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To whom it may concern

Powering performance of a bulk carrier during speed trials in ballast condition at two trim settings reduced to the nominal no wind and waves condition

As next evaluated data at the first, at the smaller trim, i. e. at the smaller nominal propeller submergence

Title of the file corrected on
1306171650

Units, constants, routines

Reference:C:\ANONYMA_5\routines .mcd

Trials identification

TID = "ANONYMA"

Constants

Trials condition	trim := 1	
Trim at trials	$\Delta T := 1.44 \cdot m$	$\Delta T := \frac{\Delta T}{m}$
Draught aft	$T_{aft} := 6.07 \cdot m$	$T_{aft} := \frac{T_{aft}}{m}$
Propeller tip below undisturbed surface, estimated	$\Delta T_{Tip} := 0.27 \ m$	

Input of mean data

means := READPRN("Means_1.prn")

rstdevs := READPRN("rSdvM_1.prn")

nr := rows(means)	run := 0 .. nr − 1	nr = 6.000
nc := cols(means)	mag := 0 .. nc − 1	nc = 17.000

Assign data

reported

Time	$t := \text{means}^{\langle 0 \rangle} \cdot \text{hr}$	$t := \dfrac{t}{\text{hr}}$	
Shaft frequency	$N_S := \text{means}^{\langle 2 \rangle} \cdot \text{Hz}$	$N_S := \dfrac{N_S}{\text{Hz}}$	$N_{S.rsdm} := \text{rstdevs}^{\langle 2 \rangle}$
Shaft power	$P_S := \text{means}^{\langle 1 \rangle} \cdot \text{W}$	$P_S := \dfrac{P_S}{\text{MW}}$	$P_{S.rsdm} := \text{rstdevs}^{\langle 1 \rangle}$
Speed over ground	$V_G := \text{means}^{\langle 3 \rangle} \cdot \dfrac{\text{m}}{\text{s}}$	$V_G := \dfrac{V_G \cdot \text{s}}{\text{m}}$	$V_{G.rsdm} := \text{rstdevs}^{\langle 3 \rangle}$
Wind speed	$V_W := \text{means}^{\langle 7 \rangle} \dfrac{\text{m}}{\text{s}}$	$V_W := \dfrac{V_W \cdot \text{s}}{\text{m}}$	$V_{W.rsdm} := \text{rstdevs}^{\langle 7 \rangle}$
Wind direction	$\psi_W := \text{means}^{\langle 6 \rangle} \cdot \dfrac{\text{deg}}{\text{rad}}$		$\psi_{W.rsdm} := \text{rstdevs}^{\langle 6 \rangle}$
Trim	$\Delta T := \text{means}^{\langle 5 \rangle} \text{ m}$	$\Delta T := \dfrac{\Delta T}{\text{m}}$	$\Delta T_{rsdm} := \text{rstdevs}^{\langle 5 \rangle}$
Ship speed in water	$V_{H.rep} := \text{means}^{\langle 15 \rangle} \dfrac{\text{m}}{\text{s}}$	$V_{H.rep} := \dfrac{V_{H.rep} \cdot \text{s}}{\text{m}}$	$V_{H.rep.rsdm} := \text{rstdevs}^{\langle 15 \rangle}$

Data in SI-Units non-dimensionalized in view of further use in some mathematical subroutines, which by definition cannot handle arguments with (different) physical dimensions!

Mean values, intermediate results

For ready reference the matrices of the mean values of the measured magnitudes, alias 'quantities', are printed here. Further down intermediate results are printed as well to permit checks óf plausibility.

$$t = \begin{bmatrix} -0.989 \\ -0.647 \\ -0.200 \\ 0.161 \\ 0.587 \\ 1.088 \end{bmatrix} \quad N_S = \begin{bmatrix} 1.588 \\ 1.580 \\ 1.746 \\ 1.892 \\ 1.893 \\ 1.747 \end{bmatrix} \quad P_S = \begin{bmatrix} 3.700 \\ 3.602 \\ 5.027 \\ 6.590 \\ 6.343 \\ 4.945 \end{bmatrix} \quad V_G = \begin{bmatrix} 6.819 \\ 4.475 \\ 5.455 \\ 6.584 \\ 7.946 \\ 7.439 \end{bmatrix}$$

$$V_W = \begin{bmatrix} 7.120 \\ 11.710 \\ 12.190 \\ 12.630 \\ 6.721 \\ 6.685 \end{bmatrix} \quad \psi_W = \begin{bmatrix} 5.095 \\ 0.406 \\ 0.369 \\ 0.306 \\ 5.489 \\ 5.442 \end{bmatrix} \quad \Delta T = \begin{bmatrix} 1.276 \\ 1.222 \\ 1.225 \\ 1.211 \\ 1.266 \\ 1.278 \end{bmatrix} \quad V_{H.rep} = \begin{bmatrix} 6.819 \\ 4.475 \\ 5.455 \\ 6.584 \\ 7.945 \\ 7.439 \end{bmatrix}$$

Relative (!) standard deviations of mean (!) values

For ready reference the matrices of the relative (!) standard deviations of mean values of the measured magnitudes are also printed here, conveniently in %. Multiplied by the factor 2 these values are estimates of the 95% confidence radii of the mean values.

