RESEARCH ARTICLE OPEN ACCESS

Research on Motion Response of The Fishing Boat In Different Heading of Waves

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ABSTRACT
In order to reduce the surging acceleration of ocean fishing boats and improve the comfort of crews, based on the theory of regular wave and irregular wave potential flow, the six- Degree-of-Freedom (6DOF) motion performance, an ocean fishing boats were predicted and analyzed by panel method. The forecasting results show that the motion range of the modified fishing boats is obviously reduced and the seasickness incidence has been significantly improved.
Keywords: *Motion response, Heave, Roll, Heading.*

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I. INTRODUCTION

Fishing vessel motions, when the vessel is in a head-on or following seas are very critical. Roll, Pitch, and Heave are critical motions besides they are likely to be weathering. The incoming waves sometimes will be in resonance with the pitch and in the worst-case heave, motion frequency matches the pitch motion and wave frequency. In one roll period the vessel undergoes two-pitch motions and the righting arm of the vessel will be high or low compared to still water condition [1]. The vessel will be subjected to further roll motion. The likely condition of the parametric roll will be very dangerous. Such condition, if any, is to be investigated through experiments too.

The position of the vertical center of gravity of the vessel influences the angular motions of the fishing vessel and causes complicated coupling. Attention paid to vessel motion [2] in random sea conditions. The vessel may be either in moored or in dynamically positioned conditions. The various aspects of vessel maneuvering at motion discussed and evaluated numerically [3]. The various aspects of vessel motion in the presence of environmental loads [4] evaluated. The effect of ocean waves,[5] when it encountering the vessel were evaluated through mathematical relations.

A numerical code [6] has generated to find the behavior of the vessel when it is encountered by a head wave during forward motion. The vessel response [7] for the encountered wave measured with different heading angles. The impact of wave/wind [8] on the vessel response, forces, maneuverability were evaluated using URANS techniques. Numerical analysis [9] conducted to evaluate the vessel responses against the encountered wave and the coupled motions. From the result, the vessel shear force and bending moment were derived. The interaction between the wave and the large cylinder and the response [10] to the incident wave were evaluated through experiments. A numerical study conducted with a fishing vessel and all the 6 degrees of motion response were evaluated. For this evaluation a fishing vessel is considered for this study and the dimensions of the vessel are as follows and the profile view of the boat is given in Fig. 1.

Length overall	: 23.5m
Breadth	: 7m
Depth	: 3.95 m
Draft	: 1.88 m

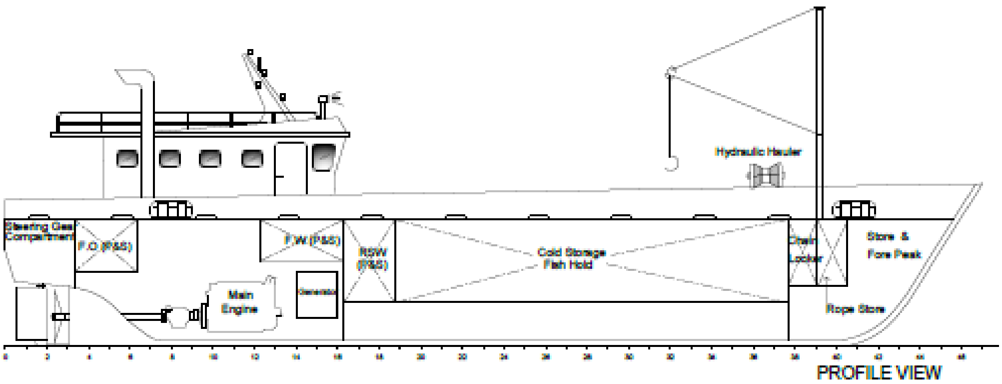

Fig. 1. Profile view of a fishing boat

II. NUMERICAL STUDY

A. Modeling of fishing vessel Geometry using Maxsurf

The fishing vessel model used for the numerical analysis is modeled in Maxsurf software. This model is subjected to numerical analysis using MOSES software.

B. Governing equation

In general, the relationship between encountering frequency and the wave frequency is given by

$$\omega_e = \omega - \frac{\omega^2 U \cos \beta_s}{g} \quad (1)$$

Where ω_e is the encountering frequency, ω is the wave frequency, U is the ship speed, β_s is the relative heading angle and g is the acceleration due to gravity. In this case, ω_e is the same as ω as the value of U is 0.

