Numerical Simulation of Brash Ice

Master Thesis Presentation: EMShip Week

13th February 2018 La Spezia

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Objectives

- Discrete Element Method tool to simulate brash ice
  - Numerical modeling of brash ice particles
  - Develop DEM scheme
  - Generating brash ice channel
  - Cylinder experiment – Sensitivity analysis
  - Simulating ship model experiment
**Brash Ice**

- Accumulated broken ice in a channel

Ship navigating in brash ice channel  
Brash ice particles
Discrete Element Method

Simple Example of DEM
(source: Simulation-Based Engineering Lab, University of Wisconsin)
Modelling of Ice Particles

- Spherical granular particles
- Particle size distributed in lognormal - ship scale
- Scaling of ice particle size to model scale
Generating Brash Ice Channel

- Input parameters – length, width, brash ice thickness and porosity
- Floating up technique
Cylinder Experiment

- Calibrate parameters
- Compare channels
- Validate forces
Sensitivity Analysis

- Parameters: Time step, Young’s Modules, Friction Coefficient, Cohesion Coefficient
Brash Ice Ship Model Test

- Self propulsion test
- Input: Ship Model and Propeller Curve
- Output: velocity, acceleration, thrust force and ice forces

Ship model simulation

23-Feb-18
Numerical Results
Conclusions

• DEM for ship-brash ice interactions
• Visualization tool
• Force model has to improve

Thank You!
DEM Algorithm

DEM algorithm in code

(Source: Numerical Simulation of Ice Ridge Breaking: Aleksei Alekseev)