Tunnel thruster sizing for NavCad

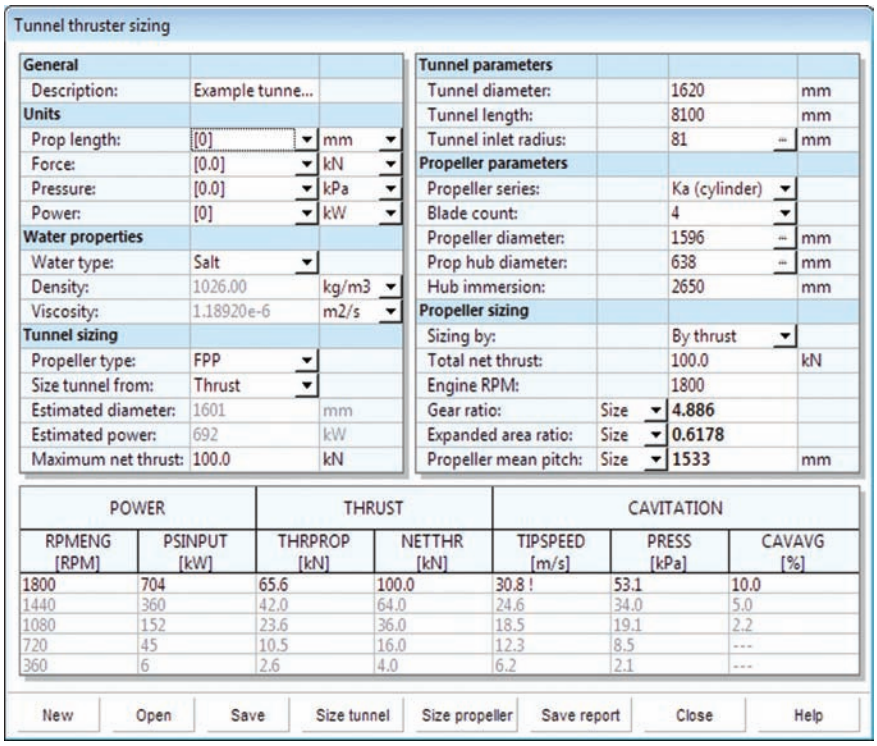
HydroComp says it has developed a reliable and accurate module for sizing and analysing the performance of bow and stern thrusters. The latest tool analyses thruster geometry for conventional tunnel thrusters. Donald MacPherson, VP technical director of HydroComp, Inc. explains further

Early in 2012, HydroComp, Inc. (with the support of Thrustmaster of Texas) embarked on the development of a new module for the HydroComp NavCad software that would provide users with a reliable, accurate, and hydrodynamically valid tool to size principal tunnel thruster characteristics.

This latest Tunnel Thruster Sizing Tool can be used to size and analyse bow and stern tunnel thruster geometry including the thruster's propeller. The current release of the tool supports conventional transverse cylindrical tunnels using a typical right-angle gear drive with a four-bladed fixed-pitch propeller (FPP) of a Kaplan shape.

The data used in this tool is independent from NavCad's active project, so no vessel needs to be defined to use the utility, and all file handling is within the utility itself. There are two principal calculation modules in the utility:

- sizing of the tunnel (diameter vs. power vs. thrust), and
- sizing of the propeller (gear ratio, blade area ratio, and pitch).



The latest HydroComp release see's enhancements in tunnel thruster performance

Tunnel as a quasi-duct

Flow curvature into (and out of) a thruster tunnel creates a useful thrust component, much in the same way that a nozzle contributes thrust to a ducted propeller unit. Therefore, the total net thrust is the sum of the thrust of the propeller plus the added thrust from the tunnel's influence.

The prediction of a tunnel's contribution is built upon a nozzle contribution methodology developed for the HydroComp PropElements detail propeller design software. The equivalent "duct" in this model is an axial cylinder (the tunnel), where the a prediction of the tunnel thrust contribution is a function of propeller loading, tunnel inlet radius, tunnel length, propeller hub size, and the tip gap (between the propeller and tunnel wall). The performance prediction model for tunnel geometry was developed using a collection of model tests of tunnel thrusters.

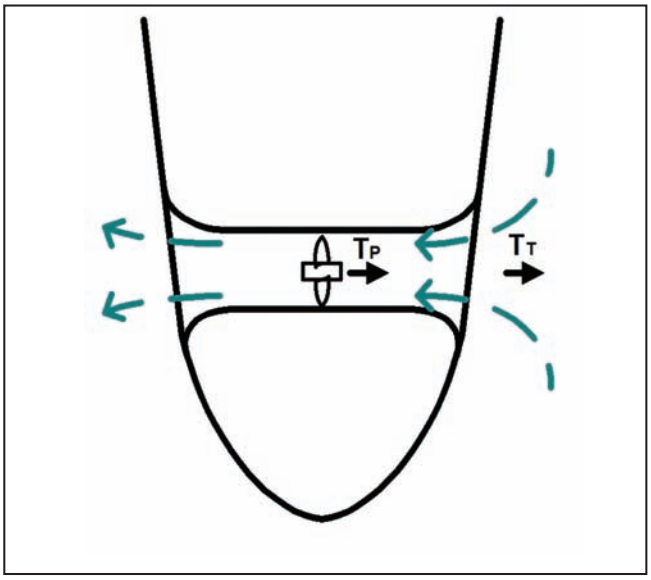
Tunnel sizing

The utility allows the initial sizing of proper tunnel diameter, input power, or maximum net thrust (given one of the three variables). For this aspect of the tool, HydroComp collected and evaluated a very large collection of published information from numerous international tunnel thruster manufacturers. The prediction of the basic tunnel characteristics is fitted from this data, whereby power and thrust are functions of the square of diameter (relating to a fundamental thrust or power loading).

This step is just for the initial sizing of the tunnel's basic characteristics, and as such, the thrust and power determined in this step are preliminary figures relating solely to the tunnel diameter. As the geometric properties of the tunnel are further defined (e.g., length, inlet radius, hub diameter), the propeller sizing step will predict real delivered thrust and power figures for the tunnel-propeller system.

Propeller sizing

The propeller sizing feature for the tunnel thruster utility uses common propeller sizing calculation functions from NavCad. The fundamental propeller KT and KQ performance is based on HydroComp-developed prediction algorithms for



The tool can be used on bow and stern thrusters

4-bladed Kaplan style propellers in axial cylinders – with a correction to properly model fully symmetric sections. The sizing is conducted at a nominal bollard case, with proper losses applied to account for the right-angle gear efficiency. The cavitation limit for the sizing is based on a "10% back cavitation" constraint.

Data entry and interface

The interface for the Tunnel Thruster Sizing Tool employs data entry tables for a) basic properties and tunnel sizing, b) propeller parameter sizing, and c) performance results. Processes are launched with the command buttons. A sample of the Tunnel Thruster Sizing Tool interface is shown below.

Validation and deployment

The tunnel thruster sizing tool has been extensively tested and validated. The tool is currently deployed as part of the NavCad 2012+ platform. Planned future development includes support for controllable-pitch propellers. A separate development effort is nearly complete for the sizing and analysis of hubless rim-driven tunnel thrusters for the HydroComp PropElements detail propeller design tool. *NA*