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A Hydrographic Approach to Safety of Navigation

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Abstract

In this paper a new methodology based on Global Navigation Satellite System (GNSS) is presented for squat modeling of the ships. As the case study, the method is applied to model the squat effect of the survey vessel of the National Geographic Organization (NGO) of Iran, operated in surrounding offshore waters of Kish harbor. Numerical assessments show that for modern navigation applications, which demand accurate squat knowledge of the ships especially for high speeds traffic in confined channels, it is necessary to use the GNSS-based methods for squat modeling. The proposed method can be reliably predicted the squat values of any types of the ships and vessels in any restricted waterways.

Introduction

Monitoring of ship squat during the cruise is an important topic in shipping, sailing, and shipbuilding industry. Squat phenomenon, as a downward displacement caused by reduction of the water pressure beneath a vessel moving ahead, reduces the under keel clearance (UKC). Reduction of the vessel UKC due to the squat effect is one of the structural characters of the ships that may affect the safety of navigation, especially in shallow waterways and confined channels. Squat, depending on the hull configurations, can be appeared at bow or stern of the full- or fine-forms ships respectively. Moreover, the maximum squat can be occurred at port or starboard of the ships due to the rotational movements of the marine platforms, i.e. trim and list angles, which has caused the numerous grounding. Therefore, in order to ensure the safety of navigation, international recommendations [1] require the maximum ship squat to be known as a function of cruise speed, whereas it mainly depends on the cruise speed [5]. According to increase in the accuracy of Global Navigation Satellite System (GNSS) in the past decade, a GPS-based method can be modeled the squat effect of the ships. The common methods for squat modeling based on GPS and tidal observations can be seen in [2], [3], and [4].

In this paper, a new methodology for squat prediction of a ship based on GNSS, heave, ship load variations and tidal information is presented. According to our methodology, the GPS antennae configuration on-board must be at stern-port and stern-starboard for fine-form vessels, besides at bow-port and bow-starboard for full-form ships. Therefore, the squat effect is modeled at each sides of the vessel. As a result, the correct UKC reduction of the ships and vessels is determined as a function of cruise speed.