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Sub: **Analysis** of **Everest** constructed test data
here: Basic analysis of **data corrected** and evaluation according to proposed rational method
Ref.: Evaluations of ISO_fin4 to fin7.mcd
Evaluations of **EVEREST_**01 **to 07.mcd**
Tamura, K.: 'An Appraisal of correction Methods ...' Trans. West-Japan S.N.A (1999) No. 97, 11-24
. Letter by Prof. Tamura dated 06.01.2001
Letters by Prof. Schmiechen dated 03./04.02.2001

Note:

This version **EVEREST_08 differs** from the preceeding version EVEREST_07
by scrutinizing the original frequency data and correcting them according to the findings.
This study could not have been performed without the preceeding detailed investigations.
Further the wind model needed to be improved and has been improved.
But scrutinity shows that something in the power data needs explanation
before the analysis can be continued.

Analysis of EVEREST constructed data

Units

Speed $kn := \frac{1852 \cdot m}{3600 \cdot sec}$

Power $W := watt$ $MW := 10^3 \cdot kW$

Test identification TID := "EVEREST"

Constants

Length of ship $L := 213 \cdot m$ $L := \frac{L}{m}$

Diameter of propeller $D := 6.6 \cdot m$ $D := \frac{D}{m}$

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

$g := 9.81 \cdot m \cdot sec^{-2}$ $g := \frac{g}{m \cdot sec^{-2}}$

Functions and subroutines

Compute left-inverse

```
LeftInv(A) := | r ← rows(A)
              | c ← cols(A)
              | s ← svds(A)
              | for i ∈ 0..c − 1
              |    ISV_{i,i} ← (s_i)^-1
              | UV ← svd(A)
              | U ← submatrix(UV, 0, r − 1, 0, c − 1)
              | V ← submatrix(UV, r, r + c − 1, 0, c − 1)
              | A_inv.left ← V·ISV·U^T
              | A_inv.left
```

Compute power

$P_{sup}(p, N, V) := p_0 \cdot N^3 + p_1 \cdot N^2 \cdot V$

$P_{req}(C, V) := C_0 \cdot V + C_1 \cdot V^2 + C_2 \cdot V^3$

Compute frequency of revolutions

```
Revs(p, V, P, N) := | n_i ← last(V)
                    | for i ∈ 0..n_i
                    |    | q_0 ← P_i
                    |    | q_1 ← V_i
                    |    | n ← N_i
                    |    | N_rat_i ← root(q_0 − p_0·n^3 − p_1·n^2·q_1, n)
                    | N_rat
```