$$\frac{N_{S.rsdm}}{\%} = \begin{bmatrix} 0.031 \\ 0.093 \\ 0.054 \\ 0.021 \\ 0.019 \\ 0.026 \end{bmatrix} \quad \frac{P_{S.rsdm}}{\%} = \begin{bmatrix} 0.139 \\ 0.297 \\ 0.210 \\ 0.083 \\ 0.077 \\ 0.115 \end{bmatrix} \quad \frac{V_{G.rsdm}}{\%} = \begin{bmatrix} 0.039 \\ 0.114 \\ 0.077 \\ 0.058 \\ 0.027 \\ 0.036 \end{bmatrix}$$

$$\frac{V_{W.rsdm}}{\%} = \begin{bmatrix} 0.619 \\ 0.356 \\ 0.252 \\ 0.352 \\ 0.556 \\ 0.578 \end{bmatrix} \quad \frac{\psi_{W.rsdm}}{\%} = \begin{bmatrix} 0.098 \\ 0.834 \\ 0.810 \\ 0.715 \\ 0.167 \\ 0.129 \end{bmatrix} \quad \frac{\Delta T_{rsdm}}{\%} = \begin{bmatrix} 1.425 \\ 4.980 \\ 3.363 \\ 2.613 \\ 1.291 \\ 1.288 \end{bmatrix} \quad \frac{V_{H.rep.rsdm}}{\%} = \begin{bmatrix} 0.039 \\ 0.114 \\ 0.077 \\ 0.058 \\ 0.027 \\ 0.036 \end{bmatrix}$$

At the up-wind conditions, runs 2, 3, 4 (indices 1, 2, 3), the wind direction is varying considerably. The variations in the trim are also noteworthy.

Normalise data

for preliminary check of consistency only!

$n_i := \mathrm{last}(t)$

$i := 0 .. n_i$

$J_{G_i} := J\left(D, V_{G_i}, N_{S_i}\right)$

$K_{P_i} := KP\left(\rho, D, P_{S_i}, N_{S_i}\right)$

$$J_G = \begin{bmatrix} 0.740 \\ 0.488 \\ 0.539 \\ 0.600 \\ 0.724 \\ 0.734 \end{bmatrix} \qquad K_P = \begin{bmatrix} 0.137 \\ 0.136 \\ 0.140 \\ 0.145 \\ 0.139 \\ 0.138 \end{bmatrix}$$

Sort data in down and up-wind

$S := \mathrm{Sort\_runs}\left(J_G, K_P, \psi_H\right)$

$J_{G.do} := S^{\langle 0 \rangle}$ $\qquad J_{G.do} = \begin{bmatrix} 0.740 \\ 0.724 \\ 0.734 \end{bmatrix}$ $\qquad K_{P.do.or} := S^{\langle 1 \rangle}$ $\qquad K_{P.do.or} = \begin{bmatrix} 0.137 \\ 0.139 \\ 0.138 \end{bmatrix}$

$J_{G.up} := S^{\langle 2 \rangle}$ $\qquad J_{G.up} = \begin{bmatrix} 0.488 \\ 0.539 \\ 0.600 \end{bmatrix}$ $\qquad K_{P.up.or} := S^{\langle 3 \rangle}$ $\qquad K_{P.up.or} = \begin{bmatrix} 0.136 \\ 0.140 \\ 0.145 \end{bmatrix}$

All results at trim 2

trim := 2

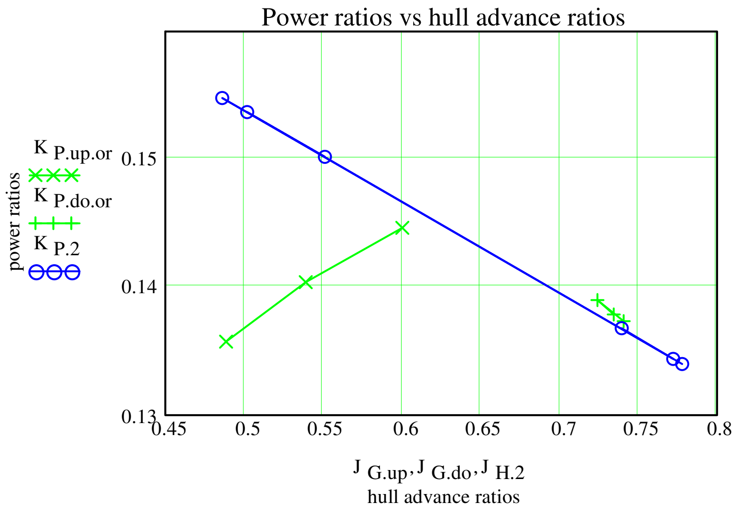
$Res_{sup\_2} := READPRN("Res\_sup\_2.prn")$

$Res_{req\_2} := READPRN("Res\_req\_2.prn")$

$\left[P_{S.E.sup.2} \; v_{C.2} \; V_{C.2} \; p_{C.2} \; V_{H.2} \; P_{S.2} \; p_{n.2} \; J_{H.2} \; K_{P.2} \right] := Res_{sup\_2}$

$\left[P_{S.E.req.2} \; q_2 \; V_{H.2} \; P_{S.req.2.0} \; P_{S.req.2.1} \; P_{S.2} \; N_{S.2} \right] := Res_{req\_2}$

Scrutinise data



Evidently **the propeller is ventilated at the up-wind condition. Thus the global evaluation is non-sensensical, particularly with 'corrected' values!**
The ventilation is presumably due to the very small submergence of the propeller in combination with the pitching in the sea state reported..

