SOUND SOURCES IN A LOW SPEED DUCTED ROTOR

By

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Abstract:

The objective of this research was to improve the understanding of the sound source mechanisms in a low speed ducted fan through experimental and analytical efforts. To this end, a new experimental model with carefully controlled boundary conditions was developed. A new method for quantifying the net acoustic transfer function between the rotor and an observer was found. This transfer function caused by the duct can significantly affect the spectral character of the radiated sound. Quantifying this function enables the study of the rotor sound source, without need of other methods for considering duct effects. A new formulation for predicting the noise generated by a ducted rotor interacting with a casing boundary layer has been developed. The method accounts for the streamwise-elongated turbulent structures that have been recently observed in flat-plate boundary layers. An approximation for the duct boundary layer two-point correlation function allows the net sound source to be estimated. Finally, the self-noise generated by a ducted rotor was studied. The flow rate through the rotor was varied independently from the rotor rotation rate in order change the mean lift on the blades. Measurements of the flow field around the rotor were found to provide insight to the mechanisms of sound that depend on mean loading conditions.

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