Normalise data

$JH(V, N) := \frac{V}{D \cdot N}$

$KP(P, N) := \frac{P}{\rho \cdot D^5 \cdot (N)^3}$

$Fn(V) := \frac{V}{\sqrt{g \cdot L}}$

$CP(P, V) := \frac{P}{\rho \cdot D^2 \cdot (V)^3}$

Analyse power supplied

$$
\begin{aligned}
&\text{Supplied}\left(D,\rho,t,\psi_0,V_G,N,P_S\right) := \\
&\quad \text{for } i \in 0..\text{last}(t) \\
&\qquad A_{sup_{i,0}} \leftarrow \left(N_i\right)^3 \\
&\qquad A_{sup_{i,1}} \leftarrow \left(N_i\right)^2 \cdot V_{G_i} \\
&\qquad d_{FM_i} \leftarrow \text{if}\left(\psi_{0_i} < \pi, -1, 1\right) \\
&\qquad A_{sup_{i,2}} \leftarrow \left(N_i\right)^2 \cdot d_{FM_i} \cdot \cos\left(2\cdot\pi\cdot\frac{t_i}{12}\right) \\
&\qquad A_{sup_{i,3}} \leftarrow \left(N_i\right)^2 \cdot d_{FM_i} \sin\left(2\cdot\pi\cdot\frac{t_i}{12}\right) \\
&\quad X_{sup} \leftarrow \text{LeftInv}\left(A_{sup}\right)\cdot P_S \\
&\quad E_{sup} \leftarrow P_S - A_{sup}\cdot X_{sup} \\
&\quad p_0 \leftarrow X_{sup_0} \\
&\quad p_1 \leftarrow X_{sup_1} \\
&\quad \text{for } j \in 0..1 \\
&\qquad v_j \leftarrow \frac{X_{sup_{2+j}}}{X_{sup_1}} \\
&\quad \text{for } i \in 0..\text{last}(t) \\
&\qquad V_{F.rat_i} \leftarrow v_0\cdot\cos\left(2\cdot\pi\cdot\frac{t_i}{12}\right) + v_1\cdot\sin\left(2\cdot\pi\cdot\frac{t_i}{12}\right) \\
&\qquad V_{S0.rat_i} \leftarrow V_{G_i} + V_{F.rat_i}\cdot d_{FM_i} \\
&\qquad P_{S.rat_i} \leftarrow p_0\cdot\left(N_i\right)^3 + p_1\cdot\left(N_i\right)^2\cdot V_{S0.rat_i} \\
&\qquad J_{H.rat_i} \leftarrow \frac{V_{S0.rat_i}}{D\cdot N_i} \\
&\qquad K_{P.rat_i} \leftarrow \frac{P_{S.rat_i}}{\rho\cdot D^5\cdot\left(N_i\right)^3} \\
&\quad \left[E_{sup}\ \ V_{F.rat}\ \ V_{S0.rat}\ \ P_{S.rat}\ \ J_{H.rat}\ \ K_{P.rat}\ \ p\right]
\end{aligned}
$$

The harmonic current model has been introduced in accordance with the test data.

Analyse power required

$$\mathrm{Required}\left(V_{S0}, P_{S}, V_{WindR.x}, V_{WindR.y}, X_{req.3}\right) := \left|\begin{array}{l} \text{for } i \in 0..\mathrm{last}\left(V_{S0}\right) \\ \quad \left| \begin{array}{l} A_{req_{i,0}} \leftarrow \left(V_{S0_i}\right)^{1} \\ A_{req_{i,1}} \leftarrow \left(V_{S0_i}\right)^{2} \\ A_{req_{i,2}} \leftarrow \left(V_{S0_i}\right)^{3} \\ V_{WindR} \leftarrow \sqrt{\left(V_{WindR.x_i}\right)^2 + \left(V_{WindR.y_i}\right)^2} \\ A_{req.3_i} \leftarrow V_{WindR.x_i} \cdot V_{WindR} \cdot V_{S0_i} \\ A_{req.4_i} \leftarrow \left| V_{WindR.y_i} \right| V_{WindR} \cdot V_{S0_i} \end{array}\right. \\ A_{req} \leftarrow \left| \begin{array}{ll} \mathrm{augment}\left(A_{req}, A_{req.4}\right) & \text{if } \left| V_{WindR.y} \right. \\ \mathrm{augment}\left(A_{req}, A_{req.3}\right) & \text{otherwise} \end{array}\right. \\ B_{req} \leftarrow \left| \begin{array}{ll} P_{S} - A_{req.3} \cdot X_{req.3} & \text{if } \left| V_{WindR.y} \right| > \\ P_{S} & \text{otherwise} \end{array}\right. \\ X_{req} \leftarrow \mathrm{LeftInv}\left(A_{req}\right) \cdot B_{req} \\ E_{req} \leftarrow B_{req} - A_{req} \cdot X_{req} \\ P_{AWind} \leftarrow \left| \begin{array}{ll} A_{req.3} \cdot X_{req.3} + A_{req.4} \cdot X_{req_3} & \text{if } \left| \right. \\ A_{req.3} \cdot X_{req_3} & \text{otherwise} \end{array}\right. \\ P_{AAir} \leftarrow \left| \begin{array}{ll} A_{req.3} \cdot X_{req.3} & \text{if } \left| V_{WindR.y} \right| > 0.01 \\ A_{req}^{\langle 2 \rangle} \cdot X_{req_3} & \text{otherwise} \end{array}\right. \\ P_{S0.req} \leftarrow P_{S} - P_{AWind} + P_{AAir} \\ \left[E_{req} \;\; P_{AWind} \;\; P_{S0.req} \;\; X_{req} \right] \end{array}\right.$$

This routine has been especially adapted to the purposes of the present scrutinity of the data and may still need to be improved.