Evaluation

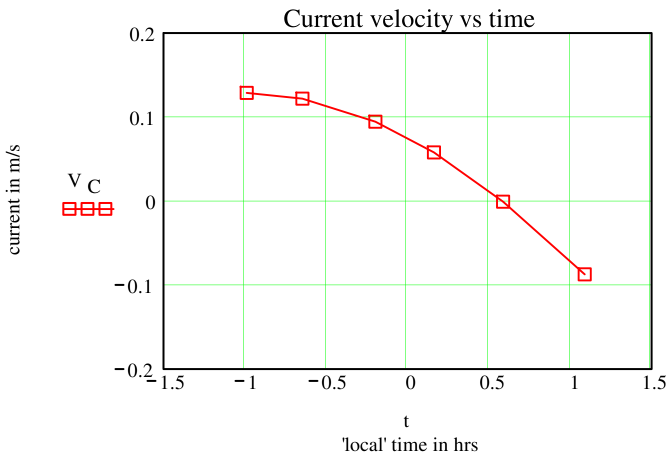
differing from my standard routine
concerning the power supplied
due to propeller ventilation up-wind

$trim := 1$

Current velocity

as extrapolated from trials at the larger trim!

$V_C := READPRN("V.C.1.prn")$

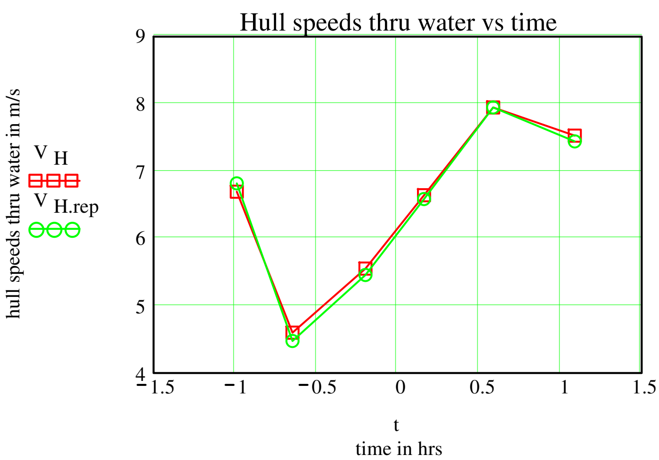


$$V_C = \begin{bmatrix} 0.129 \\ 0.122 \\ 0.094 \\ 0.058 \\ -9.648\cdot10^{-4} \\ -0.087 \end{bmatrix}$$

Hull speed thru water

$V_{H_i} := V_{G_i} - dir\left(\psi_{H_i}\right)\cdot V_{C_i}$

As in case of the reported KP = 2 π KQ values one correction has been made in the original evaluation according to ISO 15016: 2002-06 reported.



$$V_H = \begin{bmatrix} 6.691 \\ 4.597 \\ 5.549 \\ 6.642 \\ 7.947 \\ 7.526 \end{bmatrix}$$

Sort data for runs up and down wind

$S_{i,0} := V_{H_i}$ $S_{i,1} := P_{S_i}$ $S_{i,2} := N_{S_i}$ $S_{i,3} := P_{S.rsdm_i}$

$S_{i,4} := t_i$ $S_{i,5} := V_{C_i}$ $S_{i,6} := V_{W_i}$ $S_{i,7} := \psi_{W_i}$

$S := \text{csort}(S, 0)$

$V_{H.1_i} := S_{i,0}$ $P_{S.1_i} := S_{i,1}$ $N_{S.1_i} := S_{i,2}$ $sd_{m.r_i} := S_{i,3}$

$t_{srt_i} := S_{i,4}$ $V_{C_i} := S_{i,5}$ $V_{W_i} := S_{i,6}$ $\psi_{W_i} := S_{i,7}$

$n_r := \frac{n}{2} - 1$

$j := 0 .. n_r$

$V_{H.up_j} := V_{H.1_j}$ $P_{S.up.or_j} := P_{S.1_j}$ $N_{S.up_j} := N_{S.1_j}$ $sd_{m.r.up_j} := sd_{m.r_j}$

$t_{up_j} := t_{srt_j}$ $V_{C.up_i} := V_{C_j}$ $V_{W.up_j} := V_{W_j}$ $\psi_{W.up_j} := \psi_{W_j}$

$\psi_{H.up_j} := \psi_{H.up}$

$V_{H.do_j} := V_{H.1_{3+j}}$ $P_{S.do.or_j} := P_{S.1_{3+j}}$ $N_{S.do_j} := N_{S.1_{3+j}}$ $sd_{m.r.do_j} := sd_{m.r_{3+j}}$

$t_{do_j} := t_{srt_{3+j}}$ $V_{C.do_i} := V_{C_{3+j}}$ $V_{W.do_j} := V_{W_{3+j}}$ $\psi_{W.do_j} := \psi_{W_{3+j}}$

$\psi_{H.do_j} := \psi_{H.do}$

Analyse powers supplied

$\left[P_{S.E.sup.up} \; p_{up} \; P_{S.up} \; p_{n.up} \; J_{H.up} \; K_{P.up} \right] := \text{No\_current}\left(\rho, D, V_{H.up}, N_{S.up}, P_{S.up.or}\right)$

