Introduction

The noise produced by a propeller has been of considerable importance to warship designers and military strategists for many years. In recent years this subject has been of more importance for merchant shipping and is likely to maintain increased importance in the future with the consideration of its influence to marine. In the absence of upstream disturbances, a rotating propeller also radiates broadband noise.

Objects

This paper aims to analyze the broadband noise from a propeller working in uniform flow. Propeller and hydrofoil-bound cartesian coordinate system are shown in Fig. 1.

Methods

In this paper a prediction method of marine propeller broadband noise is developed based on Amiet’s model. Using strip theory the propeller blade separate into several strip of width centered at a radius ri. The blade section can be expressed in the hydrofoil-bound Cartesian coordinate system. The hydrofoils noise spectrum are predicted using Large Eddy Simulation (LES) methods and Fowcs Williams-Hawkings (FW-H) equations.

In the calculations, three-dimensional model of hydrofoil and unstructured grid are adopt to simulated the flow field by LES method, and calculated time step is $1 \times 10^{-3}$s. Fig. 2 gived out the vortex flow shedding from trailing edge of propeller blade section simulated by LES method.

Results and Discussion

The results of blade section surface fluctuation pressure spectrum are compared by LES method and the empirical model. Fig. 3 shows the comparison reslut of surface fluctuation pressure spectrum by LES method and the empirical model.

The sound pressure spectra results of each blade sections are presented in Fig. 4. The results show that the maximal sound pressure spectra of blade sections is located at about 0.8R.

The noise of model propeller was test in the Cavitation tunnel of CSSRC. The distance between the hydrophone and the propeller model is 0.62m. The sound pressure spectrum from 0.8 kHz to 40 kHz was measured in the test.

The compared results between the computed and measured sound pressure spectra are shown in Fig. 6. The comparison result shows good agreement both in the frequency spectrum characteristics and sound pressure spectra.

Conclusions

In this paper a prediction method of marine propeller broadband noise is developed based on Amiet’s model. The strip theory is used, and the airfoil noise spectrum is predicted using LES methods and FW-H equations. Using the noise numerical prediction method, the broadband noise from a propeller working in uniform flow is calculated numerically. Comparison between calculations and model experiments shows good agreement both in the frequency spectrum characteristics and sound pressure spectra. The prediction result is about 1.4dB lower than experimental in total sound pressure level.