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ANALYSIS STABILITY SYSTEM RUDDER ROLL OF SHIP CARGO A. PIONEER

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Abstract:-

Cargo Ship in dire needs good maneuverability while operating in the sea. Maneuverability is influenced by the ship's steering system which also affects the rolling stability of the ship. Rolling stability control plays an important role in the ship that can return the ship to its normal state in response to sea wave disruption, where Rudder roll is able to control the heading until the rolling motion is reduced. The disturbance used is a sea state 1 and sea state 7 in wave linear disturbances. The higher the level of interference, the longer the rolling stability reaches the steady state. The stability performance of rudder roll stabilization system has been in accordance with existing stability parameters. The maneuverability of the rudder roll stabilization system with 20^0 heading has an advanced distance of 275 meters in diameter.

Keywords: - *Cargo Ship, Rudder Roll Stability, Heading 20 degrees, Wave Disturbances*

1. INTRODUCTION

Cargo ship usually carry a large and excessive payload. This is often the cause of disturbance of stability and Maneuverability on the ship when operating first if affected by sea water wave disruption. When operating in the oceans, maneuverability of warships is affected by the ship's steering system. The steering or actuator system of warships consists of ballast and rudder systems. Ballast system serves to adjust the level of slope and draft ship. While rudder serves to control the heading Rolling stability is the ability of the system in responding to interference to attempt to return to normal. Overshoot or large amplitude of the rolling motion will cause material loss to the death of the crew. When the rudder is steered, the tilt level of the vessel remains within a certain range so that when the roll moves on the rudder. If the rudder movement can significantly influence the roll change according to the course deviation, the ship rolling amplitude movement may decrease and may reach the steady state state.

2. Method

Stages performed in data processing this research can be described in the following flowchart:

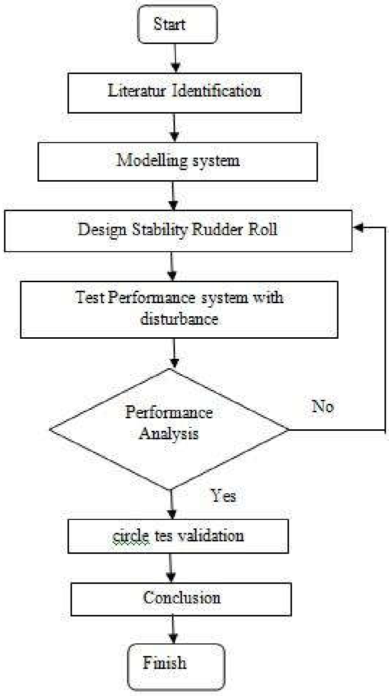


Figure 3. 1 Flowchart method

Literature study in the form of theoretical and geographical understanding of the shipping zones in free waters, including navigation, trajectory of shipping, the amount of external disturbance around the waters of the sea wave disruption. Modeling the dynamics of wave disruption is calculated based on the most extreme sea wave height data of 7 meters. Performance stability analysis of rudder rolling.

3. Cargo Ship Type A. Pioner

The hydrodynamic coefficient of physical specification owned by Cargo Ship A.Pioner namely:
Lenght (LOA) = 46.99 meter
Wide (B) = 5.3 meter
Deep (t) = 2.9 meter
Block coefficient (CB) = m / (LOA*B*T) = 2.52
Center of gravity (xG) = 1.74 meter *rho* = 1014 Kg/m^3

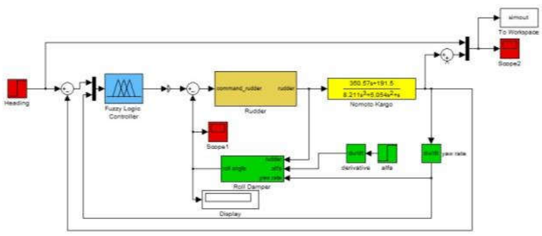


Figure 3.2 Close loop stability control system of A. pioneer cargo ships without disturbance

4. Result

Analyse of Simulation Stability with 20 degree heading with no disturbance, disturbance wave sea state 1 and 7 and turning circle validation.

Figure 4.1 shows the close loop system test response for the input heading 20^0 obtained maximum overshoot of 20.2^0, the rise time of 5 s, the settling time of 60 s, and the steady state error of 0.4. It shows that the rudder will turn 20.2^0 first before reaching the setpoint. Rudder is in a steady state with a 20^0 heading at a time of 60 seconds.