Check distribution of residua

$$
\text{Norm\_distr}(\text{Sampl}) := \left|
\begin{array}{l}
r \leftarrow \text{rows}(\text{Sampl}) \\
c \leftarrow \text{cols}(\text{Sampl}) \\
\text{for } i \in 0..r-1 \\
\quad \left| \begin{array}{l}
\text{fract} \leftarrow \dfrac{2\cdot(i+1)}{r+1} - 1 \\
\text{distr} \leftarrow \text{fract} \\
\text{Distr}_i \leftarrow \sqrt{2}\cdot\text{root}(\text{erf}(\text{distr}) - \text{fract}, \text{distr}) \\
\text{for } j \in 0..1 \\
\quad A_{i,j} \leftarrow \left(\text{Distr}_i\right)^j
\end{array} \right. \\
\text{for } j \in 0..c-1 \\
\quad \text{Sampl}_{\text{sort}}^{\langle j \rangle} \leftarrow \text{sort}\left(\text{Sampl}^{\langle j \rangle}\right) \\
\text{Par} \leftarrow \text{LeftInv}(A)\cdot\text{Sampl}_{\text{sort}} \\
\text{Sampl}_{\text{sort.fair}} \leftarrow A\cdot\text{Par} \\
\text{for } j \in 0..c-1 \\
\quad \text{Par}_{2,j} \leftarrow \dfrac{\text{Par}_{1,j}}{\sqrt{r}} \\
\begin{bmatrix} \text{Distr} \\ \text{Sampl}_{\text{sort}} \\ \text{Sampl}_{\text{sort.fair}} \\ \text{Par} \end{bmatrix}
\end{array}
\right.
$$

Data supplied with files

$Data := READPRN("data.txt")^T$

time | course | speed over ground

$t_{File} := Data^{\langle 0 \rangle} \cdot min$ $\quad \psi_{0.File} := Data^{\langle 1 \rangle} \cdot deg$ $\quad V_{G.File} := Data^{\langle 2 \rangle} \cdot kn$

frequencies of revolution: | brake powers measured:

$N_{File} := (submatrix(Data, 0, 11, 3, 8)) \cdot min^{-1}$ $\quad P_{S.File} := submatrix(Data, 0, 11, 9, 14) \cdot mhp$

$ni := rows(N_{File})$ $\quad ni = 12.00$ $\quad nj := cols(N_{File})$ $\quad nj = 6.00$

$i := 0 .. ni - 1$ $\quad j := 0 .. nj - 1$

$$t := \begin{bmatrix} 0.00 \\ 1.10 \\ 2.10 \\ 3.00 \\ 3.45 \\ 4.25 \end{bmatrix} \cdot hr$$

Time data replaced by correct values 03.02.2001

Data reorganised

$\psi_{0_j} := \psi_{0.File_j}$

$V_{G_j} := V_{G.File_j}$

$N_{10} := (submatrix(N_{File}, 0, nj - 1, 0, nj - 1))$

$N_{20} := (submatrix(N_{File}, nj, ni - 1, 0, nj - 1))$

$N := augment(N_{10}, N_{20})$

$P_{S.10} := (submatrix(P_{S.File}, 0, nj - 1, 0, nj - 1))$

$P_{S.20} := (submatrix(P_{S.File}, nj, ni - 1, 0, nj - 1))$

$P_S := augment(P_{S.10}, P_{S.20})$

Data in SI units except for time in view of further use in some mathematical subroutines, which by definition cannot handle arguments with (different) dimensions

$t := \frac{t}{hr}$ $\quad \psi_0 := \frac{\psi_0}{rad}$ $\quad V_G := \frac{V_G}{m \cdot sec^{-1}}$ $\quad N := \frac{N}{Hz}$ $\quad P_S := \frac{P_S}{W}$

Scrutinizing the data

In this case the data used for the construction of the test data are known,
so rigorous scrutinity of the data provided is possible.
In any other case the scrutinity has to based on preliminary analysis.

