CPPの軸回転数と翼角の同時制御による船舶の省エネ技術の開発

かもめプロペラ株式会社

The Energy-saving system of Controllable Pitch Propeller

Development of ship energy-saving system by simultaneous control of the shaft speed and the blade angle of CP Propeller

MLIT Ministry of Land, Infrastructure, Transport and Tourism

ClassNK R&D PROJECT

OSAKA UNIVERSITY

National Maritime Research Institute NMRI

FURUNO

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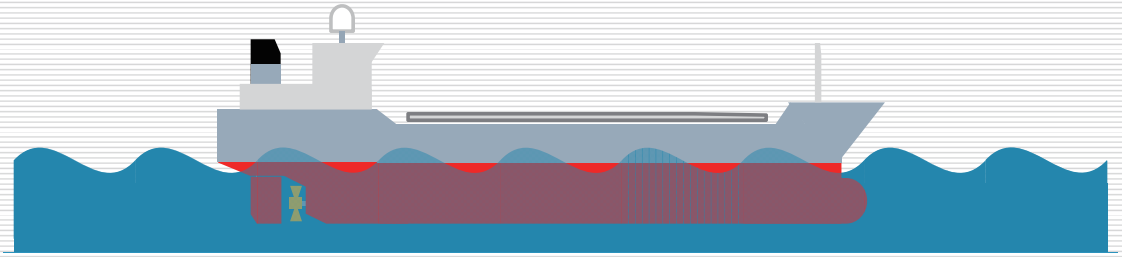
1. Development overview

Background of the research project

CPP has been installed mainly in the coastal vessels for the purpose of maneuverability and the main engine overload protection. Considering the recent requirement to the reduction of CO_2 emission from ships, the novel energy-saving operation system has been developed using the energy-saving aspect of the CPP.



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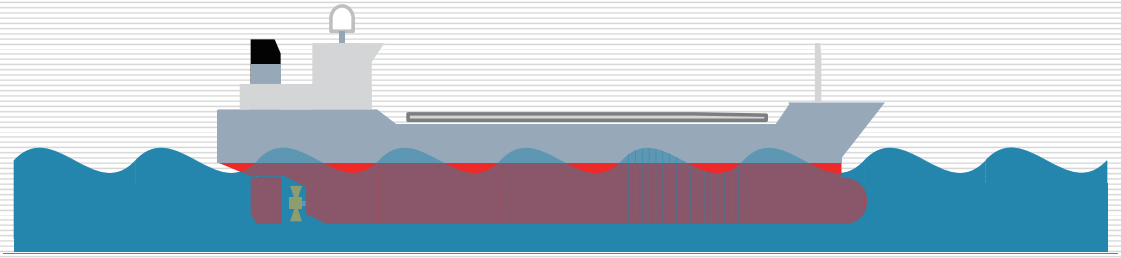
1. Development overview

Purpose

Development of the electric pitch control CPP to improve the response speed and preciseness of pitch control of the existing CPP.

Development of ship Energy-saving system by simultaneous control of the shaft speed and the blade angle of CPP.

Electric propulsion system is selected as a research target from the viewpoint of response of the prime mover .



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2. Future Targets

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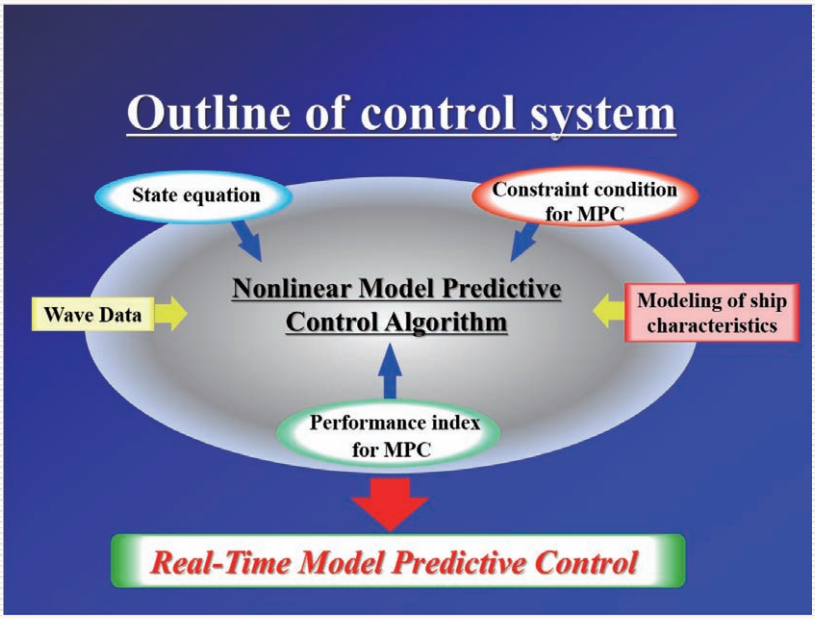
Energy Saving for a Ship in Waves by Using Real-Time Optimal Control of Propeller Pitch and Electric Propulsion



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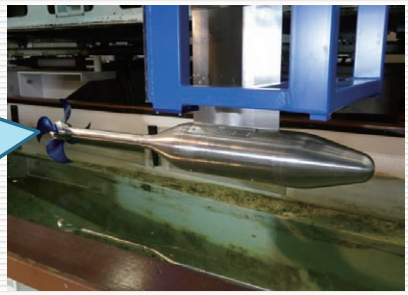
Measurement of propeller performance under pitch control

Device to Measure Propeller Thrust and Torque, even under Propeller Pitch Controlling.

