How can we simulate ship performance in level ice reliably and efficiently?

Contents of the dissertation

Shipping activities in polar and sub-polar regions rely on ice-strengthened ships with capability to navigate through ice-covered waters. An important index of a ship’s icebreaking capacity is the thickness of level ice which the ship can break continuously. To estimate this, knowledge and methods are needed to calculate the attainable speed of a ship in level ice with various thickness. This thesis focuses on numerical methods to make such calculations.

To achieve the goal, this thesis starts with an evaluation of the state-of-art methods for the estimation of ship performance in ice and identify the most critical aspects to be further investigated. A framework is proposed following the evaluation to investigate the methodological issues regarding the establishment of a reliable and efficient numerical model. The thesis then proposes models in local ship-ice interaction scale and assembles the models into a global scale model, which simulates ship motion in level ice either in straight course or during maneuvering.

The results of this thesis can be used as the basis to develop future numerical models for ship performance in level ice. The resulting numerical model has good potential to be applied in practical ship design process, which enables credible estimation of ship performance at early design stage and promotes innovation on icebreaking hull forms.