Speed over ground, current velocity, ship speed

$T := 12 \cdot hr$ The correct value would have been T = 12 hr + 25 min

$T := \frac{T}{hr}$ $A := 0.5 \cdot kn$ $A := \frac{A}{m \cdot sec^{-1}}$ $V_F(\tau) := A \cdot \sin\left(\frac{2 \cdot \pi}{T} \cdot \tau\right)$

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

$V_{F.Tam_i} := V_F(t_i)$

$V_{S.Tam_i} := V_{G_i} - V_{F.Tam_i} \cdot if(\psi_{0_i} < \pi, 1, -1)$

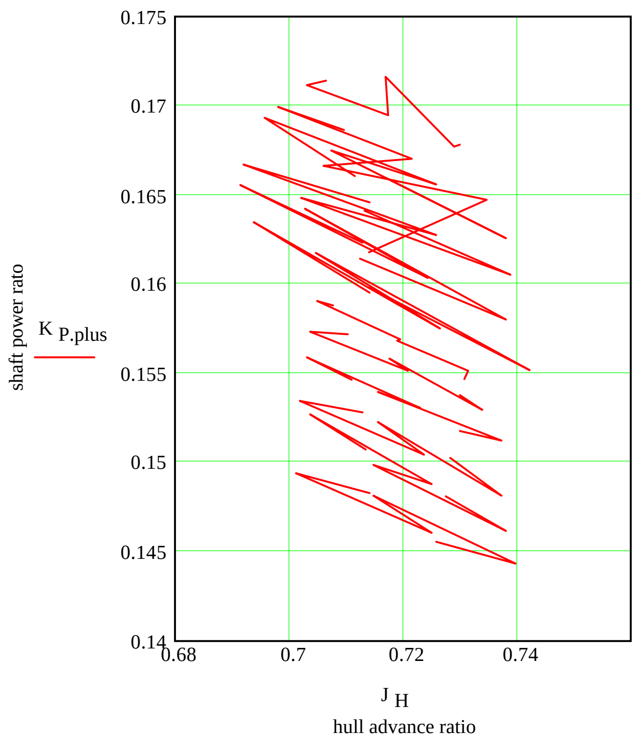
Normalised data

$j := 0 .. cols(N) - 1$

$J_{H_{i,j}} := JH(V_{S.Tam_i}, N_{i,j})$ $K_{P_{i,j}} := KP(P_{S_{i,j}}, N_{i,j})$

$K_{P.plus}^{\langle j \rangle} := K_P^{\langle j \rangle} + j \cdot 0.002$

Constants added to improve the display!



This plot suggests that the values of the frequencies of revolution in the test data have not been determined consistently! This suspicion is supported by the results of the following analysis.

Powering data provided at no wind and no waves

$V_{S0.Tam} := \begin{bmatrix} 14 \\ 16 \\ 17 \end{bmatrix} \cdot kn$ $N_{S0.Tam} := \begin{bmatrix} 88.9 \\ 103.7 \\ 112.1 \end{bmatrix} \cdot \frac{1}{min}$ $P_{S0.Tam} := \begin{bmatrix} 8207 \\ 13226 \\ 16938 \end{bmatrix} \cdot mhp$

$V_{S0.Tam} := \frac{V_{S0.Tam}}{m \cdot sec^{-1}}$ $N_{S0.Tam} := \frac{N_{S0.Tam}}{Hz}$ $P_{S0.Tam} := \frac{P_{S0.Tam}}{W}$

$k := 0 .. 2$

$V_{S0_{2 \cdot k}} := V_{S0.Tam_k}$ $V_{S0_{2 \cdot k+1}} := V_{S0.Tam_k}$

$P_{S0_{2 \cdot k}} := P_{S0.Tam_k}$ $P_{S0_{2 \cdot k+1}} := P_{S0.Tam_k}$

$V_{G.corr_i} := V_{S0_i} + V_{F.Tam_i} \cdot if\left(\psi_{0_i} < \pi, 1, -1\right)$

