

북극항로 운항 선박의 빙저항 · 추진 성능 DB 개발

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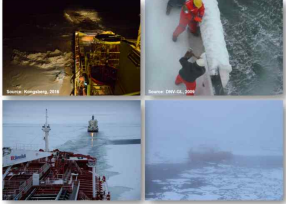
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요 약 : 여름철 북극 해빙 면적의 감소 추세로 빙해선박의 북극항로 통항회수가 증가하고 있어 선박의 안전 항해를 위한 기술 개발에 관심이 집중되고 있다. 본 연구에서는 선박해양플랜트연구소에서 개발 중인 KRISO Arctic Safe Routing System(KARS)의 개념과 함께 핵심 모듈 중 하나인 빙저항 · 추진 성능 DB 개발 과정을 소개하였다. 우선 빙해수조에서 다양한 빙상환경(평탄빙, 유빙, 빙맥 등)에 따른 선박의 빙 성능 평가 시험을 수행한 후 대상선박의 기본적인 빙 성능을 도출하였고 빙 성능 추정 S/W의 해석결과와 비교 · 검증을 수행하여 다양한 환경 변수를 고려한 빙저항 · 추진 성능 DB를 생성하였다. 아울러, 생성된 DB의 검증을 위해 2017년 8월 쇄빙연구선 아라온의 빙해역 실선시험 동안 계획된 결과와 비교 · 분석하여 정확도를 분석하였고 KARS의 개선 사항 및 향후 활용 가능성을 고찰하였다.

핵심용어 : KRISO Arctic Safe Routing System(KARS), 빙해수조, 빙저항 · 추진 성능 DB, 빙해역 실선시험

Overview

- Identifying the hazards in NSR
 - Darkness
 - Pressure ridge, multi-year ice
 - Icing
 - Low temperature
 - Unknown danger areas, etc.

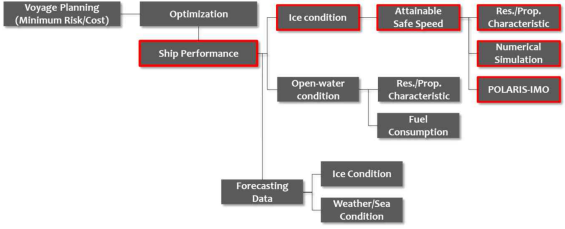


- A safe voyage planning system is needed when hazards cannot be thoroughly eliminated and some risks remain. This system is to ensure the safety of vessels operating in the NSR

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System Concept

- KARS includes the prediction of ice, weather and sea conditions, and ship performances derived from the ship transit model based on model tests and numerical simulations.

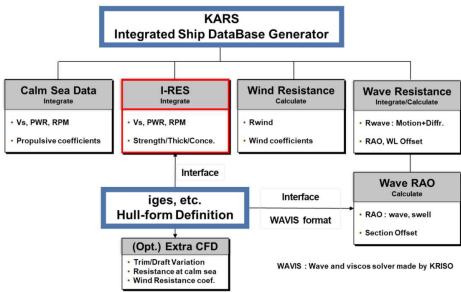


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Function – Ship Performance

- Ship transit model : open water condition

- Prediction of ship resistance characteristics



Based on ISO 15016:2002 – Speed Trial Analysis Methods

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Function – Ship Performance

- Ship transit model : ice condition

- Ice model test conditions

Cat.	Level Ice	Pack Ice	Broken Ice	Brash Ice	Ice Ridge
A	○ (thick. & strength variations)	-	-	-	-
A	○ (thick. & strength variations)	○ (concentration variation)	-	-	-
B	○ (thick. & strength variations)	○ (concentration variation)	○ (channel width variation)	○ (ice grade variation)	○ (ridge formation variation)
B	-	○ (concentration variation)	-	○ (ice grade variation)	○ (ridge formation variation)

IMO Polar Code

Category A ship means a ship designed for operation in polar waters in at least medium first-year ice, which may include old ice inclusions. This corresponds to vessels built to the IACS Polar ice classes PC1 to PC5.

