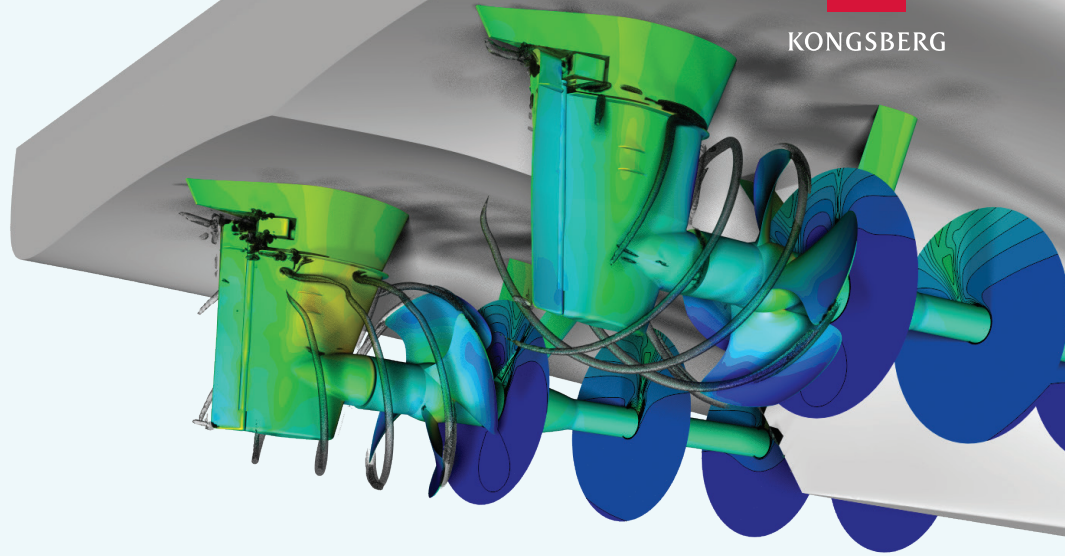


HYDRODYNAMIC SERVICES



KONGSBERG



KONGSBERG ENGINEERING SERVICES

Hydrodynamic services

KONGSBERG is the only marine propulsion company with its own hydrodynamic test facility, research centre and ocean hydrodynamics group. Kongsberg Maritime is at the forefront of marine technology research and makes a significant contribution to the fuel efficiency and environmental performance of the global maritime industry.

Ship & Propulsion performance simulations

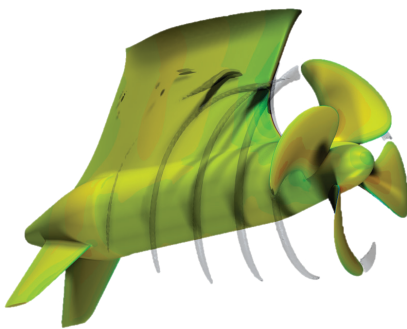
CFD simulations is a key part of the hydrodynamic capabilities at KONGSBERG supporting both internal and external customers. KONGSBERG'S High-Performance Computer Clusters allow simulations conducted in a short time frame. These simulation capabilities are available for our customers, as a hydrodynamic service, to support design and optimization.

Manoeuvring and vessel response simulations

Estimation of environmental loads are important when designing ships having manoeuvring and operational criterions. KONGSBERG have capability to combine CFD and time-domain analysis tools for simulation of ships both in calm water and seaways with variable heading and speed. Results can be used for vessel response, seakeeping, station keeping and DP analysis.

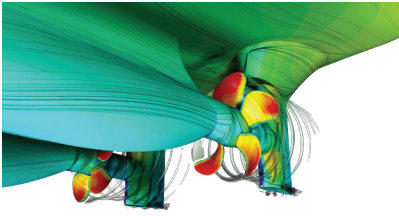
Cavitation tunnel testing

Unlike other propulsor suppliers, KONGSBERG has its own marine propulsion laboratory in Kristinehamn, Sweden, equipped with two cavitation tunnels, one free-surface and one conventional tunnel, giving a unique capability of KONGSBERG to combine in-house experimental testing and numerical simulations build confidence in CFD models used for design and optimization.

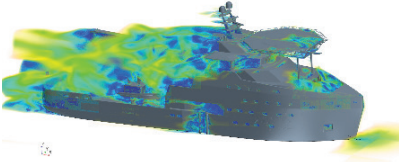


HYDRODYNAMIC SERVICES

- Ship & Propulsion performance simulations
- Manoeuvring and vessel response simulations
- Cavitation tunnel testing
- Full-scale observations & measurements



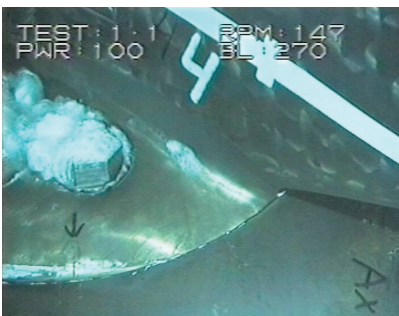
Ship & Propulsion performance simulations



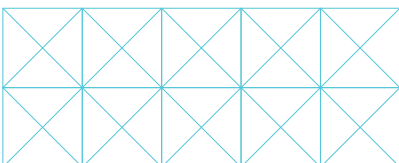
Manoeuvring and vessel response simulations



Cavitation Tunnel Testing



Full-scale observations & measurements



Full-scale observations & measurements

KONGSBERG has since the mid 1950's been conducting observations and measurements of full-scale propeller cavitation for the purpose of correlating with model-scale observations and verify performance of the real ship. For most propulsion suppliers it is a normal procedure to check the propulsor designs with regard to their general performance i.e. power absorption, efficiency etc. by analysing the results achieved at ordinary sea trials. The feedback thus obtained is a basic condition for success in future design work. However, in order to obtain more detailed full-scale information required for deeper analysis of theoretical calculations and model test results, several steps must be taken beyond the routines of ordinary sea trials.

EXAMPLES OF SERVICES

Ship & Propulsion performance simulations

- Hull resistance and nominal wake
- Propulsion in a seaway
- Propeller or thruster open water
- Self-propulsion and speed prognosis
- Propulsion and hull integration
- Optimization of propulsion systems
- Cavitation and pressure pulse predictions
- Waterjet propulsion

Manoeuvring and Vessel Response Simulations

- Analysis of wind, current and waves
- Station keeping / low speed manoeuvring analysis
- IMO Manoeuvres
- Zig-zag and Turning Circle
- Time domain vessel response simulations in calm water and waves

Cavitation Tunnel Testing

- Propeller & hull cavitation test
- Propeller open water test
- Propeller, rudder, nozzle test
- Cavitation erosion resistance testing
- Thruster/POD cavitation test
- Thruster/POD bollard pull test
- Waterjet system cavitation test
- Waterjet pump loop test

Full-scale observations & measurements

KHRC supports the following the full-scale measurement methods/ techniques:

- Cavitation observations
 - Hull windows and stroboscopic lights
 - Borescopes
- Load measurements – strain gauges
 - Shaft torque/power
 - Stresses
- Pressure, sound, noise
 - Pressure gauges
 - Hydrophones
 - Microphones
- Vibration levels
 - 3-axis accelerometers