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Effect of Geometry Parameters on Low-speed Cavity Flow by Wind Tunnel Experiment

Guangjun Yang[a,*], Jing Sun[b], Yong Liang[b,c], Yingchun Chen[d]

[a]*National Key Laboratory of Science and Technology on UAV, Xi'an 710065, China*
[b]*School of Aeronautics, Northwestern Polytechnical University, Xi'an 710072, China*
[c]*China Aerodynamics Research and Development Center, Mianyang 622700, China*
[d]*Commercial Aircraft Corporation of China Ltd, Shanghai 200232, China*

Abstract

In this paper, experiment platform for cavity flow is built in low-turbulence wind tunnel. based on the measurement of wall static pressure and sound pressure with microphones, the basic flow oscillation characteristics of different type cavity in low speed are studied. The effect of geometry parameters of length to depth ratio and width to depth ratio on cavity flow pattern and noise characteristics is obtained. The results show that in the incompressible flow state, the basic flow pattern of cavities is not affected by flow velocity; length-to-depth ratio of 1 to 12 covers the flow pattern from open to close, and with the length-to-depth ratio increase, the cavity radiation SPL increases; with aspect ratio increase, the sound pressure energy of cavity also increase.

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Keywords: cavity; length to depth ratio; width to depth ratio; shear layer; sound pressure

* Yang Guangjun. Tel.: +86-029-8845-1160
E-mail address: yanggj_1031@nwpu.edu.cn
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1. Introduction

Cavity flow is a problem often encountered in practical engineering, and is currently a hot aerodynamics research field internationally. there are a variety of complex unsteady cavity flow such as aircraft landing gear, weapons bay, car sunroof and so on. When the flow passes over the cavity, flow oscillation will be produced and radiate noise. The research of cavity flow typically involving complex flow-sound-vortex interference, unsteady character and shear layer instability problems, which has great research significance.

For the study of cavity flow, since the 1950s, more tests have been carried out, and since the 1980s, numerical simulation was widely used in cavity flow study on mechanism and flow control design. Certain Studies [1-8] showed that the geometric parameters such as the length to depth ratio L/D, the aspect ratio W/D, flow parameters such as Mach number affect the cavity flow pattern and the acoustic characteristics.

In this paper, experiment platform for cavity flow studies was built in low-turbulence wind tunnel, with the use of wall pressure sensors and microphones, the effects cavity geometry on low-speed cavity flow oscillation characteristics were studied experimentally and provide reference for cavity noise suppression research.

2. Experimental Method

2.1. Experimental Model

The Cavity model is structured by wood and the model blockage in wind tunnel is about 8%.

The maximum depth of the cavity 116mm, maximum length 700mm, and the maximum width 120mm.. Figure 1 shows the parameter definition of cavity geometry. The contact surface of cavity with wind tunnel is filled with soft foam padding to avoid local airflow crossing up and down and reduce the effects of wind tunnel vibration on the flow structure of cavity.

Length to depth ratio and width to depth ratio of Cavity vary by adding blocks in cavity or adjusting the cavity depth while the maximum width of the cavity remains unchanged. The effect of geometry changes on the aeroacoustic characteristics of cavity flow were discussed, and specified programs are shown in Table 1.

Table 1. Experimental program

L/D	W/D	Fixed parameter
1	1	
2	1	D=116mm
4	1	
6	1	
8	1.4	D=700mm
10	1.7	
12	2.1	
4	2	D=58mm
2	2	