Category B ship means a ship not included in Category A, designed for operation in polar waters in at least thin first-year ice, which may include old ice inclusions. This corresponds to vessels built to the IACS Polar ice classes PC6 and PC7.

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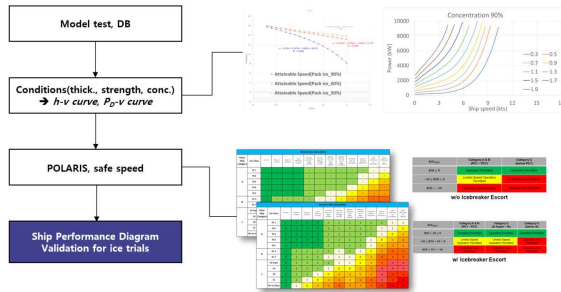
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Function – Ship Performance

- Ship transit model : ice condition

- Model tests in ice tank

DB construction process for ship performance in ice



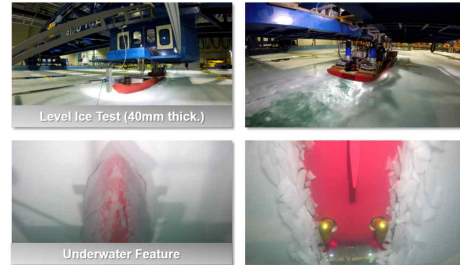
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Function – Ship Performance

- Ship transit model : ice condition

- Model tests in ice tank

Level ice, pre-sawn ice, pack ice, brash ice, ridge, etc.



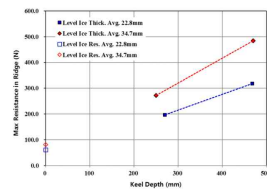
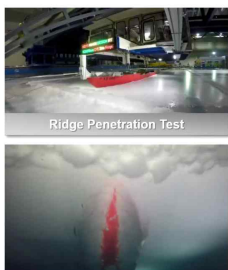
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Function – Ship Performance

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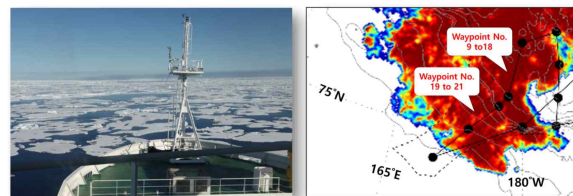


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Validation

- Comparison of full scale ice trials data and calculated data

- Ice trials of IBRV "ARAON" around East Siberian Sea (5th to 26th Aug. 2017)



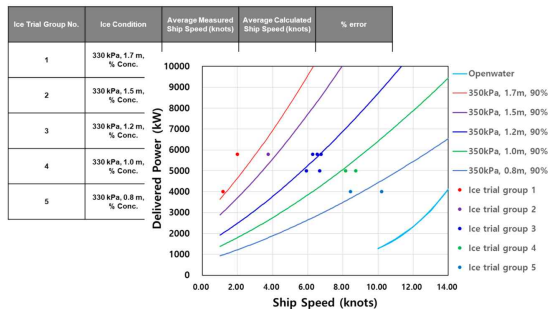
- Ice conditions (conc., thick., strength), Voyage conditions (RPM, power, azimuth angle, trim, location, trajectory, etc.)

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Validation

- Ship speed and power validations

- Prediction of ship performance in ice



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Future Plan

- Application

- Application of KARS on the vessels operating in NSR
- Full scale data acquisition (real voyage data)

- Validation

- Verification of accuracy for the ship transit model in open-water and ice conditions
- Evaluation of optimal voyage route finding method
- Comparison between real voyage data and calculated data

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후 기

본 논문은 해양수산부의 국가연구개발사업인 “북극항로 운항선박용 항해안전지원시스템 개발(PMS3880)”에 의해 수행되었습니다.