$\left[P_{S.E.sup.do} \; p_{do} \; P_{S.do} \; p_{n.do} \; J_{H.do} \; K_{P.do} \right] := \text{No\_current}\left(\rho, D, V_{H.do}, N_{S.do}, P_{S.do.or}\right)$

Confidence ranges of mean powers

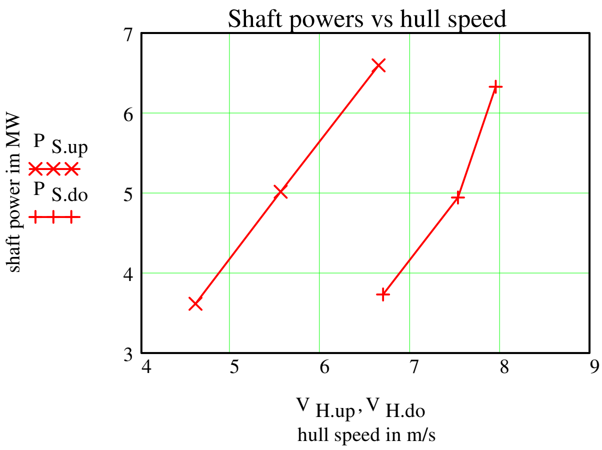
$j := 0 .. n_r$

$P_{S.sdv.up_j} := sd_{m.r.up_j} \cdot P_{S.up_j}$

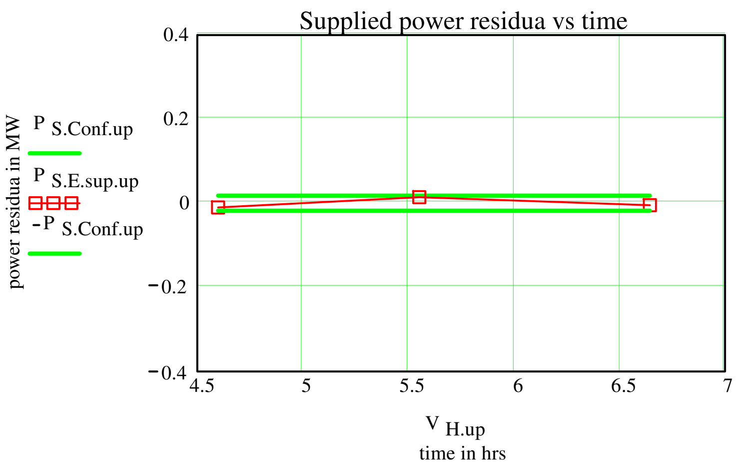
$P_{S.Conf.up_j} := 2 \cdot \text{mean}\left(P_{S.sdv.up}\right)$

$P_{S.sdv.do_j} := sd_{m.r.do_j} \cdot P_{S.do_j}$

$P_{S.Conf.do_j} := 2 \cdot \text{mean}\left(P_{S.sdv.do}\right)$

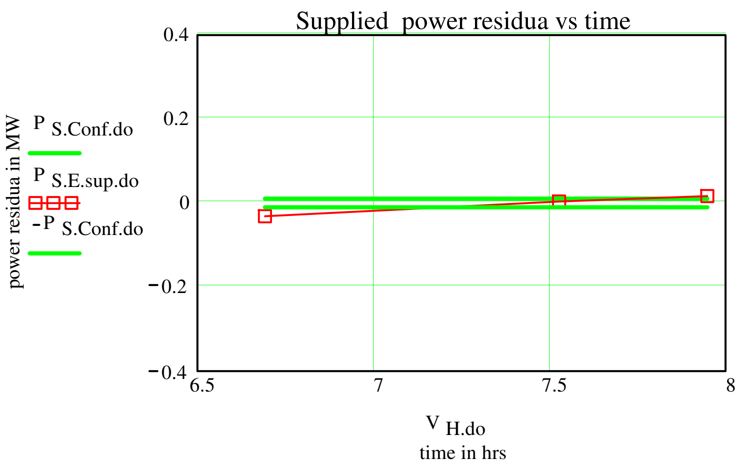


Supplied power residua up wind



$$P_{S.E.sup.up} = \begin{bmatrix} -0.011 \\ 0.014 \\ -0.005 \end{bmatrix}$$

Supplied power residua down wind



$$P_{S.E.sup.do} = \begin{bmatrix} -0.032 \\ 0.003 \\ 0.016 \end{bmatrix}$$

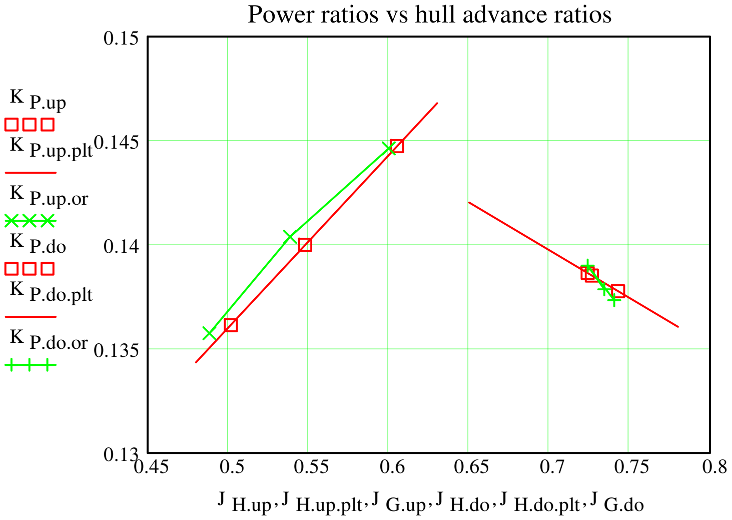
Plot normalised results

$k := 0 .. 1$

$J_{H.up.plt} := \begin{bmatrix} 0.48 \\ 0.63 \end{bmatrix}$ $\quad K_{P.up.plt_k} := p_{n.up_0} + p_{n.up_1} \cdot J_{H.up.plt_k}$

