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Ship Speed Trial Evaluation

MS9906211300

Rational method proposed
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Data storage in 'standard' format

Input of reported data from traditional measurements

Units $kn := \frac{1852 \cdot m}{3600 \cdot sec}$ $W := watt$

Test identification TID := "05010"

Constants

Density of sea water $\rho := 1.025 \cdot 10^3 \cdot kg \cdot m^{-3}$ $\rho_n := \frac{\rho}{(kg \cdot m^{-3})}$

Diameter of propeller $D := 6.0 \cdot m$ $D_n := \frac{D}{m}$

$Const := [TID \quad \rho_n \quad D_n]$

$File := concat(TID, "\_const.prn")$ $WRITEPRN(File) := Const$

Data reported from traditional measurements

$t := \begin{bmatrix} 0 \\ 15 \\ 30 \\ 45 \\ 60 \\ 75 \\ 90 \\ 105 \end{bmatrix} \cdot min$ $\phi := \begin{bmatrix} 90 \\ 90 \\ 90 \\ 90 \\ 270 \\ 270 \\ 270 \\ 270 \end{bmatrix} \cdot deg$ $V_{Grd} := \begin{bmatrix} 17.3 \\ 18.3 \\ 19.3 \\ 20.3 \\ 19.7 \\ 18.7 \\ 17.7 \\ 16.7 \end{bmatrix} \cdot kn$

t	time of run
ϕ	course
V_{Grd}	speed over ground
N_{Shaft}	rate of revolution
P_{Shaft}	measured, break power

$N_{Shaft} := \begin{bmatrix} 103.4 \\ 111.6 \\ 120.1 \\ 129.0 \\ 132.5 \\ 125.4 \\ 118.2 \\ 111.2 \end{bmatrix} \cdot \frac{1}{min}$ $P_{Shaft} := \begin{bmatrix} 6407 \\ 8212 \\ 10477 \\ 13477 \\ 15021 \\ 12610 \\ 10470 \\ 8697 \end{bmatrix} \cdot kW$

Ship speed

$n := last(t)$ $i := 0 .. n$

$V_{S.Grd_i} := V_{Grd_i} \cdot e^{-i \cdot (\phi_i - 90 \cdot deg)}$

Absolute wind Beaufort, increasing from 4 to 6, WNW

$B_4 := 14 \cdot kn$ to $B_6 := 25 \cdot kn$ $V_{W.Grd.dir} := 112.5 \cdot deg$

$$V_{W.Grd.abs_i} := \left[B_4 + \left(B_6 - B_4 \right) \cdot \frac{t_i}{t_n} \right]$$

$$V_{W.Grd} := V_{W.Grd.abs} \cdot e^{-i \cdot \left(V_{W.Grd.dir} - 90 \cdot deg \right)}$$

Relative Wind

in ground fixed coordinates

$$V_{W.S.Grd} := V_{W.Grd} - V_{S.Grd}$$

in ship fixed coordinates

$$V_{W.rel_i} := V_{W.S.Grd_i} \cdot e^{i \cdot \left(\phi_i - 90 \cdot deg \right)}$$

$$V_{W.rel.abs_i} := \left| V_{W.rel_i} \right|$$

$$V_{W.rel.dir_i} := \arg\left(V_{W.rel_i} \right)$$

Non-dimensional, not normalized(!) values

Values of data in coherent units, exept for time values

$$t_n := \frac{t - mean(t)}{1 \cdot hr}$$

$$\phi_n := \frac{\phi}{rad} \qquad V_{Grd.n} := \frac{V_{Grd}}{m \cdot sec^{-1}}$$

$$N_{Shaft.n} := \frac{N_{Shaft}}{Hz} \qquad P_{Shaft.n} := \frac{P_{Shaft}}{W}$$

$$V_{W.rel.abs.n} := \frac{V_{W.rel.abs}}{m \cdot sec^{-1}} \qquad V_{W.rel.dir.n} := \frac{V_{W.rel.dir}}{rad}$$

Storage

$Data\_meas\_trad^{\langle 0 \rangle} := t_n$

$Data\_meas\_trad^{\langle 1 \rangle} := \phi_n$ $Data\_meas\_trad^{\langle 2 \rangle} := V_{Grd.n}$

$Data\_meas\_trad^{\langle 3 \rangle} := N_{Shaft.n}$ $Data\_meas\_trad^{\langle 4 \rangle} := P_{Shaft.n}$

$Data\_meas\_trad^{\langle 5 \rangle} := V_{W.rel.abs.n}$

$Data\_meas\_trad^{\langle 6 \rangle} := V_{W.rel.dir.n}$

$File := concat(TID, "\_meas\_trad.prn")$ $WRITEPRN(File) := Data\_meas\_trad$

Check of data using normalized data

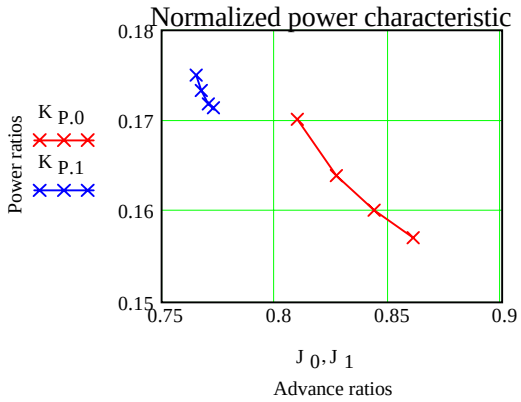
$n := rows(t)$

Traditional measurements

$$j := 0 .. \frac{n}{2} - 1$$

$$J0_j := \frac{V_{Grd_j}}{D \cdot N_{Shaft_j}} \qquad J0 = \begin{bmatrix} 0.861 \\ 0.844 \\ 0.827 \\ 0.81 \end{bmatrix} \qquad KP.0_j := \frac{P_{Shaft_j}}{\rho \cdot D^5 \cdot \left(N_{Shaft_j}\right)^3} \qquad KP.0 = \begin{bmatrix} 0.157 \\ 0.16 \\ 0.164 \\ 0.17 \end{bmatrix}$$

$$J1_j := \frac{V_{Grd_{j+\frac{n}{2}}}}{D \cdot N_{Shaft_{j+\frac{n}{2}}}} \qquad J1 = \begin{bmatrix} 0.765 \\ 0.767 \\ 0.77 \\ 0.773 \end{bmatrix} \qquad KP.1_j := \frac{P_{Shaft_{j+\frac{n}{2}}}}{\rho \cdot D^5 \cdot \left(N_{Shaft_{j+\frac{n}{2}}}\right)^3} \qquad KP.1 = \begin{bmatrix} 0.175 \\ 0.173 \\ 0.172 \\ 0.171 \end{bmatrix}$$



END Data storage in 'standard' format

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