Hydrodynamic Effects of Waves on a Floating Kuroshio Turbine

Forng-Chen Chiu[*1], Jun-Yen Shieh[#2], Yu-Sheng Peng[#3]

[*1]*Department of Engineering Science and Ocean Engineering, National Taiwan University*
No.1, Sec.4, Roosevelt Road, Taipei 106, Taiwan

[1]fcchiu@ntu.edu.tw

[2] r04525008@ntu.edu.tw

[3] r05525080@ntu.edu.tw

I. Keywords

Ocean current, Floating Kuroshio Turbine, wave, wave exciting forces, CFD

II. Abstract

Waves are inevitable environmental factor to all marine structures. In the present study, we are going to study wave exciting forces and moment acting on a Floating Kuroshio Turbine (FKT) when long waves propagate over it. FKT will have corresponding motion responses due to the wave exciting forces and momen. In general, FKT may have to face the challenge when weather is severe. Long waves may make FKT do some significant movements, and these movements will affect its performance and the tension force of mooring line. Therefore, for the development of FKT the wave exciting forces and moment acting on FKT need to be investigated and its motions due to these forces and moment need to be evaluated in advance.

In the present study, the CFD software ANSYS FLUENT is applied for dealing with the hydrodynamic problems. To simulate the situation that FKT operating under waves, we add different wavelength and wave height keeping wave slope constant at the inlet, and then calculate the wave exciting forces in both x and y direction as well as moment in z direction for a 20kW rated FKT operating at the depth of 25 meters. In addition, Fast Fourier Transformation was applied to investigated the frequency components of these wave exciting forces and moment. Then a simulation tool OrcaFlex was used to simulate the motions of FKT operating in current with applying of these wave exciting forces and moment on it. After that, we changed the depth of FKT, make it to the depth of 10 and 40 meters respectively and compare their results to clarify the variation depending on depth.

The results show that the longer the wavelength or the higher the wave height will make the wave exciting forces and moment larger, and it is obvious that when FKT goes down deeper, the wave exciting forces and moment reduced significantly, motions and tension force of mooring line as well. The validity of the present approach of combining application of CFD tool and simulation tool to evaluate the hydrodynamic effects of waves on FKT operating in current was confirmed.

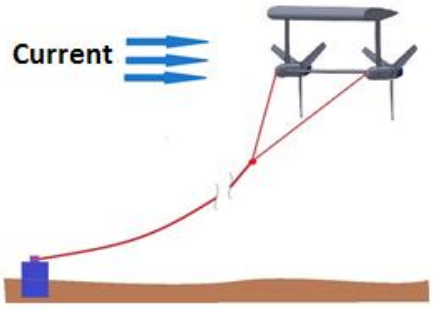

Fig.1 Sketch of FKT system

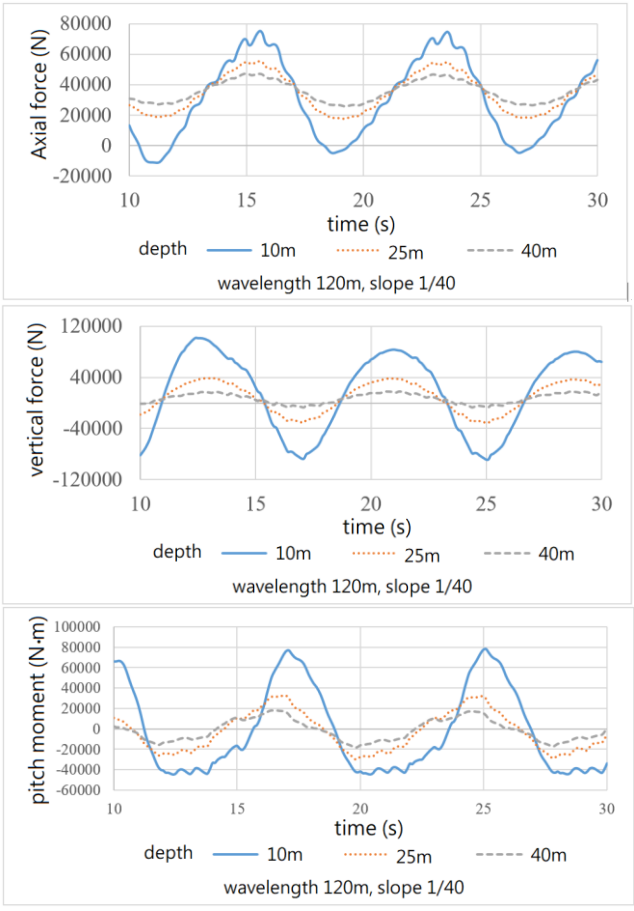

Fig 2 wave exciting forces and moment acting on 20kW FKT