$J_{H.do.plt} := \begin{bmatrix} 0.65 \\ 0.78 \end{bmatrix}$ $\quad K_{P.do.plt_k} := p_{n.do_0} + p_{n.do_1} \cdot J_{H.do.plt_k}$

$J_{H.2.plt} := \begin{bmatrix} 0.45 \\ 0.85 \end{bmatrix}$ $\quad K_{P.2.plt_k} := p_{n.2_0} + p_{n.2_1} \cdot J_{H.2.plt_k}$



$J_{H.do} = \begin{bmatrix} 0.726 \\ 0.743 \\ 0.724 \end{bmatrix}$

$K_{P.do} = \begin{bmatrix} 0.139 \\ 0.138 \\ 0.139 \end{bmatrix}$

Analyse powers required

Due to the ventilation of the propeller at the up-wind runs of the trial with the first, the smaller trim the routines had to be further adapted.

Partial powers required identified

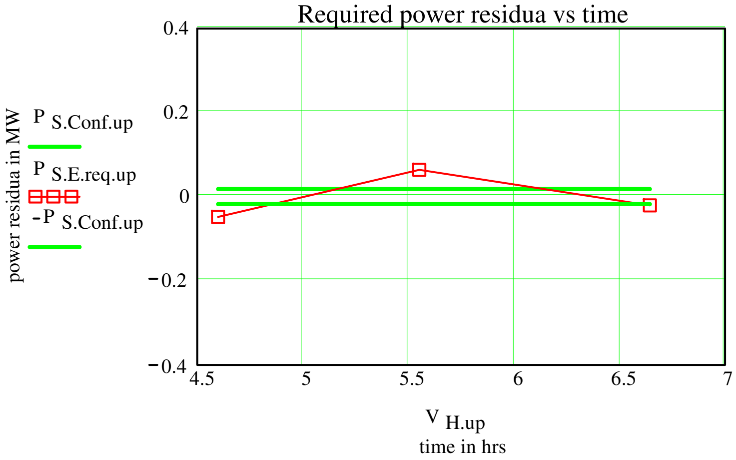
$Res_{req.up} := Required(V_{H.up}, \psi_{H.up}, V_{C.up}, P_{S.up.or}, V_{W.up}, \psi_{W.up})$

$\begin{bmatrix} P_{S.E.req.up} & q_{1.up} & P_{S.req.up} & P_{S.req.up.0} & P_{S.req.up.1} \end{bmatrix} := Res_{req.up}$

$Res_{req.do} := Required(V_{H.do}, \psi_{H.do}, V_{C.do}, P_{S.do.or}, V_{W.do}, \psi_{W.do})$

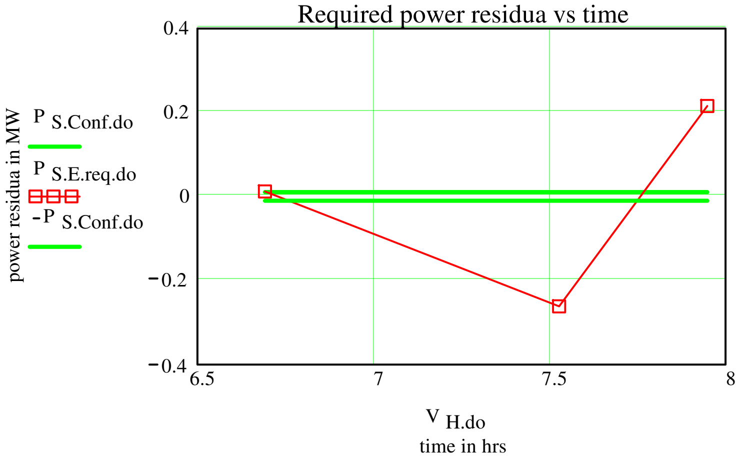
$\begin{bmatrix} P_{S.E.req.do} & q_{1.do} & P_{S.req.do} & P_{S.req.part.0} & P_{S.req.part.1} \end{bmatrix} := Res_{req.do}$

Required power residua up wind



$$q_{1.up} = \begin{bmatrix} 0.0064 \\ 0.0052 \end{bmatrix}$$

Required power residua down wind



$$q_{1.do} = \begin{bmatrix} 0.0122 \\ -9.2718 \cdot 10^{-4} \end{bmatrix}$$

As usual the required power residua are much larger than the supplied power residua due to the uncertainties of the wind measurements and the crude wave observations.