The motion RAO can be combined with the sea elevation or sea slope spectrum to obtain the motion spectra [1] as discussed by Fossen.

$$S_{\varepsilon\varepsilon i}(\omega_e) = |H_i(\omega_e, X)|^2 S_{\zeta\zeta}(\omega_e) \text{ for i=1, 2 …6} \quad (2)$$

If the motions RAO of the rotational components are normalized by the wave slope, a similar expression holds for the wave slope spectrum

$$S_{\varepsilon\varepsilon i}(\omega_e) = |H_i(\omega_e, X)|^2 S'_{\zeta\zeta}(\omega_e) \text{ for i=4, 5, 6} \quad (3)$$

The results are plotted against the Response Amplitude Operator (RAO) and to the frequency.

C. Numerical Analysis

In this study, motion analysis is conducted using MOSES software. The numerical study is conducted in stationary mode and forward speed conditions for different heading angles. The selected heading angles are 180, 90 and 45-degree headings. The selected wave frequency for the study is 0.4 to 8 rad/sec.

III. RESULTS AND DISCUSSION

A. Fishing vessel response in stationary mode

The fishing vessel response in the different heading angle at stationary mode evaluated and are given in Fig.2-4. In head sea condition there is a number of peaks that are there around the frequency 2 rad/sec. The peak values of RAO of heave and pitch is important for the selection of location for mooring. The heave and pitch have more influence on the fishing vessel. In the case of beam sea condition, that means 90 degrees heading roll motion effect will be more in the smaller vessel as shown in Fig. 3. The similar effect also there in 45 degrees heading.

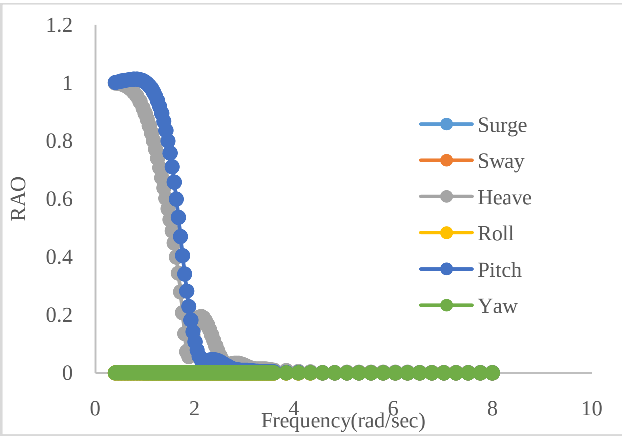

Fig. 2. RAO in stationary condition at 180 degree heading.

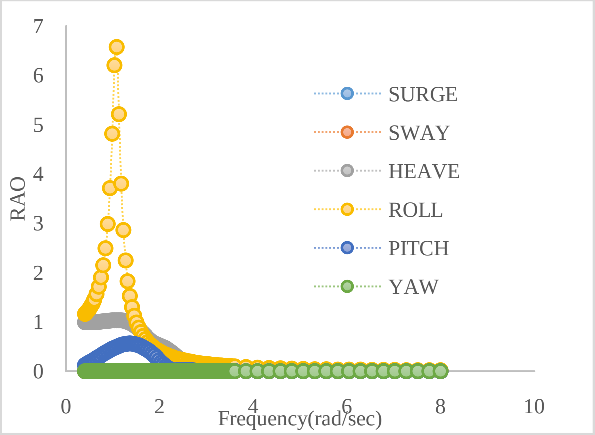

Fig. 3. RAO in stationary condition at 90 degree heading.

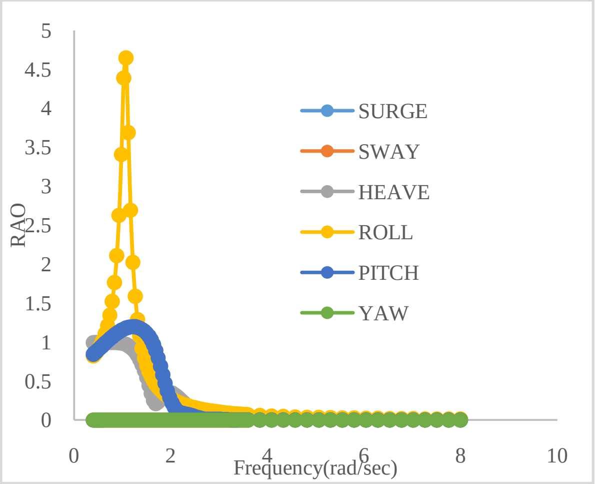

Fig. 4. RAO in stationary condition at 45-degree heading.

