NUMERICAL SIMULATION STUDY ON THE PROPAGATION OF WAVES GENERATED BY VESSELS USING A MODIFIED VERSION FUNWAVE

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1. Introduction

The propagation away from a ship of waves generated by it has been investigated because of their impact on erosion of the margins and on movements induced on moored ships (Cornett et al. 2008).

The force associated with wave generation by a moving ship is an important part of ship's resistance, that is, the force along the longitudinal axis of the ship necessary for it to move with the desired speed setting. Several numerical models have been developed to determine this resistance to the advance, the most recent being the ones that solve the Navier-Stokes equations with a Reynolds average, for instance FLUENT, (Fluent Incorporated, 2002). In spite of their features, such models cannot be used to simulate the propagation of these waves away from the ship, because the growth of computing time with the size of the simulated area leads to excessive time requirements.

The numerical models developed for the study of these waves propagation are based on the shallow water equations, Stockstill and Berger (2001), or on improved versions of the Boussinesq equations, Nwogu and Demirbilek (2004), Dam et al. (2006) and Nascimento (2007).

The numerical model FUNWAVE that is based on extended Boussinesq equations (Wei and Kirby, 1995) was adapted by Nascimento (2007) to model the propagation for ship generated waves. For this an additional pressure on the moving free surface was added to the momentum equations, to simulate the generation and propagation of ship waves to shoreline. This model reproduces most of the phenomena involved in the transformation of a wave in variable depth, including the frequency dispersion, amplitude dispersion, diffraction, bottom and current refraction, energy transfer among harmonic components and energy dissipation by wave breaking and bottom friction.

2. Methodology

This work aims to establish a methodology to select the pressure distribution and the corresponding maximum pressure value to be used in the modified version FUNWAVE to simulate the propagation of waves generated by barges convoys. The ultimate goal of this work is to simulate the barges convoys that are becoming a common sighting in the Tietê-Paraná waterway (Brazil) where the river traffic is expected to increase in the coming years.

Several pressure distributions available in the literature will be tested and results from the FLUENT model will be used to set the wave pattern close to the convoy that is to be met by the results of the modified FUNWAVE version. The pressure distributions of Ertekin et al (1986), Wu (1987), Casciola & Landrini (1996) and Li & Sclavounos (2002) will be tested and their influence on the results quality assessed.

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