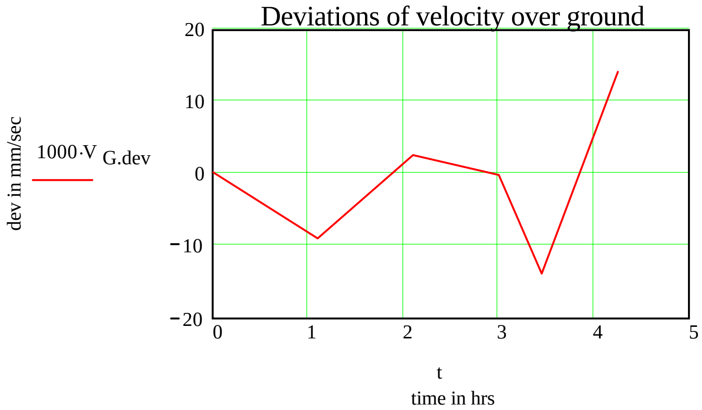
$n_{rd} := 3$

$V_{G.corr_i} := round\left(V_{G.corr_i}, n_{rd}\right)$

Introduction of rounding noise!
Three decimal places are necessary!

Inconsistencies in the test data

$V_{G.dev} := V_G - V_{G.corr}$



In the following evaluation the rounded correct values of the speed over ground are being used.

$V_G := V_{G.corr}$

Powering characteristic identified

$A_{Tam_{k,0}} := \left(N_{S0.Tam_k}\right)^3$

$A_{Tam_{k,1}} := \left(N_{S0.Tam_k}\right)^2 \cdot V_{S0.Tam_k}$

$p_{Tam} := \mathrm{LeftInv}\left(A_{Tam}\right) \cdot P_{S0.Tam}$

This is an approximation of the behind condition!

Systematic! errors due to approximation

$E_{Tam} := P_{S0.Tam} - A_{Tam} \cdot p_{Tam}$

$e_{lin_k} := \dfrac{E_{Tam_k}}{P_{S0.Tam_k}}$

$\dfrac{e_{lin}}{\%} = \begin{bmatrix} 0.05 \\ -0.04 \\ 0.01 \end{bmatrix}$

Less than one twentieth of a per cent!

Frequency of revolution

$i := 0 .. \mathrm{rows}\left(V_{S.Tam}\right) - 1$

$j := 0 .. \mathrm{cols}\left(P_S\right) - 1$

$N_{init_i} := 1$

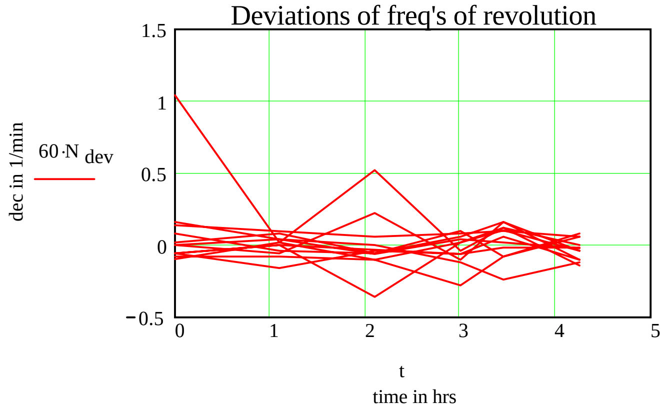
$N_{corr}^{\langle j \rangle} := \mathrm{Revs}\left(p_{Tam}, V_{S.Tam}, P_S^{\langle j \rangle}, N_{init}\right)$

$N_{corr_{i,j}} := \mathrm{round}\left(N_{corr_{i,j}}, n_{rd}\right)$

Introduction of rounding noise!

