On the logics of the evaluation of ship speed trials

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Introduction

The traditional way of conducting and evaluating ship speed trials is very costly and involved and at the same time **not very trustworthy**.

A proposal for a clear-cut procedure based on the directly identified power function alone has been submitted as contribution to ISO/WD 15016.

Power function

The **power function of ship propellers in the behind condition can be identified with systems identification techniques from a minimum of test runs**, which need not even be stationary, and with a minimum of conventions and without reference to model test results, **as it should be**.

Power function, cont'd

P = Power(V, N)

relating shaft power P, speed through the water V and the rate of shaft revolutions N, to be visualized as a surface in three dimensional space.

The format and the direct identification of its parameters are not subject of the present discussion.

Contract conditions

Contracted power P_{contr} at the speed V_{contr} and at the rate of revolutions N_{contr}, **derived from or at least confirmed by model test results**.

For given power P_{contr} and speed V_{contr} rate of revolution actually required:

$$P_{contr} = \text{Power}(V_{contr}, \mathbf{N_{req}}) .$$

Resistance function

R = Resist(V, N)

relating resistance R, speed through the water V and rate of shaft revolutions N, again to be visualized as a surface in three dimensional space.

The format and the direct identification of its parameters are again not subject of the present discussion.

Traditional procedure

Determination of the resistance extrapolated to contract conditions

$\mathbf{R_{extr}} = R_{trial} - \Delta R$,

the rate of shaft revolutions required

$\text{Resist}(V_{contr} , \mathbf{N_{req}}) = R_{extr}$,

and subsequently the power required

$\mathbf{P_{req}} = \text{Power}(V_{contr}, N_{req})$.

Traditional procedure, cont'd

If every step of this procedure is free of error, systematic or random, the required rate of revolutions equals the one determined via the direct path and the required power equals the contracted power:

$\mathbf{P_{req} = P_{contr}}$.

Unsolved problems

The parameters of the resistance function **can in practice not be identified directly** for the ship due to the difficulty of thrust measurements; **one has to rely on model test results**. **But the traditional conventions on the thrust deduction fraction are not adequate.**

Unsolved problems, cont'd

The determination of the extrapolated resistance has to rely on a large number of further traditional conventions.

Consequently **the values of the extrapolated resistance and of the corresponding required rate of revolutions cannot be very reliable.**

Unsolved problems, cont'd

The traditional procedure is further obscured by the iterative identification of the power function and the current velocity. In the proposed method optimum estimates are obtained for both in one step, identifying them together by solving only one system of linear equations.

Unsolved problems, cont’d

Usually in the discussion **normalised quantities are being used instead of physical quantities**. This does of course not change the argument but introduces further confusion although instead of two arguments, speed and rate of revolution, only one, the advance ratio, is necessary.

Open question

In view of these problems why should one climb all the way through the resistance surface, not directly identified, and **arrive at best approximately at a point, which can be reached exactly without any problems on the direct route** along the directly identified power surface?

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