# COMPARISON OF DIFFERENT SCALING METHODS FOR MODEL TESTS WITH CLT PROPELLERS

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Energy saving is a primary objective, if not the first and probably still the most important one, especially considering the present worldwide economic crisis, in the design of marine propellers. In parallel to this, the stricter regulations in terms of air pollution, and the lower limits for $NO_X$ and $SO_X$ emissions require ever more efficient designs. CLT propellers represent an opportunity to increase ship propulsion efficiency [1]; however, being unconventional, their design presents larger difficulties, among which the necessity for suitable scaling procedures from model to full scale.

As it is well known, the propulsive performances of a propeller are usually checked by means of Open Water Tests in uniform flow and Self Propulsion Tests with hull; both SPT and OWT are carried out at much lower Reynolds number than full scale, so that model test results are affected by viscous scale effects, and suitable extrapolation procedures are needed.

CLT propellers are affected by larger scale effects than conventional propellers because of the higher tip loading and of the complex phenomena related to the presence of the end plate, with possible separation phenomena at model scale. In order to overcome this issue, SISTEMAR and CEHIPAR have introduced ad hoc corrections to the ITTC 1978 OWT results scaling procedure, taking into account scale effects on lift and viscous forces over the blades and on viscous forces over the end plates [2]. This CLT scaling procedure has been validated and refined by means of the continuous comparison between model and full scale tests, increasing the database for the correlation coefficients and thus the reliability of the procedure.

In present work, possible alternatives to the usually adopted procedure are considered, in order to have a better insight into this phenomenon. In particular, a scaling method, based on the strip method developed by SINM [3] is presented, together with direct calculations in model and full scale made with panel methods developed by UNIGE [4], and with direct computations by a RANS solver made by VTT [5].

The corrections in KT and KQ derived by means of different approaches are compared, considering a reference case, the high speed ferry “Fortuny” of the Spanish company ACCIONA TRASMEDITERRANEA, for which reliable model test and sea trials results with CLT propellers are available thanks to a previous R&D project sponsored by the Spanish authorities in 2003 [6]. This comparison allows to assess the merits and shortcomings of different methods; moreover, the analysis of the numerical calculations adopted allows to obtain a more direct view of the various phenomena typical of the

CLT propellers, gaining further information for the development of suitable scaling procedures.

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