Assessing Structural Integrity of Maritime Assets through Fluid-Structure Interaction using SPH and FE.

Bruce Cartwright*, Paul Groenenboom† and Damian McGuckin†2

* The University of Newcastle, Australia
e-mail: Bruce.Cartwright@newcastle.edu.au

† ESI-Group Netherlands, Postbus 1000, Box E57, 2260BA, Leidschendam, The Netherlands
e-mail: Paul.Groenenboom@esi-group.com

†2 Pacific ESI, Sydney Australia
e-mail : DamianM@esi.com.au

ABSTRACT

This paper presents a numerical modelling technique for the prediction and understanding of structural degradation of maritime assets, including defence vessels and offshore structures. The response of such structures to specific sea-state conditions is considered, accounting for the effect of the structure under degradation processes such as cracks, corrosion and accidents.

The paper specifically considers the stresses developed in a ship traversing ocean waves using the technique of fluid-structure interaction by combination of smoothed particles for the hydrodynamics (SPH) with finite elements (FE) for the structure [1]. Selected aspects of the employed SPH and the coupling approach will be discussed. The time-varying stresses are the consequences of the hydrodynamic forces on the ship, the resulting ship motions, and the reaction of the ship structure to those motions. The wave height and wave period of the sea state are specified in the simulation.

The simulations are based on the as-built condition of the ship. The paper will also describe a procedure for stress analysis of the ship in waves under a variety of structural degradation possibilities known, from practical experience, to occur throughout the life of a ship. Such degradations may be the results of accidents or incidents, environmental degradation such as loss of material through corrosion, or caused by fatigue cracks. Through simulation of the pre-determined sea-state, the actual stress state that results from the degradation can be predicted. Such a simulation is expected to provide useful indications of the likelihood of the ship surviving a limiting sea-state, or they could indicate a structurally threatening scenario.

REFERENCES

[1] Groenenboom P.H.L and Cartwright B.K., “Hydrodynamics and fluid-structure interaction by coupled SPH-FE method”, Journal of Hydraulic Research, **48** (Extra Issue), 61–73 (2010)