Simulation of Ice Management Operations

Quentin Hisette
University of Rostock, Faculty of Mechanical Engineering and Marine Technology
Rostock, Germany

Peter Jochmann
Hamburg Ship Model Basin (HSVA), Arctic Technology
Hamburg, Germany

Robert Bronsart
University of Rostock, Faculty of Mechanical Engineering and Marine Technology
Rostock, Germany

ABSTRACT

The present paper describes a simulation tool for physical ice management operations. Resistance in level ice or in floes, ridge breaking and manoeuvrability in ice are estimated thanks to semi-empirical methods. From a target floe size, trajectory of management vessel is calculated in order to protect a structure against drifting ice according to linear, sector and circular management techniques. The tool produces visualization of the operations, with indication of the requested power level and distributions of the resulting floe size.

KEY WORDS: Arctic; Ice Management; Simulation; Icebreaker; Manoeuvrability; Ridges.

INTRODUCTION

In Arctic regions, sea water can be covered, fully or partially, by many kinds of sea ice features. Numerous industrial and economical activities take place in the Arctic Ocean, mainly shipping routes and hydrocarbon exploration and extraction. In order to protect against drifting ice the offshore infrastructures requested for these activities to take place, ice forecasting, monitoring, hazard detection and clearing operations are generally needed. In this context, a simulation tool for physical ice management operations has been developed at the Hamburg Ship Model Basin. According to several input parameters, like ice distribution, vessel capabilities and requested target floe size, the simulation code is able to predict an operation scenario, compute several working limits (manageable area,…) and produce a visualization of the operations.

SOFTWARE STRUCTURE

The MatLab code for simulation of ice management operations is written according to the structure proposed in the flow chart of Fig. 1. Each box consists in a different module, and the corresponding set of modules altogether form the simulation script. Such a modular structure allows easy improvements and modifications by simply replacing any module by another or adding new modules in order to meet any specific demand of clients from the offshore industry.

Fig. 1 – Flow chart of the simulation

Inputs

From the study of the different ice management techniques, the relevant parameters to be considered in order to accurately define the operating conditions are defined. For example: ice thickness and drift velocity, managed ice concentration, icebreaking vessel power and dimensions, etc. The structure to defend is described by its main dimensions, and the maximum acceptable size of the broken floes that can hit the structure is considered as a target value of the calculation.