But in case of the down wind condition the few values available evediently do not permit to identify the value of the second parameter reliably. To solve this problem the convention is adopted, that its value is the same as in case of the lager trim.

$$q_{1.do_1} := q_{2_1}$$

Power required, propeller not ventilating, at the nominal no wind and waves condition

$C_{PV.1} := q_{1.do_0} + q_{1.do_1}$ $C_{PV.1} = 0.01419$ $P_{S.1.do.0_i} := C_{PV.1} \cdot \left(V_{H.1_i}\right)^3$

Power required, at the larger trim interpolated, at the nominal no wind and waves

$C_{PV.2} := q_{2_0} + q_{2_1}$ $C_{PV.2} = 0.01437$ $P_{S.2.0.int_i} := C_{PV.2} \cdot \left(V_{H.1_i}\right)^3$

$$P_{S.1.do.0} = \begin{bmatrix} 1.378 \\ 2.424 \\ 4.156 \\ 4.248 \\ 6.048 \\ 7.119 \end{bmatrix}$$

$$P_{S.2.0.int} = \begin{bmatrix} 1.396 \\ 2.456 \\ 4.211 \\ 4.304 \\ 6.127 \\ 7.213 \end{bmatrix}$$

Thus the power ratio at the two different trim settings

$$\frac{C_{PV.2}}{C_{PV.1}} = 1.0131$$

According to this analysis **the power required at the no-wind condition at the second, the larger trim is 1.3 % larger than at the first, the smaller trim** in the down-wind, the non-ventilated propeller condition, **'in accordance' with the crew's best trim practice, provided the propeller is not ventilating.**

In view of the average confidence radii of the mean values of the powers observed, roughly 0.02 MW, the small difference in the no wind conditions for both trials of about 0.06 MW is considered as negligible without further analysis of the progression of errors.

All results plotted

Trim 2: over-all

Power at no wind and waves faired

$$C_{PV.2.n} := \frac{C_{PV.2} \cdot 10^6}{\rho \cdot D^2}$$

Identify equilibrium

$J := 1$ $\qquad K := 1$

Given

$K = p_{n.2_0} + p_{n.2_1} \cdot J$

$K = C_{PV.2.n} \cdot J^3$

Solve

$$\begin{bmatrix} J_{H.equil.2} \\ K_{P.equil.2} \end{bmatrix} := \mathrm{Find}(J, K)$$

$J_{H.equil.2} = 0.695$

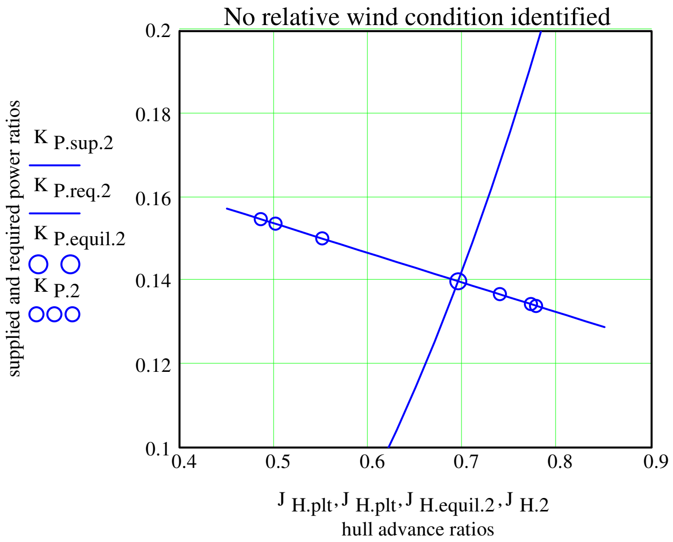
$K_{P.equil.2} = 0.140$

Results plotted

$k := 0 .. 20$ $\qquad J_{H.plt_k} := 0.45 + 0.02 \cdot k$

$K_{P.sup.2_k} := p_{n.2_0} + p_{n.2_1} \cdot J_{H.plt_k}$

$K_{P.req.2_k} := C_{PV.2.n} \left(J_{H.plt_k}\right)^3$



Trim 1: down-wind, non-ventilated

Power at no wind faired

$$C_{PV.1.n} := \frac{C_{PV.1} \cdot 10^6}{\rho \cdot D^2}$$

Identify equilibrium

$J := 1 \qquad K := 1$

Given

$$K = p_{n.do_0} + p_{n.do_1} \cdot J$$

$$K = C_{PV.1.n} \cdot J^3$$

Solve

$$\begin{bmatrix} J_{H.equil.do} \\ K_{P.equil.do} \end{bmatrix} := \mathrm{Find}(J, K)$$