The heave RAO and the roll RAO of the fishing vessel at different heading angles at stationary mode is given in Fig. 5 and 6. In roll response of the vessel at 2 rad/sec have the maximum peaks due to the beam sea condition.

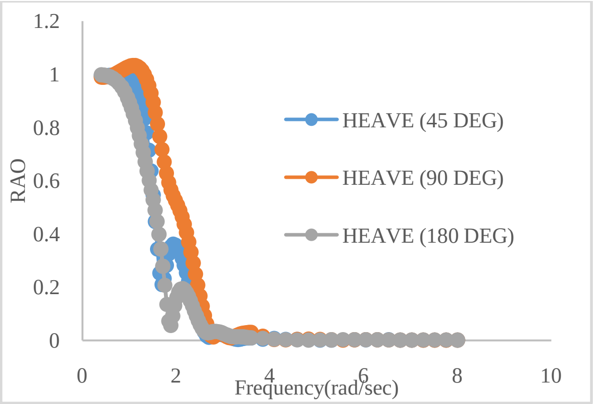

Fig. 5. Heave RAO in stationary condition at different heading.

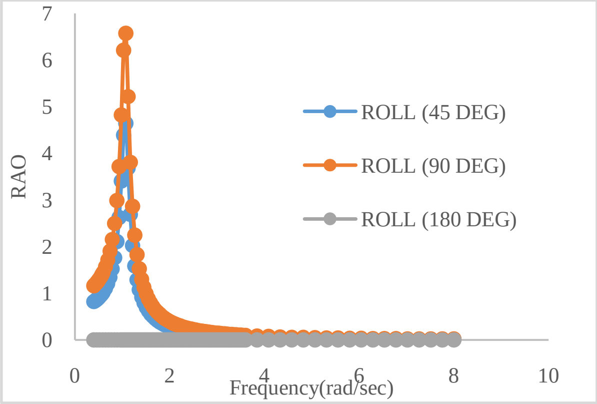

Fig. 6. Roll RAO in stationary condition at different heading.

B. Fishing vessel response in forward speed condition

The response of the vessel in forward speed condition at 180 degrees heading and 90-degree heading is given in Fig. 7 and 8 respectively. The selected speed for this analysis is 8 knots. In 90 degree heading the vessel subjected to maximum response around 1 rad/sec.

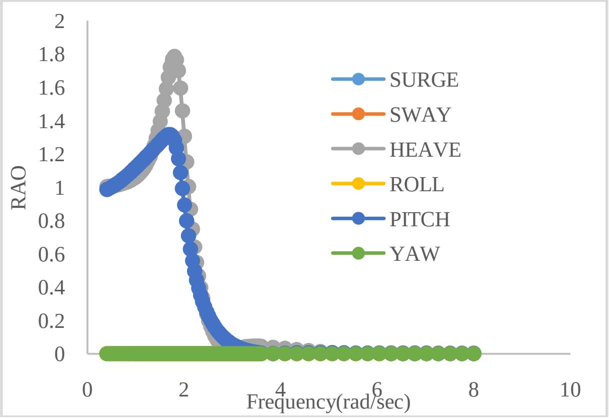

Fig. 7. Response of the vessel at 8 knots and 180-degree heading.

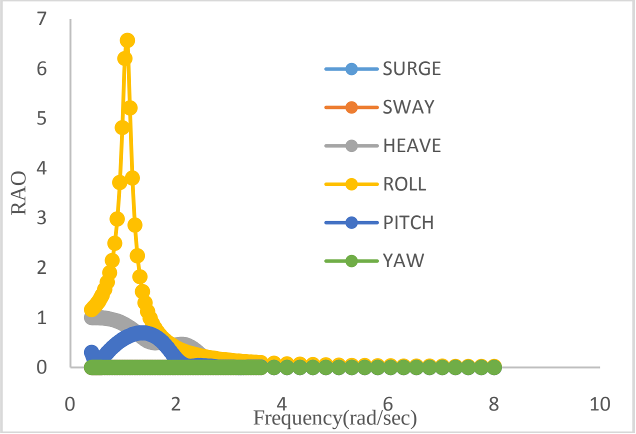

Fig. 8. Response of the vessel at 8 knots and 90-degree heading.

IV. CONCLUSION

In this study there is a fishing vessel is considered for motion analysis. The analysis conducted both for the stationary condition and the forward speed condition. The fishing vessel is smaller in size compared with the ship,it responds more for small-amplitude waves also. The roll motion effect will be more in smaller vessels. In beam sea condition the roll effect is much higher than compared with the other angle of heading.

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