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Theoretical Approach of Development of Tracking Module for ARPA system on Board Warships

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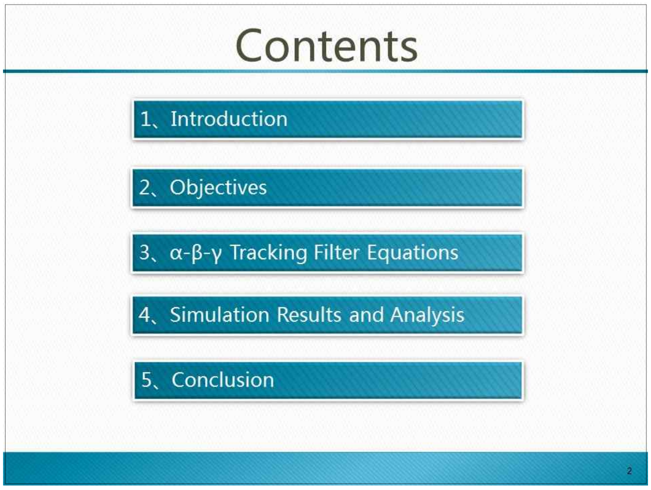
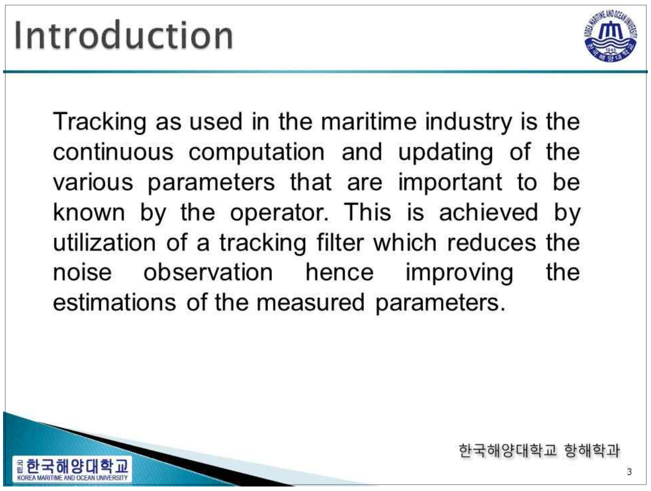
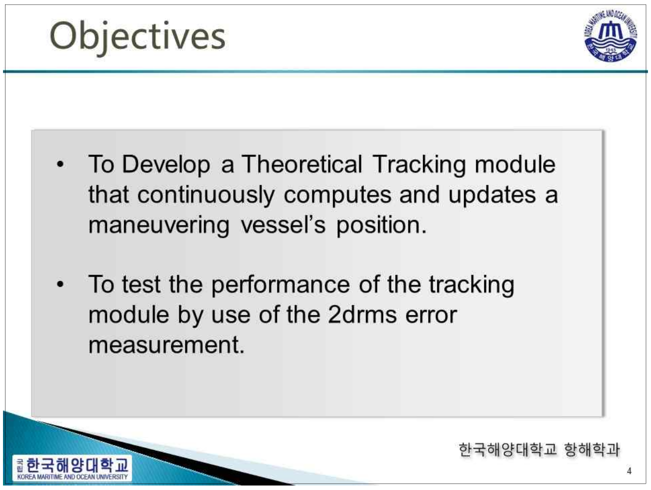
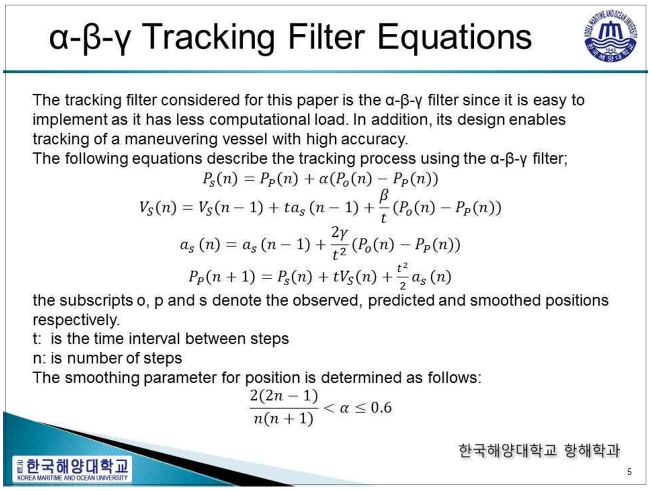
Abstract : *The maritime industry is expanding at an alarming rate and as such there is a perpetual need to improve situation awareness in the maritime environment using new and emerging technology. Tracking is one of the numerous ways of enhancing situation awareness by providing information that may be useful to the operator. The tracking system described herein comprises determining existing states of own ship, state prediction and state compensation caused by random noise. The purpose of this paper is to analyze the process of tracking and develop a tracking algorithm by using α-β-γ tracking filter under a random noise or irregular motion for use in a warship. The algorithm involves initializing the input parameters of position, velocity and course. The actual positions are then computed for each time interval. In addition, a weighted difference of the observed and predicted position at the nth observation is added to the predicted position to obtain the smoothed position. This estimation is subsequently employed to determine the predicted position at (n+1). The smoothed values, predicted values and the observed values are used to compute the twice distance root mean square (2drms) error as a measure of accuracy of the tracking module.*