Inconsistencies in the test data

$N_{dev} := N - N_{corr}$

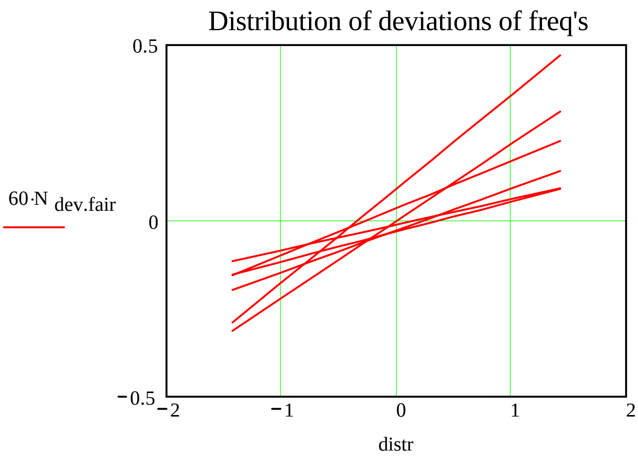


These inconsistencies, deviations from the underlying powering characteristic, must have been picked up during the construction of the test data.

$$N_{dev.m_i} := \text{mean}\left[\left(N_{dev}{}^T\right)^{\langle i\rangle}\right]$$

$$\begin{bmatrix} distr^{\langle i\rangle} \\ N_{dev.sort}{}^{\langle i\rangle} \\ N_{dev.fair}{}^{\langle i\rangle} \\ par^{\langle i\rangle} \end{bmatrix} := \text{Norm\_distr}\left[\left(N_{dev}{}^T\right)^{\langle i\rangle}\right]$$

$$60 \cdot N_{dev.m} = \begin{bmatrix} 0.0900 \\ -0.0117 \\ -0.0017 \\ -0.0283 \\ 0.0350 \\ -0.0317 \end{bmatrix}$$



The original test data do not only vary widely in quality but exhibit also systematic 'errors'.

In the following evaluation the rounded correct values of the frequency of revolution are being used.

$N := N_{corr}$

Rational evaluation

Power supplied

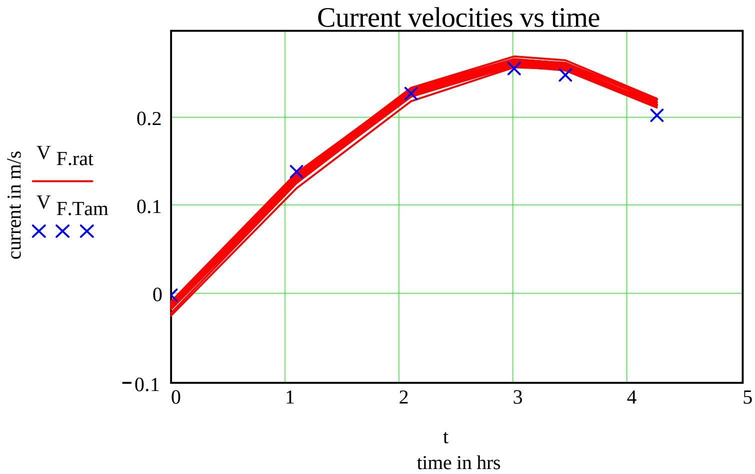
$ni := rows(N)$ $\quad ni = 6.00$ $\quad nj := cols(N)$ $\quad nj = 12.00$

$i := 0 .. ni - 1$ $\quad j := 0 .. nj - 1$

$$Res_{sup_j} := Supplied\left(D, \rho, t, \psi_0, V_G, N^{\langle j \rangle}, P_S^{\langle j \rangle}\right)$$

$$\left[E_{sup}^{\langle j \rangle} \;\; V_{F.rat}^{\langle j \rangle} \;\; V_{S0.rat}^{\langle j \rangle} \;\; P_{S.rat}^{\langle j \rangle} \;\; J_{H.rat}^{\langle j \rangle} \;\; K_{P.rat}^{\langle j \rangle} \;\; p_{rat}^{\langle j \rangle}\right] := Res_{sup_j}$$

