ISSN No:-2456-2165

Design Control System Stability Gas Tanker with Fuzzy Logic Control

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Abstract:- Tanker is a ship designed to transport oil or its derivative products. There are main types of tankers including oil tankers, chemical tankers and LNG carriers. The tanker studied is a gas carrier tanker, in which the level of accident risk is considered more. The level of stability of the Tanker ship is influenced by the wave activity in the ocean. So that in this study, the design of ship rudder roll stability was made with sea state 1 to sea state 7. The response results showed the maximum overshoot rolling value reached 2.2 degrees with step time -1 and the settling time of 60 s at sea state 7. Rudder is in a steady state with a 1^0 heading at a time of 55 seconds.

Keywords:- *Tanker, Rudder Roll Stability, Sea State 7.*

I. INTRODUCTION

Tanker is a ship designed to transport oil or its derivative products. There are main types of tankers including oil tankers, chemical tankers and LNG carriers. Besides transporting pipelines, tankers usually also carry crude oil, chemicals, and gas. This causes many risks of ship accidents caused by both external and internal factors. Internal factors that usually occur are due to good weather conditions and the presence of sea water waves disruption which causes ship imbalance. External factors that occur can be caused by human error, damage to the engine, and overload which also causes instability on the ship. Therefore, in this study the design of ship stability (rolling) using the fuzzy logic method to prevent accidents on tankers. In this study, it is limited to Komodo Gas Tankers, which are ships carrying gas. The rolling stability of the ship is the ability of the system to respond to disturbances to try to return to normal conditions. To reduce the shaky motion used load can be moved to maintain the stability of the ship.

II. METHOD

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

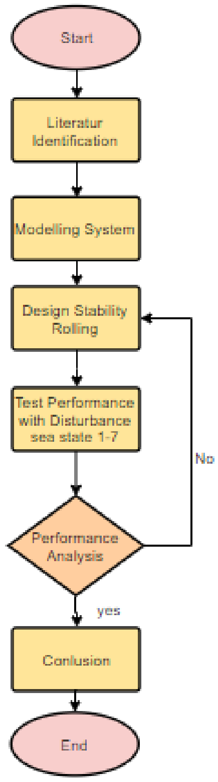

Fig 1:- Flowchart Method

Literature study in the form of theoretical and geographical understanding of the shipping zones in free waters, including navigation, and external disturbance around the waters of the wave disruption. Modeling the dynamics of wave is calculated based on the most extreme sea wave height data of 1 - 7 meters. The input heading is 1 degree.

A. *Komodo Gas Tanker*

The hydrodynamic coefficient of physical specification owned by Komodo Gas Tanker namely:

Lenght (LOA) = 224 meter
Wide (B) = 36 meter
Deep (t) = 21.8 meter
Block coefficient (CB) = m / (LOA*B*T) = 45032/ 175.795 = 256.16
Center of gravity (xG) = 1.74 meter
rho = 1014 Kg/m^3

ISSN No:-2456-2165

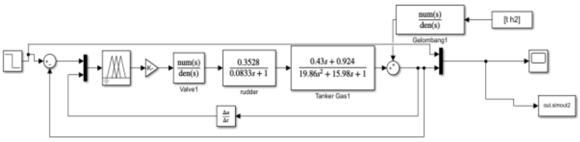

Fig 2:- Design close loop stability control system of Komodo Gas Tanker with disturbance

Seen in the picture that the resulting hydrodynamic coefficient of tanker gas is equal to :