Key words : *Tracking module, warship, α-β-γ filter, state matrix, state compensation, smoothing, prediction, stable condition*









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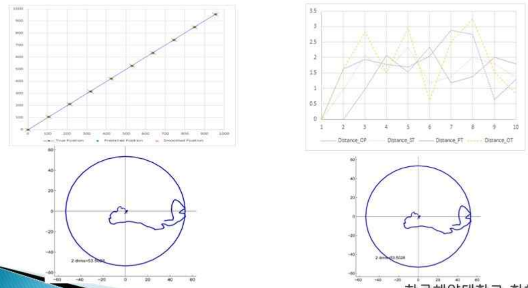
Simulation Results

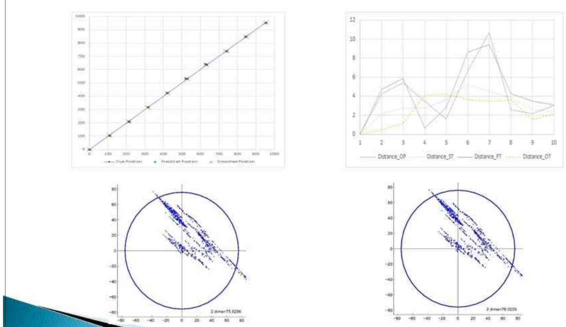
The following simulation tests were performed in order to evaluate the performance of the α-β-γ filter algorithm;

i. **No input noise**



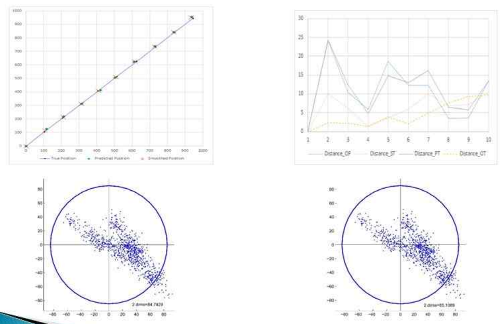
Simulation Results

ii. **Varying course**



Simulation Results

iii. **Varying course and velocity**



Result Analysis

- The residual and prediction errors were computed by calculating twice the root mean square from the true positions to the observed, smoothed and predicted positions of the circle containing 95% of the respective 1000 positions. These radial distances were then used to compare the tracking filter performance among the three cases.
- The radial distances were larger in the two cases that had noise input than in the noise free simulation.
- The residual errors were lower than the prediction errors.

Conclusion

- ✓ The performance of the tracking module developed was satisfactory.
- ✓ Better estimates of position measurements were obtained after smoothing which led to near accurate predictions of position.
- ✓ The noise-free situation out-performed the simulations with noise input. However, practically the simulation environment must be designed to allow for noise input.

Recommendation

Future development of this research recommends determination of the optimum values of α, β and γ parameters required to improve the performance of this tracking module.
In addition, the authors recommended application of the tracking module to a real time environment in order to test its performance.