Mechanism for Pitch Control is Same to Full-size on Actual Ship.

CPP Dynamometer for Tank Experiment

Computer for control



Average: 22[deg]
Amplitude: 4[deg]
Period: 2[sec]

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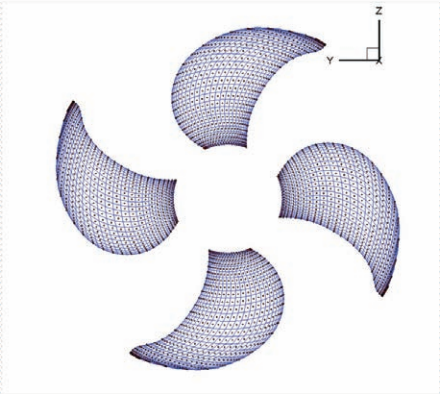
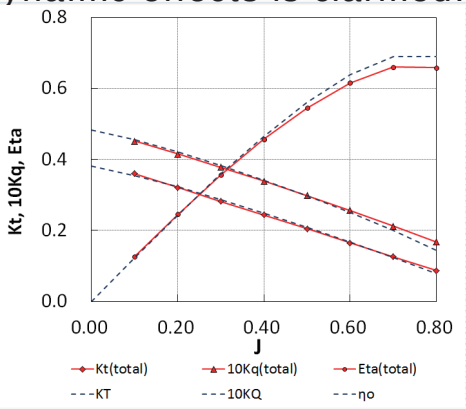
Numerical simulation of propeller performance under pitch control

Dynamic effects on propeller performance under pitch control is evaluated by means of QCM. Through the simulation, a mechanism of the dynamic effects is clarified.



Panel arrangements by means of QCM



Propeller open water performance

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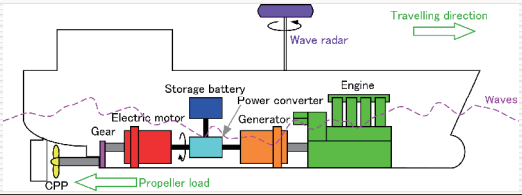
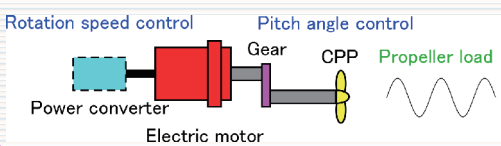
Developments of Dynamic Mathematical Model and Simulator of Electric Propulsion Unit

Purpose: Experimental verification of energy savings due to the simultaneous control of the pitch angle and the rotation speed of CPP

- Propulsion conditions: (Ocean-going)
  - ・Propeller load due to waves is a periodic fluctuation
  - ・Average vessel speed in the waves is constant
- Comparing control Types:
  - ・Constant pitch angle + Constant rotation speed
  - ・ Constant pitch angle + Controllable rotation speed
  - ・Controllable pitch angle + Constant rotation speed
  - ・Controllable pitch angle + Controllable rotation speed



- Basic electric propulsion unit:



Experimental verification of energy savings using a simple test system, which can simulate the load and rotation speed of the CPP

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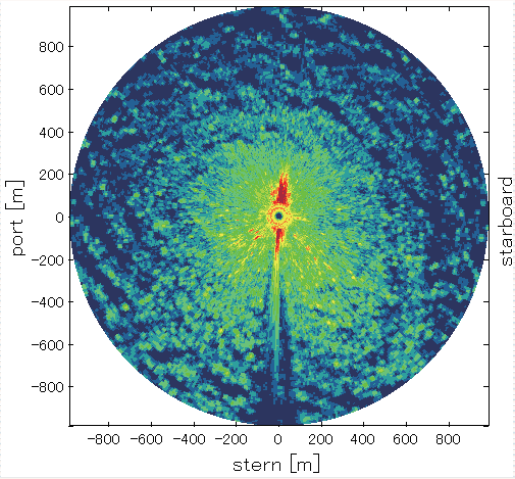
An actual example of the radar image



The crest line of wave represents back scattering intensity of the microwave from the sea surface. The intensity is not related to waveheight.

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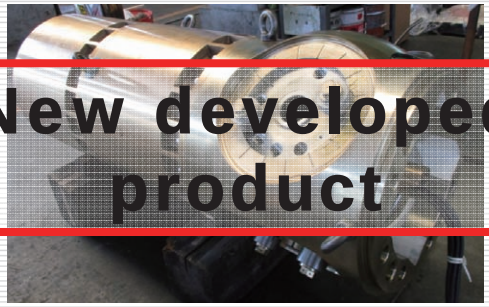
Development of high response electric pitch control CPP capable of blade angle control at encounter wave frequency

☐ Development overview

We will develop the electric pitch control CPP having a higher response than compared to the existing CPP.



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THANK YOU
for
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This project is supported by the Ministry of Land, Infrastructure, Transport and Tourism and conducted as a joint research theme with ClassNK.

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