Abstract

Exploitation of the Arctic's resources requires the mastery of the risks caused by extreme ice conditions. The design of offshore structures subjected to extreme ice conditions is a challenge for engineers since there are very few advanced design tools available on the market, especially those able to cope with the large variety of ice interaction and failure mechanisms.

Different approaches have been used to model and study ice behavior. Among them are analytical, numerical and empirical approaches with different models being considered. Each model has its own advantages and drawbacks and is only generally dedicated to certain circumstances. In 2012 Technip, Cervval and Bureau Veritas initiated a common development program to offer a new tool for the design of offshore structures interacting with ice (Septseault, 2014, 2015) combining a variety of approaches and models.

After three years, the first version of the Ice-MAS software (www.ice-mas.com) is now available. It simulates the ice loadings on a structure and the dynamic behavior of the drifting ice-sheet and floes around. Thanks to multi-agent technology, it is possible to combine in a common framework multiple phenomena from various natures and heterogeneous scales (drag, friction, ice-sheet bending failure, local crushing, rubble stack up) (Le Yaouanq, 2015). This work has been the subject of numerous validations, particularly by comparison with ice basin and in-situ results (Dudal, 2015).

The Ice-MAS development program continues in 2016 with the addition of a capability to model the interaction of icebergs with offshore structures. This paper will introduce the co-simulation architecture proposed to simulate the complex interaction between an iceberg and a platform structure. It will focus on the hydrodynamic behavior of the platform and the iceberg including its stability. It will also consider the interaction between both bodies; including the non-linearity of the mooring system (in the case of a floating platform) and the local fracture mechanisms of the iceberg. The objective is to propose a new more accurate design method that will improve the overall ice management system for a project.

Introduction

Designing offshore structures for Arctic conditions creates a number of challenges related to complex phenomenon of ice failure and interaction with the said structures. The phenomenon of ice interaction with offshore structures of different shapes has been investigated by many scientists using analytical and empirical techniques (Ralston, 1980) (Nevel, 1992), and numerical methods (Konuk, 2009) (Lubbad, 2011). These methods are widely used for prediction of ice behavior and ice loads exerted on offshore