Propulsion tests: quasi-steady for efficiency and quality

Report explains why the quasi-steady approach is gradually replacing the conventional method in model propulsion tests.

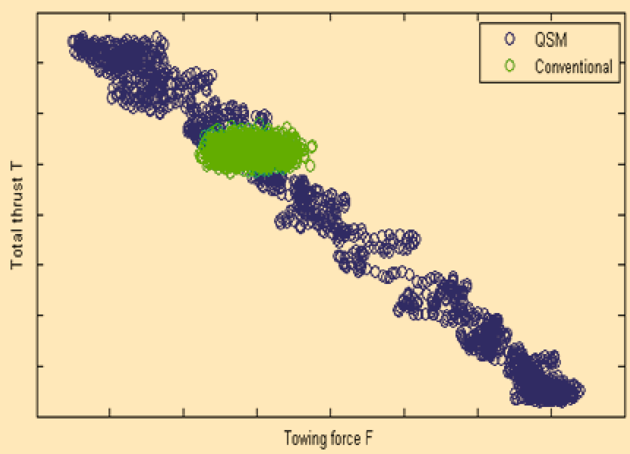
For open water tests the quasi-steady approach has been the standard for some years now. And we have made good progress to have this technique also available for model propulsion tests. Instead of a constant loading (RPM) of the propulsors during the measurement, a variation is imposed which is slow enough to basically consider each sample representative of a steady situation (quasi-steady).

The information obtained from this load variation is required because the assumption of constant interaction coefficients for any propeller load (which is made when the variation is not done) often is too crude. For example, the variation of the effective wake fraction for full block vessels. An extreme case would be contra-rotating propulsors, where the interaction between the propellers is large and no complete analysis (e.g. power distributions) can be done without loading variations.

At MARIN the loading variation part - by means of additional runs - has always been a standard part of the propulsion test. ITTC now also requires model test data to include this information for use in the analysis of full-scale speed and power trials. The figure shows the additional information that is obtained with the quasi-steady method (QSM) over the conventional one. With the QSM approach there is no need to do the additional runs, which makes the tests more efficient without sacrificing quality. All the important effects are still captured.

Recently we completed a validation campaign in which propulsion tests with both the conventional, as well as the quasi-steady method, were performed for each ship model. Comparisons between the results of both methods show on average identical results, with differences in predicted power of less than 2% and generally around 1%. This is in line with earlier work from Holtrop[1].

We will gradually replace the conventional method by the new one, initially by applying it to short tests for measurement series such as trim tests, where a complete and accurate analysis can now already be made for a single test speed. In this way we combine increased model test efficiency with higher model test quality.



Thrust – towing force samples measured in a single measurement for the conventional and QSM method

1 Holtrop J, Hooijmans P, (2002), "Quasi-Steady Model Experiments on Hybrid Propulsion Arrangements", Group Discussion A.1: New Experimental Techniques and Facilities, Proceedings of the 23rd ITTC, Vol 3.

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