Development of Full Scale Truncated Wind Tunnel Slat Model for Aeroacoustic Testing

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To reduce aviation noise, the International Civil Aviation Organization has imposed standards to limit aircraft noise emissions since 1977. Historically, these requirements were addressed through engine redesigns, as engines were formerly the dominant source of aviation noise. Following the development of quieter propulsion technologies, the airframe has become a significant noise source during approach and takeoff. Among the various components of the airframe, the slat stands out as a major contributor to airframe noise.

Hybrid wind tunnels with acoustically permeable walls have become increasingly popular for testing lifting models. They avoid the detrimental flow distortion effects of open-section wind tunnels while enabling noise measurements in the surrounding anechoic chamber. However, the Kevlar-walled test sections of these hybrid wind tunnels are typically small, further reducing the size of the already smaller-scale wing-body test models.

In the present study, a novel truncated slat model (see Figure 1) was designed to achieve full-scale slat cove flow without the need for a large wind tunnel. This model was tested in the hybrid anechoic wind tunnel of the University of Toronto Institute for Aerospace Studies. A detailed description of this facility is provided by Okoronkwo et al. [1]. The model was tested for its aerodynamic similarity to the full-scale, 3-element high lift profile used in the LEISA2 campaign by Manoha and Pott-Pollenske [2], demonstrating its similarity.

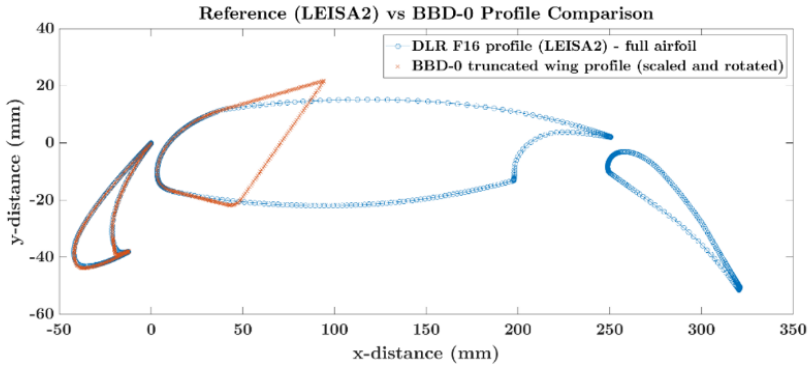

Figure 1: Conventional profile (blue) and truncated profile (orange)

References

[1] Okoronkwo, M.K., Alsaif, R., Haklander, R., Baba, S., Eburn, J.M., Lu, Z., Arafa, N., Stalnov, O., Ekmekci, A., Lavoie, P. 2025. Design and characterization of the University of Toronto hybrid anechoic wind tunnel. Applied Acoustics. Volume 228. 2025, 110294

[2] Manoha, E., Pott-Pollenske, M., 2015. LEISA2: an experimental database for the validation of numerical predictions of slat unsteady flow and noise. AIAA/CEAS Paper No. 2015-3137. Dallas, Texas, 2015.

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