WIND-ASSISTED SHIP PROPULSION

DEVELOPMENT OF A PERFORMANCE PREDICTION PROGRAM FOR COMMERCIAL SHIPS

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INTRODUCTION

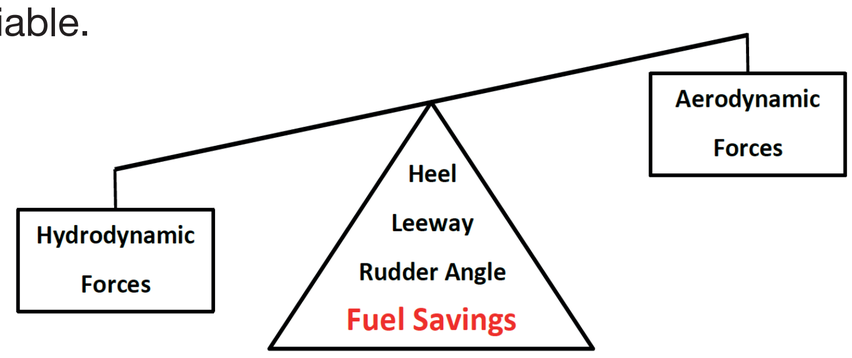
Wind energy as an auxiliary form of propulsion for commercial ships has again become of great interest as a possible solution to reduce fuel consumption, thereby reducing operating costs and emissions. However, the development of practical and commercially feasible wind-assisted ships is hampered by difficulties in modelling the sophisticated aerodynamic and hydrodynamic aspects involved.

PROJECT STRUCTURE

The goal is to deliver a Performance Prediction Program (PPP) that is founded on accurate physical models. This work is supported by the European Commission as part of the JOULES project. Industry partners include MARIN, DAMEN Group, and Dykstra Naval Architects. Expected delivery in 2018.

STRUCTURE OF THE PPP

The fundamental task of the PPP solver is to balance the aerodynamic and hydrodynamic forces acting on the wind-assisted ship under study to arrive at a sailing equilibrium. The PPP solver optimizes the equilibrium by maximizing fuel savings while maintaining operating speed, or by maximizing forward speed. The first option is now considered to be the most comercially viable.



THE PPP AS A DESIGN TOOL

The use of regression formulas based on databases, gives an easy-to-use, quick and reliable tool for initial exploration of the design space. During the advanced design stage, the PPP solver structure can also accept forces obtained by means of dedicated experiments and/or CFD computations, leading to more accurate results.

The aerodynamic forces are influenced by the presence of the ship (hull, cargo, etc.)

