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Noise Source Analysis for Simulated Turbulent Jets

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ABSTRACT

Large Eddy Simulation (LES) is an efficient computational approach to study turbulent flows and has seen increasing application to the study of jet noise. The main challenge of LES has been the realistic simulation of experiments at reasonable cost. Recent LES studies have been realistic enough to gain important insight into jet noise from the large amount of data generated. This study attempts to characterize the sources of noise from a turbulent jet via analysis of the LES results. Three different analysis tools are implemented. The first two are comparable to analyses used on experimental data: two-point cross-correlations between far-field pressure signals, and correlations of near-field density fluctuations with far-field pressure. The third analyzes a 2-D plane of flow field data over time and masks selected frequency components to highlight which flow features correspond to certain frequency ranges. Noise produced by the simulated jet shows similar directional behavior as has been found in experiments. Sound waves are shown to be more coherent at low angles to the downstream jet axis and more random at high angles. Separating the pressure fluctuations by frequency masking shows how noise at different frequencies corresponds to near-field flow structures and possibly shed light on the sources of noise. All three analyses support a model that posits two jet noise sources that behave in distinct ways.

KEYWORDS

Large Eddy Simulation, Jet Noise, Turbulent Jets, Computational Aeroacoustics

REFERENCES

Tam, C. K. (1995). Supersonic jet noise. Annual Review of Fluid Mechanics, 27(1), 17-43.

Tam, C. K., Viswanathan, K., Ahuja, K. K., & Panda, J. (2008). The sources of jet noise: experimental evidence. Journal of Fluid Mechanics, 615, 253-292.