ABSTRACT ONLY

Deterministic Wave Prediction as Support for Launch & Recovery Operations

A study into applications of the waveradar in the Feadship Comfort System

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Master of Science Thesis

TU Delft Delft University of Technology

Department of Maritime & Transport Technology

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Deterministic Wave Prediction as Support for Launch & Recovery Operations

A study into applications of the waveradar in the Feadship Comfort System

Master of Science Thesis

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Abstract

Experience-based decision making by crew plays a key role in the safe and effective execution of maritime operations. For yachts and naval vessels, common operations can be identified as helicopter operations (take-off and landing), launch and recovery of small craft and (dis)embarkment to and from these small craft. All of these operations are limited by wave-induced ship motions.

For these operations, experience-based decision making does however not always guarantee that the operations are carried out in the most safe and effective manner possible. Also, the level of comfort as experienced by a yacht-owner or guests can be directly affected by this type of decision making. With this in mind, Feadship aims to develop a Feadship Comfort System (FCS), which can contribute to the decision making process. One of the elements of this system is ought to be a waveradar. The aim of this thesis is to describe how the waveradar can be included effectively in the FCS, and how it can be used for the above mentioned operations.

The waveradar is in basis a common navigation radar that can perform measurements of the surface elevation in the direct surrounding of a vessel. These measurements can be used to predict the ship's motions up to approximately two minutes ahead in time. With this, windows of opportunity can be distinguished when operations can be carried out best. These windows depend on the corresponding limiting criteria that are set on the ship's motions. A major issue is however that sea trials have shown that the roll prediction is inaccurate.

Due to this problem, two methods are evaluated in this thesis to improve the accuracy of the roll prediction. These methods are set up such that they are practical in use and can be applied directly to the deterministic wave predictions from the waveradar. The first method is scaling the response based on the roll motion history, whereas the second method is based on scaling the roll damping. The latter is effectively linearising the viscous contribution to the roll damping.

As no data from sea-trials is present to compare these methods, a benchmark calculation is carried out based on Cummins approach. In these time-domain calculations, a linear and non-linear roll damping coefficient are taken into account, which are based on a decay test that is available at De Voogt Naval Architects (DVNA). This follows from model tests performed by MARIN.

Comparing both methods to this benchmark calculation showed that the method of scaled damping resulted in the best approximation, with a Pearson correlation coefficient of (only)

33 %. Also, in terms of the behaviour of the motion envelope, this method showed the closest approximation of the two methods. It is found that the way in which both methods influence the RAO of the roll motion has a great influence on the results found. More suitable methods that should provide a better approximation are suggested from this, such as a frequency dependent scaling of the roll damping. This is however not discussed further.

With the method of scaled damping, the practical application of the waveradar within the FCS is evaluated. For the common operations of yachts and naval vessels, limiting criteria on ship motions are obtained from literature or stated by the author. The majority of these criteria are RMS values, for which a method is suggested to use them real-time. In this method, the most probable maxima are obtained from the RMS criteria, which are then applied as real-time criteria. This showed impractically large results, which showed that this method does not suffice.

From this conclusion it follows that the analysis of the practical application of the waveradar is only carried out for the (dis)embarkment of small craft. From this, design considerations for the FCS are obtained, from which the main result is that heading suggestion is one of the most important tasks that the system needs to be capable of.

Finally, a performance monitor has been evaluated for yachts at anchor. This performance monitor displays the predicted Comfort Rating (CR) real time, which can be used by the yachts crew to evaluate the current anchor location. This is a specific desire of Feadship and is developed next to the other operations. For this application, heading suggestion is also one of the most important tasks that the FCS needs to be capable of.