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Validation of Thickness and Loading Noise Codes by Isom's Formula Applied to Subsonic Axial and Centrifugal Fans

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The thickness noise predicted by the Ffowcs Williams and Hawkings (FW&H) equation depends on the normal velocity v_n which is very sensitive to the meshing size. Isom showed that in far field a monopolar source is equivalent to a dipolar source induced by a uniform distribution of the load on the entire moving surface. Consequently, the calculation of the thickness noise becomes completely independent of the normal velocity v_n . Its expression, as suggested by Farassat, is for any moving surfaces. The main objective of this paper is to determine a specific expression of Isom's thickness noise in time and frequency domains for axial and centrifugal subsonic fans. The scope of the proposed expression of Isom's thickness noise is threefold: (1) highlight the effect of each geometrical parameter of the fan on the overall thickness noise, (2) a fast computational mean and low memory storage capability since the acoustic pressure in frequency domain is calculated for only one blade, and (3) a benchmark test of consistency for thickness and loading noise codes in both time and frequency domains when using the free field solution of FW&H's equation.