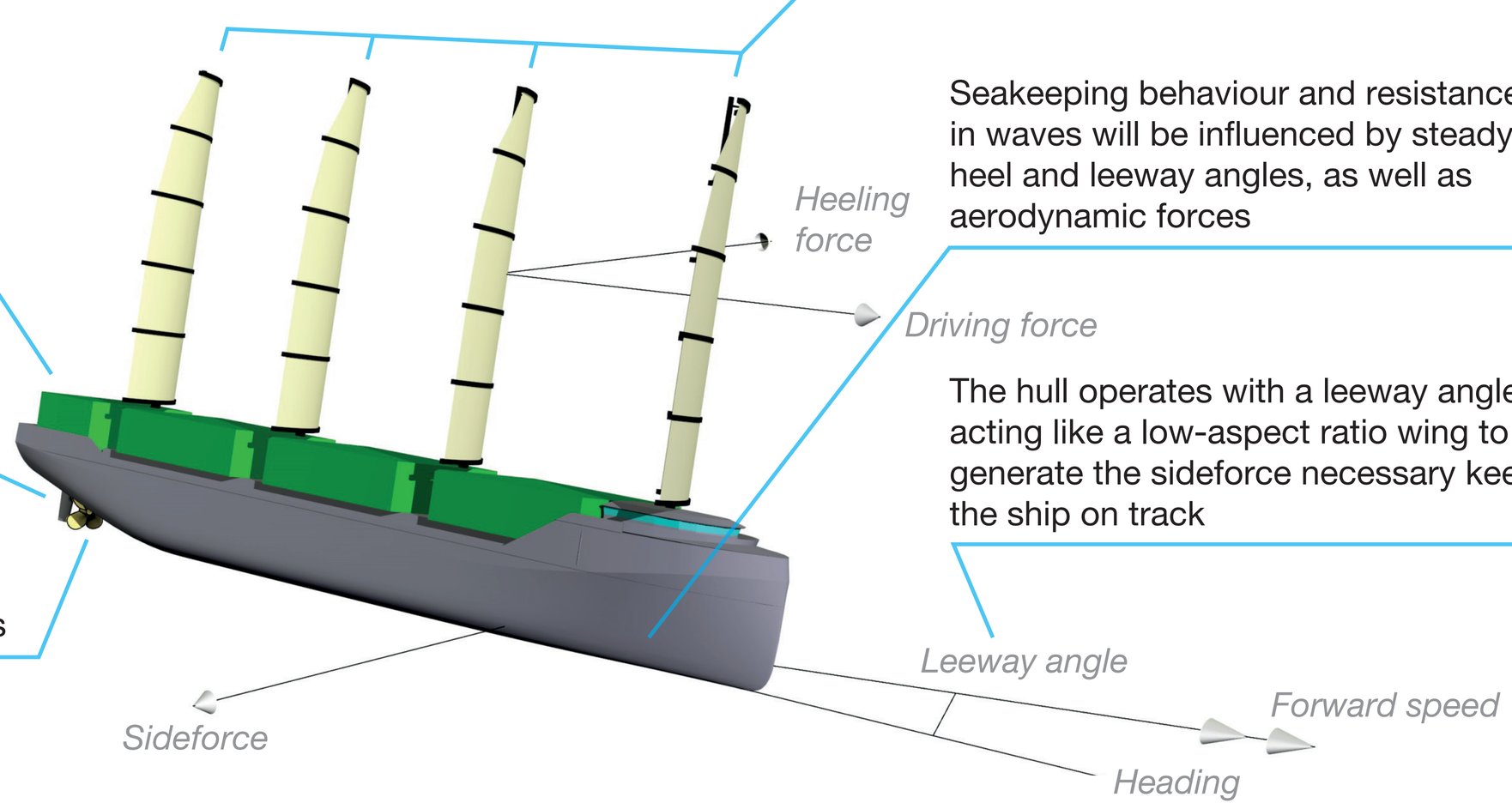
Helm/Yaw balance: the sum of acting moments must be within acceptable limits for maneuverability

Off-design propeller inflow and lightly-loaded operating conditions

Interaction effects between multiple wind propulsors on the deck of the ship

Seakeeping behaviour and resistance in waves will be influenced by steady heel and leeway angles, as well as aerodynamic forces

The hull operates with a leeway angle: acting like a low-aspect ratio wing to generate the sideforce necessary keep the ship on track

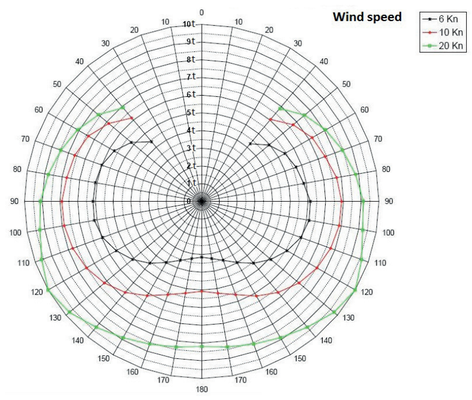


THE PPP WITHIN THE ECONOMIC/ENVIRONMENTAL EVALUATION

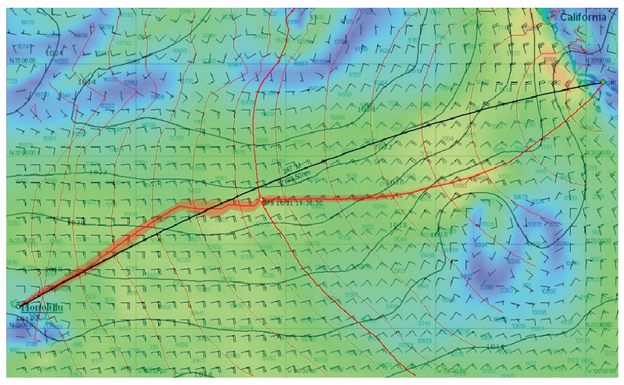
The reliable prediction of the performance of a wind-assisted ship is necessary to make a sound economic and evironmental evaluation.

1. PPP Output

Tons fuel saved per hour



2. Routing programs compute the fuel saving potential for a given shipping route



3. Economic and environmental evaluation



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