$$J_{H.equil.do} = 0.698$$

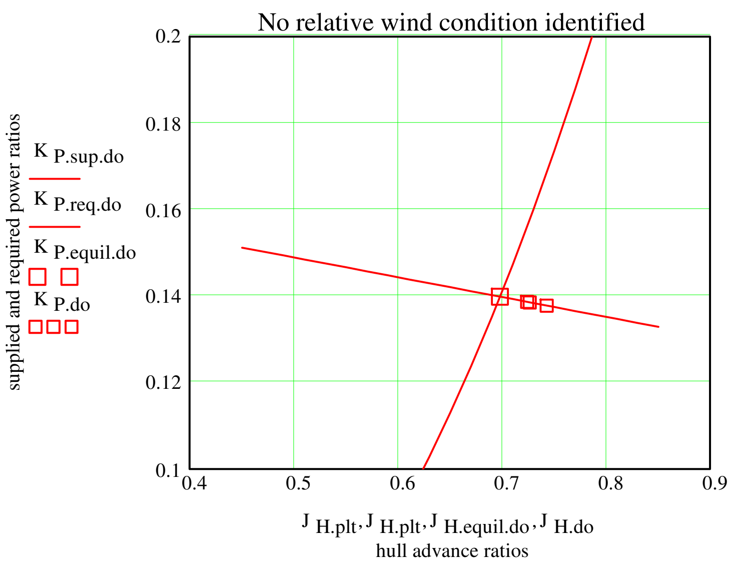
$$K_{P.equil.do} = 0.140$$

Results plotted

$k := 0 .. 20 \qquad J_{H.plt_k} := 0.45 + 0.02 \cdot k$

$$K_{P.sup.do_k} := p_{n.do_0} + p_{n.do_1} \cdot J_{H.plt_k}$$

$$K_{P.req.do_k} := C_{PV.1.n} \cdot \left(J_{H.plt_k}\right)^3$$



Trim 1: up-wind: propeller ventilated

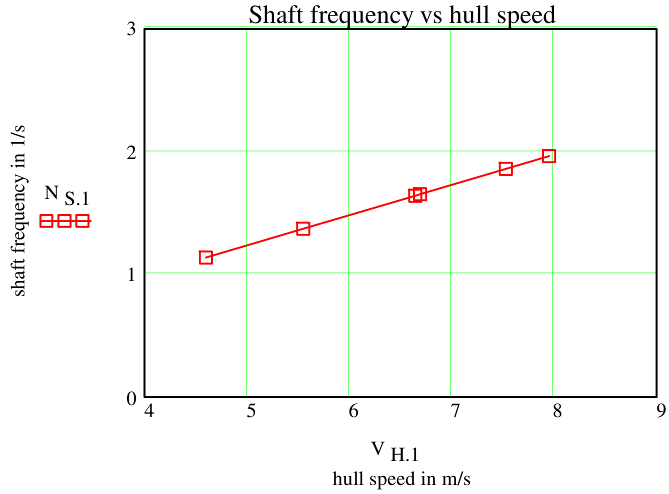
A separate no wind and waves equilibrium does not exist The propeller has only one characteristic, though with a discontinuity in slope.

Check consistency

Frequency of shaft rev's vs speed, propeller not ventilating, at the nominal no wind and waves condition

$N_{S.1_i} := 1$ initial values

$N_{S.1} := \text{Identify\_freq}(p_{do}, V_{H.1}, P_{S.1.do.0}, N_{S.1})$



$$N_{S.1} = \begin{bmatrix} 1.136 \\ 1.371 \\ 1.641 \\ 1.653 \\ 1.859 \\ 1.963 \end{bmatrix}$$

Linear approximation

$A_{N.1_{i,0}} := 1$ $\quad A_{N.1_{i,1}} := V_{H.1_i}$ $\quad X_{N.1} := \text{geninv}(A_{N.1}) \cdot N_{S.1}$ $\quad X_{N.1} = \begin{bmatrix} -1.4166 \cdot 10^{-4} \\ 0.2471 \end{bmatrix}$

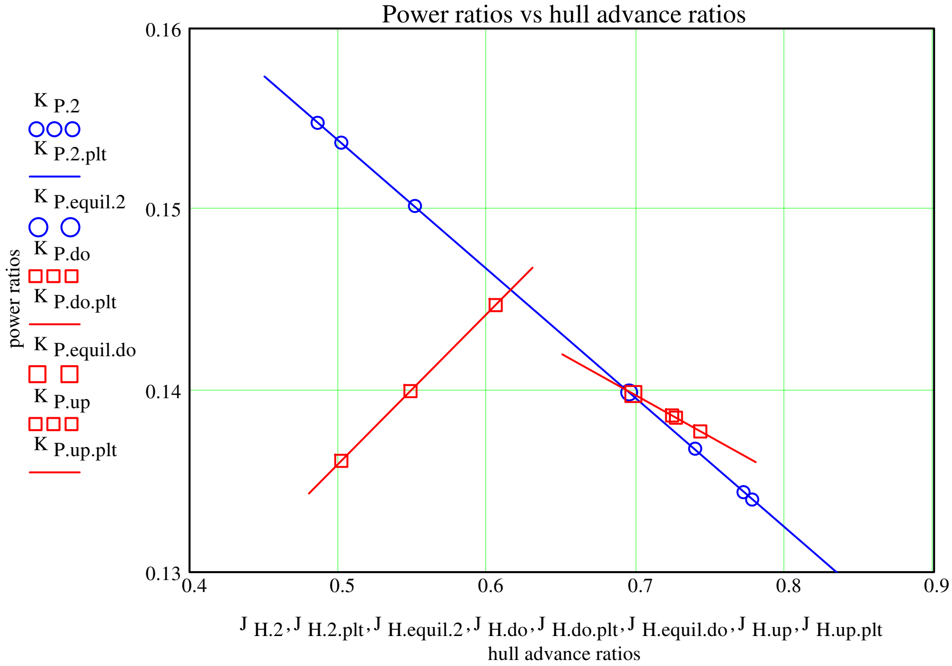
$N_{S.E.1} := N_{S.1} - A_{N.1} \cdot X_{N.1}$ $\quad N_{S.E.1.Conf} := 2 \cdot \text{stdev}(N_{S.E.1})$ $\quad N_{S.E.1.Conf} = 2.662 \cdot 10^{-5}$

Per definition this result is in accordance with the no wind and waves condition derived: the frequency of shaft rotation is directly proportional to the hull advance speed.

