonal noise is effectively reduced at the expense of approximately 1% performance reduction.

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