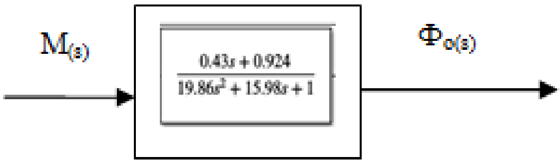

Fig 3:- Hydrodynamic Coefficient of Komodo Gas Tanker

III. RESULT

➢ *Open Loop Test Response*

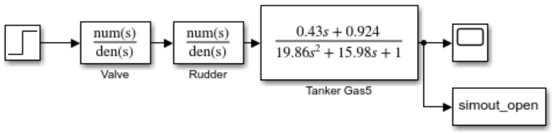

Fig 4:- Design open loop stability control system of Komodo Gas Tanker

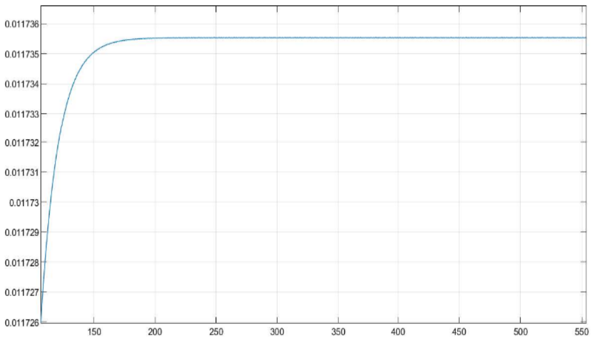

Fig 5:- Chart open loop stability control system of Komodo Gas Tanker

Open loop test response above is the result of the system response without controller. In this response it can be seen that there are no problems in the open loop system because the graph is positive. The input heading in this system is 1 degree. The result of chart response is in 0.011735.5 degree and in a steady state condition. There are no overshoot in this response and can be optimal in 150 sekon.

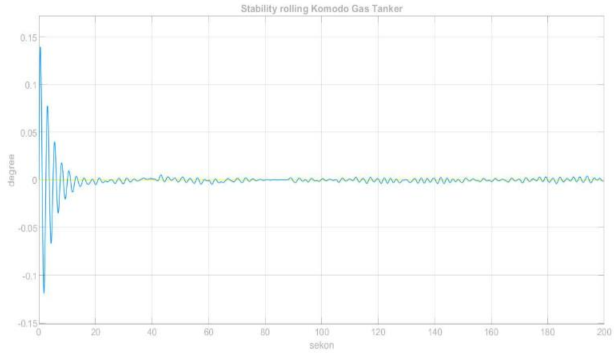

Fig 6:- Chart Close loop stability control system of Komodo Gas Tanker

Figure 6 shows the close loop system test with sea state 1 wave disturbance above, it can be seen that with step time -1,response for the input heading 1^0 obtained maximum overshoot of 0.14^0, the rise time of 1 sekon, the settling time of 18 sekon, and the steady state error of 0.13.

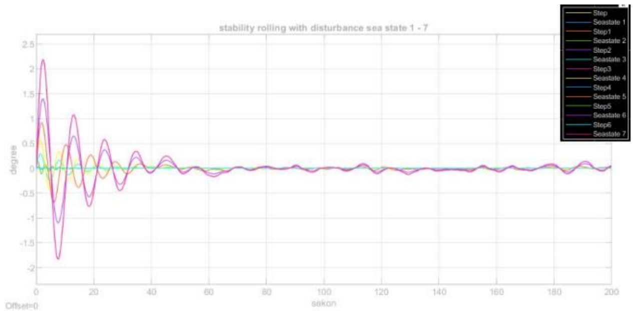

Fig 7

Figure 7 shows the close loop system test response with sea state 1 until sea state 7 wave disturbance, it can be seen that step time -1, for the input heading 1^0 in sea state 7 obtained maximum overshoot of 2.2^0, the settling time of 60 s. Rudder is in a steady state in 1^0 heading at a time of 55 seconds. And in sea state 1, the result is minimum overshoot of 0.4, the settling time of 20 s.

IV. CONCLUSION

After designing the stability rolling of Komodo Gas Tanker, it can be concluded as follows:

➢ Based on the performance test of ship stability with step time -1. The result of chart response is in 0.011735.5 degree and in a steady state condition. There are no overshoot in this response and can be optimal in 150 sekon.

➢ The close loop system test response with sea state 1 until sea state 7 wave disturbance, it can be seen that step time -1, for the input heading 1^0 in sea state 7 obtained maximum overshoot of 2.2^0, the settling time of 60 s. Rudder is in a steady state in 1^0 heading at a time of 55 seconds.

ISSN No:-2456-2165

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