Improving the Performance of a Sail-asssisted Cargo Vessel

E. Mobron

3ME, Delft University of Technology

INTRODUCTION

The shipping industry is known to be one of biggest contributors to pollution and global warming. Fortunately, shipping authorities have come up with stringent regulations aiming at large reductions in CO_2, NO_x and SO_X. These require double digit efficiency improvements rather than one or two percents. To comply with these regulations and to satisfy shareholders, suffering from high oil prices, sail-assist is proposed as a solution to save fuel. To convince investors that wind-assist is beneficial for the environment as well as their bank account, there is a need for reliable predictions on fuel savings. In this research, a methodology is developed that can give trustworthy figures on fuel savings and margins of profit and provides more insight into the hull form of a sail-assisted cargo vessel.

THEORY

A sail-assisted cargo vessel works by the forward force induced by engine and sails. The larger the force from the sails, the less power is required by the engine and thus the larger is the fuel saving. However, the sails also produce a force in lateral direction, called the heeling force. This force is counteracted by an equal and opposite force induced by the hull: side force. The hull form and dimensions determine how much resistance is associated with producing this side force and thus how much additional power is required from the engine.
The dimensions of the hull also have an effect on the costs of building it: a longer vessel is more expensive. As in many engineering problems a hull that performs well in terms of kilonewtons performs badly in terms of euros. The question then is what hull dimensions provide the optimum compromise.

METHODS

A combination of existing methods has been used in order to assess the total costs of a number of vessel variations. First, the hydrodynamic performance of the hull is determined by use of Computational Fluid Dynamics (CFD). This data is used for a routing simulation that uses historic weather data in order to simulate a vessel's operation during twenty years. From this, the fuel consumption can be determined. Finally, the fuel costs and the building cost are combined to provide a figure for the economic performance. By systematically assessing a set of variations an optimum hull can be found and it can be compared to a conventional cargo vessel with the same capacity.

RESULTS

The simulation shows that the extra investment in the rig is compensated by the fuel savings and cost reductions of 28% can be achieved, leading to higher profit and lower emissions.

CONCLUSIONS

It is concluded that for a roundtrip between Gibraltar and Miami and for a given average speed, sail-assist is a good alternative for conventional cargo vessels, both in terms of economics and emissions.