The Application of Hybrid Prediction Models in Investigating Sources of Railway Interior Noise and Achieving Noise Reduction

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Noise and vibration control has been an increasingly valued concern within railway transportation mainly due to its negative health impacts. Sources of noise and vibration within operating railways include wheel-rail noise, engine noise, traction noise, gearbox noise, and aeroacoustics. For high-speed railways, aeroacoustic noise dominates other structure-borne sounds. This research presents a study that applies the active control strategy in reducing aeroacoustic noise. A combination of computational fluid dynamics (CFD) and Ffowcs Williams and Hawkings (FW-H) equation is used for predicting the far-field acoustic propagations in a two-dimensional computational. It has been found from the simulation results that the surface static pressure coefficient distributions are in good agreement with the experiments and the predicted lift coefficients are close to the measurements calculated from steady RANS. The mean vertical velocity of unsteady flow is in accordance with the measurement results, while some difference exists for the mean stream-wise velocity. Moreover, it is observed that the two-dimensional approach can only predict discrete values of sound pressure level (SPL) associated with the fundamental frequency (Strouhal number) and its harmonics. Cancellation results demonstrate the cancellation capability of the proposed ANC system for the far-field aeroacoustics and reflect that within a reasonable physical distance range, the cancellation performance is better when the detector is placed closer to the secondary than the primary source. This conclusion is the main innovative contribution to this thesis, and it provides useful instructions for future practical experiments. However, detailed physical distance values must be dependent on individual cases.

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