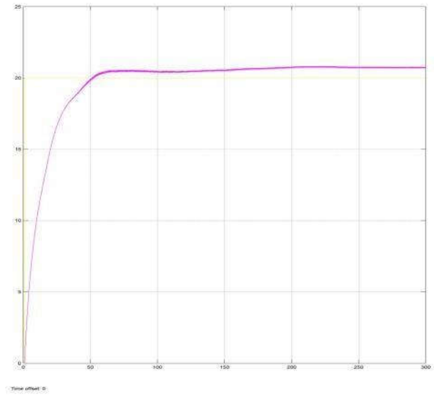


Figure 4.1 with no disturbance

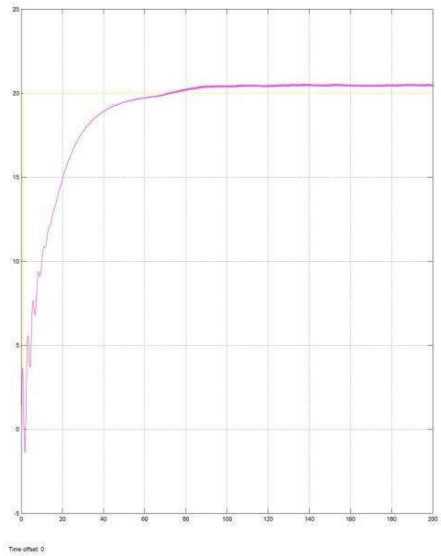


Figure 4.2 with disturbance wave sea state 1

Figure 4.2 shows the close loop system test response for the input heading 20^0 obtained maximum overshoot of 20.4^0, the increase of overshoot 7 times before reaching steady condition, the rise time of 3 s, the settling time of 70 s, and the steady state error of 0.4. It shows that the rudder will turn 20.4^0 first before reaching the setpoint. Rudder is in a steady state with a 20^0 heading at a time of 70 seconds. in Figure 4.3 shows the close loop system test response for the input heading 20^0 obtained maximum overshoot of 20.5^0, the increase of overshoot 9 times before reaching steady rise time of 7 s, settling time of 100 s, and steady state error of 0.5. This shows that the rudder will heading 20.5^0 first before reaching the setpoint. Rudder is in steady state with 20^0 heading at 100 seconds.

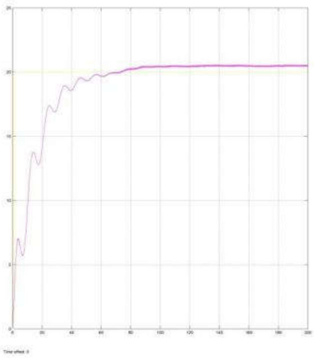
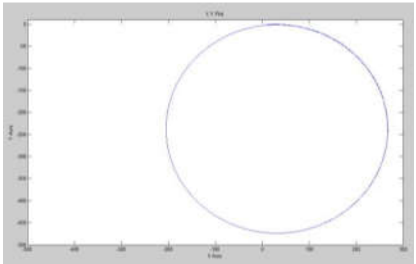


Figure 4.3 with disturbance wave sea state 7



Figurer 4.4 Circle Test ship stability

The higher the level of disturbance given, the greater the maximum overshoot generated. Maximum overshoot represents the first error which is the difference of setpoint and output of gyrocompas as transmitter. The addition of sea wave disruption also affects the time set. A higher the level of sea wave disruption, the longer it takes to reach the steady state. This is caused by marine wave interference that is used linearly and pushes the ship, resulting in rudder oscillation so that the longer it takes to reach steady state.

Based on the simulation results shown in Figure 4.4, the distance of the diameter of A.Pioner's cargo ships is 275 m. The circle movement starts from the coordinates (0,0) and the time required for a single round of 360^0 is 225 seconds.

5. Conclusion

After designing the stability of cargo ship type A. pioneer, it can be concluded as follows:

1. Based on the performance test of ship stability with heading of 20^0, with wave disturbance sea state 1 shows the presence of overshoot 7 times and settling time 70 s, whereas with wave disturbance sea state 1 produce overshoot 9 times and settling time 100 s. This shows that with the maximum disturbance of sea state 7 the performance of system stability that has been made is still stable with the maximum percentage of steady state error of 0.5.
2. The distance of diameter of A.Pioner's cargo ship is 275 m. The circle movement starts from the coordinates (0,0) and the time required for a single round of 360^0 is 225 seconds.

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