$C_{NV.1} := \dfrac{1}{D \cdot J_{H.equil.do}}$ $\quad C_{NV.1} = 0.2471$ $\quad N_{S.1} := C_{NV.1} \cdot V_{H.1}$ $\quad N_{S.1} = \begin{bmatrix} 1.136 \\ 1.371 \\ 1.641 \\ 1.653 \\ 1.859 \\ 1.963 \end{bmatrix}$

The value of the constant is very nearly the same as that at the larger propeller submergence provided the propeller is not ventilating.

All normalised results



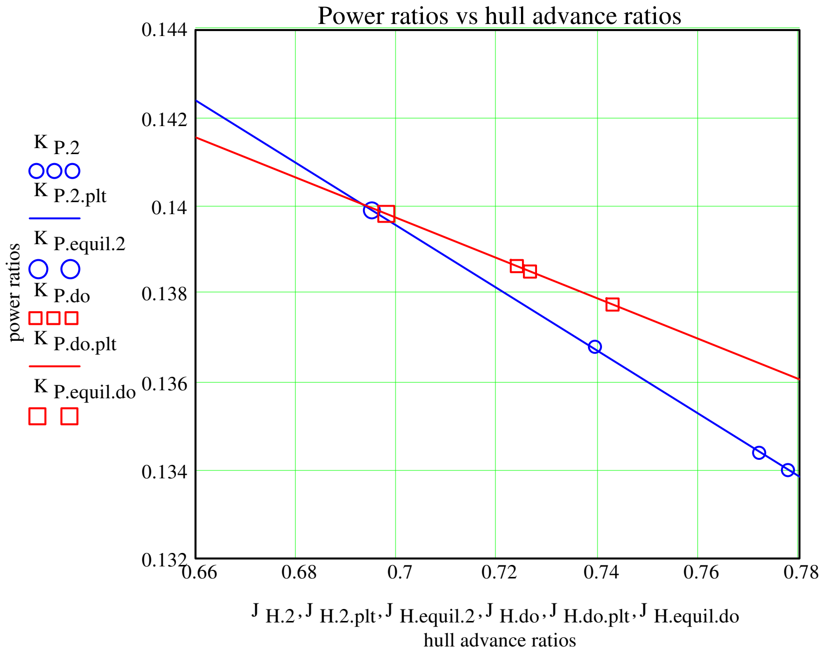
According to these results the nominal no wind and waves powering performance at the smaller trim differs from that at the larger trim even in the non-ventilating condition. One of the reasons may be the surface effect due the very small nominal submergence of the propeller.

Further it is noted that due to a considerable swell the ship has been pitching. This together with the very small nominal submergence of the propeller may have favoured intermittent ventilation at the up-wind condition.

Blow up around the no wind and waves conditions

$k := 0..1 \quad J_{H.2.plt_k} := 0.66 + 0.12 \cdot k$

$K_{P.2.plt_k} := p_{n.2_0} + p_{n.2_1} \cdot J_{H.2.plt_k}$



Note: The values of the power ratios at the down wind conditions for both trim settings are 'of course' the faired values, being based on the current velocity identified, as are the hull advance ratios!

Conclusions

Important observations

The most important lesson of this very elaborate exercise is that the results of trials, as any tests with any hydromechanical system, depend crucially on the precise determination of the current speed. If this is not possible any further evalution has to be terminated! Full stop!

'Accordingly' the final results of this final evaluation of the two trials at different trim settings differ from the results of earlier evaluations. **The changes are due to replacing the former much too crude current convention by a very robust, more reasonable and more acceptable convention permitting reliable extrapolation of the current identified from data observed at the larger trim to the trials at the smaller trim performed earlier at the same day.**

This extrapolation became necessary due to the propeller ventilation during the up-wind runs at the smaller trim, resulting in sets of data not permitting the evaluation successfully applied at the larger trim.

According to this analysis **the power required at the no wind and waves condition at the second, the larger trim is 1.5 % larger than at the first, the smaller trim** in the down-wind, the non-ventilated propeller condition, **'in accordance' with the crew's best trim practice provided the propeller is not ventilating. But even in view of the very small confidence level of the powers observed this small difference may be considered as negligible.**

In the absence of detailed observations of the sea state there is no possibility to identify the influence of the sea state on the required power. The procedure followed is the only reasonable and perfectly sufficient for the comparison of the no wind and waves performance at the two trim settings.

This result suggests that the reliable estimation of propulsive performance at the ballast condition depends crucially on the correct estimation of the propeller power characteristic and of the current at the conditions in question. **The problem is that for those conditions reliable data are not readily available, resulting in breakdown of all traditional codes including the ISO code and the more recent ITTC 2012 code.**

In the light of this very detailed analysis the evaluation according to ISO 15016: 2002-06 is considered as doubtful in many respects. The main reservation is that the standard, since its adoption known to be error prone even at fully loaded conditions, provides no adequate procedures at all, neither for ballast conditions nor for extremely small submergences of propellers in seaways. The same applies to evaluations according to the STA and ITTC procedures.

Further explanations

The rationale of the present exercise is explained in detail in a paper drafted for publication and presentation on occasion of the 25th anniversary of the METEOR tests in the Greenland Sea in November 1988.

The draft with hyperlinks, including hyperlinks to the present evaluations, is to be found under 'News on ship speed trials' on my website www.m-schmiechen.de and is open for discussion and contributions.

END
As next evaluated data at the first, at the smaller trim, i. e. at the smaller nominal propeller submergence