Traditionally ships have been designed and optimised with one single design point in focus - one speed and one draught. The past years increasing fuel prices and less cargo have forced ship owners to leave the design point and operate their ships at lower speeds and lighter draughts. Consequently ships are now not operating at their design point and depended on the design this can result in a poor performance primarily ships with a bulbous bow are sensitive to operation at ‘off design’ conditions.

**Advantages**

As mentioned above cargo ships are generally not just operating on a single draught and speed but at a variety of draughts and speeds therefore a new paradigm for ship design has begun; which is optimising a ship for an operational profile, hence resulting in a design which at a certain condition might not be as optimal as possible however the penalty for operating off this condition is low. Basically offering the owner a ship with a broad range of good performance instead of one condition with excellent performance and poor performance out of this condition.

The poor ‘off design’ performance can for existing ships particularly with bulbous bows to some extend be improved by changing the trim however there is also the possibility for retrofitting the ship with a new bulbous bow to further improve the performance.
A new bulbous bow

In a case study performed on a Clipper G-class multipurpose vessel with a pronounced upwards pointing bulbous bow designed for deep draught and high speed, FORCE Technology found that changing the design of the bulbous bow would lead to a weighted saving of 11.7% based on the ships’ operational profile.

In a bulbous bow retrofit study the limits defining the cut-off area are essential. Increasing the cut-off area increases the cost of the retrofit, but gives larger freedom for the optimisation process and possibility of larger savings. Therefore, defining the cut-off area is a trade off between retrofitting costs and potential savings.

Combining methods

To obtain the best possible design of the new bulbous bow parametric optimisation is utilised.

The parametric optimisation which is performed utilising the FRIENDSHIP Framework coupled to the RANS CFD code STAR-CMM+. The design space is investigated before a tangent search algorithm is used searching for minimum weighted power based on the operational profile. Various constraints such as bulbous bow length etc. can be considered during the optimisation procedure.

The calculated power/fuel savings and rebuilt cost are finally used as input to a financial analysis determining the payback period for the retrofit.

A sea of candidates

Looking at the world fleet many potential candidates for a bulbous bow retrofit can be found ranging from smaller multipurpose vessels to very large container vessels.

Due to the present market conditions, the most obvious candidates have a pronounced upwards pointing bulbous bow designed for deep draught and high speed.