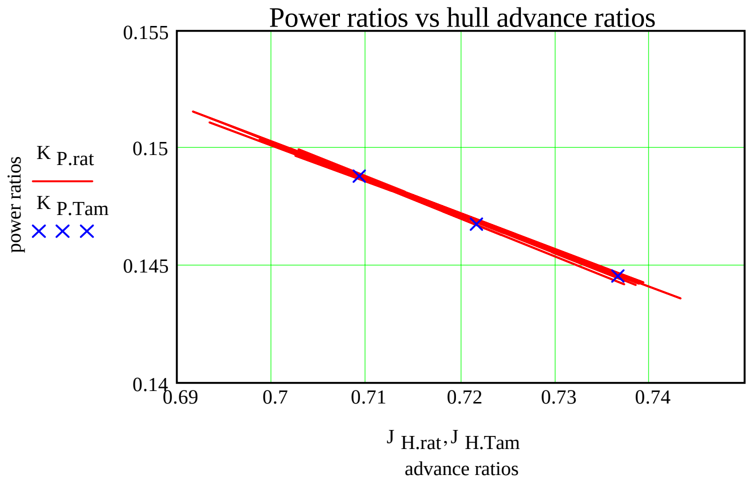
Plots of results
identified by rational method



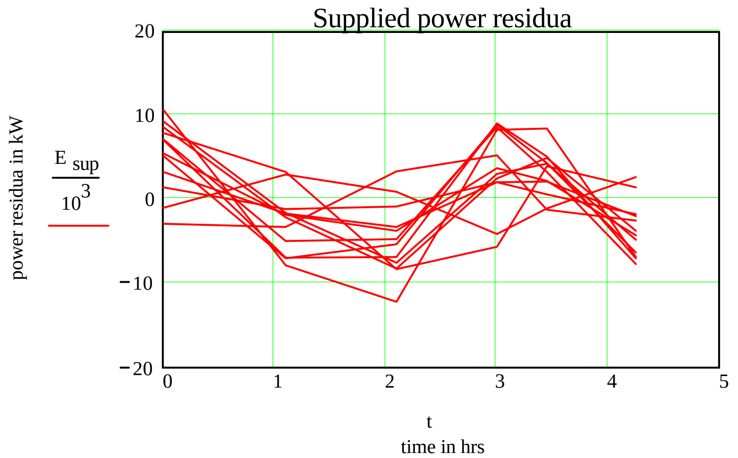
After removal of the inconsistencies in the frequency data all results coincide with the correct answer!

The crossing line is due to an unexplained bug in the plot routine!

$$J_{H.Tam_k} := JH\left(V_{S0.Tam_k}, N_{S0.Tam_k}\right) \qquad K_{P.Tam_k} := KP\left(P_{S0.Tam_k}, N_{S0.Tam_k}\right)$$



After removal of the inconsistencies in the frequencies data all results coincide with the correct answer!



The values of the residuals are very small, but exhibit **some systematic effects**!

Power required

Absolute wind velocities

$V_{WindA.10} := 10 \cdot kn$ $\qquad V_{WindA.10} := \dfrac{V_{WindA.10}}{m \cdot sec^{-1}}$

$V_{WindA.20} := 20 \cdot kn$ $\qquad V_{WindA.20} := \dfrac{V_{WindA.20}}{m \cdot sec^{-1}}$

Absolute wind directions

$$\psi_{WindA} := \begin{bmatrix} 0 \\ 30 \\ 45 \\ 60 \\ 75 \\ 90 \end{bmatrix} \cdot deg \qquad \psi_{WindA} := \frac{\psi_{WindA}}{rad}$$

Assumed to be 'measured' against the bow direction until further notice!

