

Probability Model Estimation of Aberrant Vessel Trajectory Using VTS Data

Hyun-Joong KIM

Doctoral Course Student
Seoul National University
Seoul, Korea
hjkim@sel.snu.ac.kr

Wonsuk PARK

Chief Researcher
Seoul National University
Seoul, Korea
wpark@sel.snu.ac.kr

Jeong-Hyun LIM

Unified Master and Doctor
Course Student
Seoul National University
Seoul, Korea
jhlhim@sel.snu.ac.kr

Jun-Kyoung LEE

Master Course Student
Seoul National University
Seoul, Korea
jklee@sel.snu.ac.kr

Hyun-Moo KOH

Professor
Seoul National University
Seoul, Korea
hmkoh@snu.ac.kr

Summary

In this paper, probability model estimations are presented for vessel trajectories passing beneath a sea-crossing long span bridge. Two methods are developed and compared, which are a model based on 3D vessel maneuvering simulations and one using real world Vessel Traffic Service (VTS) data. Both methods are found to be able to represent the human factor and site specific characteristics to vessel location distribution, which is resulted in a biased shape unlike simple probability distribution function typically assumed in design specifications. Nevertheless, there still exists some discrepancies between the results of two methods. Inadequate mass distribution of samples in VTS and 3D simulation is regarded as a reason for the discrepancy. Further studies on VTS data and research on the application for the vessel collision risk assessment will attain safe and reliable bridge design.

Keywords: VTS system; vessel collision probability distribution; risk assessment.

1. Introduction

Aberrant vessels' location and behaviour around the bridge, which are crucial factors in bridge design against ship collision accident, are influenced by a lot of uncertainties such as human factors, adverse environmental condition, and constructed structure, etc. Previously a research on ship trajectory generation method using 3D real-time ship maneuvering simulation [1] was proposed which takes into account those uncertainties hard to be estimated by simple numerical simulation or assumption. Even so, 3D real-time ship maneuvering simulation based collision probability estimation method still requires verification since the limitation of sample number. The realization of bridge construction effect and the various environmental conditions on maneuverability in the 3D vessel maneuvering simulation needs to be validated with actual vessel traffic data.

This paper proposes a method with respect to the probabilistic modelling of vessel trajectory using Vessel Traffic Service (VTS). The VTS system has been developed for the safe and efficient vessel traffic which can detect and record the traces of the vessels move in waterway. The recorded data from VTS can be utilized to extract statistical information for probability distribution estimation.

The proposed method is applied to an actual sea-crossing cable-stayed bridge in Korea that will be opened in 2012. Estimated probabilistic model of aberrant vessels' trajectory using VTS data, which is recorded under the existence of the bridge, will be compared of the 3D real-time simulation based model in terms of statistical properties.

2. Estimation of aberrant vessel's trajectory

2.1 Ship aberrancy

Vessels are expected to navigate through safely defined waterways. However there may be some kind of uncontrollable situation caused by various reasons which may result in ship collision with a