

EFFECTS OF SLAT PARAMETERS ON NOISE CHARACTERISTICS OF AN AIRFOIL

WANG Hongjian¹, and LUO Wang² YANG Zhichun³

¹ Northwestern Polytechnical University, Xi'an 710072, China, wanghj@nwpu.edu.cn

² Northwestern Polytechnical University, Xi'an 710072, China, luowangstar@qq.com

³ Northwestern Polytechnical University, Xi'an 710072, China, yangzc@nwpu.edu.cn

Key Words: *Slat, Structure Parameter, Flow Features, LES, Flow-induced Noise.*

Slat noise is largely dependent on its structure parameters such as geometric and morphing parameters. The investigation of the effects of these two types of parameters on the characteristics of flow field around an airfoil with slat and the induced noise can be an effective way to study and suppress the slat noise radiations. Three-element airfoil model 30P30N is employed to establish the model of investigation for analyzing the flow field and noise features.

Based on RANS and LES methods, steady and unsteady flow field characteristics of the airfoil are studied for typical geometric (overlap, gap and rotation angle) and reshaped profiles (morphed trailing edge of slat seals the gap). The corresponding distribution of pressure and turbulent kinetic energy are obtained. FW-H acoustic analogy formulation is employed to solve the far-field noise radiation of the slat. The effects of various slat structure parameters on the far-field sound pressure level and its directivity characteristics are investigated. Finally, based upon the obtained characteristics of flow field and slat noise radiations, the interaction between slat noise suppression and corresponding lift change are analyzed and discussed. The results show that the variation of geometric and morphing parameters can effectively change the flow field mode around the slat and the airfoil. Choosing proper slat parameters, the far-field noise radiation can be reduced with little penalty for the lift performance of airfoil.

The current study demonstrates that it is a promising method for slat noise attenuation, through slat structure parameter adjustments and controls, which include slat setting and adaptive morphing parameter controls. These controls are dynamic and adaptive, which can be adjusted to different flight conditions. It can significantly weaken or even eliminate some of the slat noise sources while keeping the high aerodynamic performance of slat which is very important for normal functions of civil aircraft wings.

REFERENCES

- [1] Pagani C C, Souza D S, Medeiros M A F. Experimental investigation on the effect of slat geometrical configurations on aerodynamic noise[J]. *Journal of Sound & Vibration*, 2017, 394: 256-279.
- [2] Herr, M., et al., Large-Scale Studies on Slat Noise Reduction, in Proceedings for the 21st AIAA/CEAS Aeroacoustics Conference. 2015, AIAA 2015-3140: 22-26 June, Dallas, TX
- [3] Murayama M, Nakakita K, Yamamoto K, Ura H, Ito Y, Choudhari M. Experimental study of slat noise from 30P30N three-element high-lift airfoil in JAXA hard-wall low-speed wind tunnel. AIAA paper, 2014-2080; 2014