Relative wind velocities

$i := 0 .. ni - 1 \qquad j := 0 .. ni - 1$

$V_{WindA.x.10_j} := V_{WindA.10} \cdot \cos\left(\psi_{WindA_j}\right)$

$V_{WindA.x.20_j} := V_{WindA.20} \cdot \cos\left(\psi_{WindA_j}\right)$

$V_{WindR.x_{i,j}} := V_{G_i} + V_{WindA.x.10_j} \cdot if\left(\psi_{0_i} < \pi, 1, -1\right)$

$V_{WindR.x_{i,ni+j}} := V_{G_i} + V_{WindA.x.20_j} \cdot if\left(\psi_{0_i} < \pi, 1, -1\right)$

$V_{WindR.y_{i,j}} := V_{WindA.10} \cdot \sin\left(\psi_{WindA_j}\right) \cdot if\left(\psi_{0_i} < \pi, 1, -1\right)$

$V_{WindR.y_{i,ni+j}} := V_{WindA.20} \cdot \sin\left(\psi_{WindA_j}\right) \cdot if\left(\psi_{0_i} < \pi, 1, -1\right)$

Scrutinizing the power data

At this stage I scrutinize the power data
which I have taken for granted so far.
After all I have expereinced with the data
I want to know what has been done,
and if it has been done correctly.

Runs in wind from ahead and behind

$n := 0 .. 1$

$X_{req.3} := 0$

$Res_{req_n} := Required\left(V_{S0.rat}^{\langle n \cdot 6 \rangle}, P_S^{\langle n \cdot 6 \rangle}, V_{WindR.x}^{\langle n \cdot 6 \rangle}, V_{WindR.y}^{\langle n \cdot 6 \rangle}, X_{req.3}\right)$

$\left[P_{req.res}^{\langle n \rangle} \quad P_{AWind}^{\langle n \rangle} \quad P_{S0.req}^{\langle n \rangle} \quad X_{req}^{\langle n \rangle}\right] := Res_{req_n}$

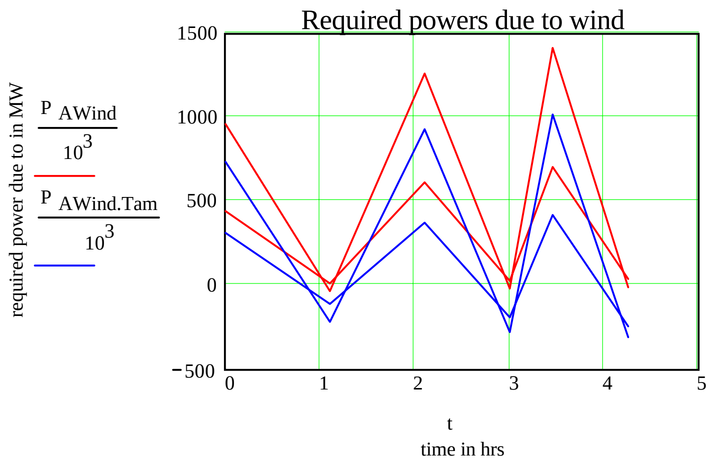
$$X_{req} = \begin{bmatrix} 3.90 \cdot 10^6 & 3.82 \cdot 10^6 \\ -1.08 \cdot 10^6 & -1.07 \cdot 10^6 \\ 91091.62 & 90498.86 \\ 403.25 & 436.01 \end{bmatrix}$$

$k := 0 .. 3$

$X_{req.mean_k} := mean\left[\left(X_{req}^T\right)^{\langle k \rangle}\right]$ $\qquad X_{req.mean} = \begin{bmatrix} 3.862 \cdot 10^6 \\ -1.077 \cdot 10^6 \\ 9.080 \cdot 10^4 \\ 4.196 \cdot 10^2 \end{bmatrix}$ $\qquad X_{req.3} := X_{req.mean_3}$

Analysis of wind powers

$P_{AWind.Tam}^{\langle n \rangle} := P_S^{\langle n \cdot 6 \rangle} - P_{S0}$



$P_{AWind.dev} := P_{AWind} - P_{AWind.Tam}$

$$\frac{P_{AWind.dev}}{10^3} = \begin{bmatrix} 132.26 & 226.44 \\ 121.71 & 185.04 \\ 239.88 & 330.71 \\ 214.87 & 258.76 \\ 283.94 & 397.29 \\ 284.20 & 295.03 \end{bmatrix}$$

There are systematic, nearly constant differences between the wind power identified and the wind power in the data!

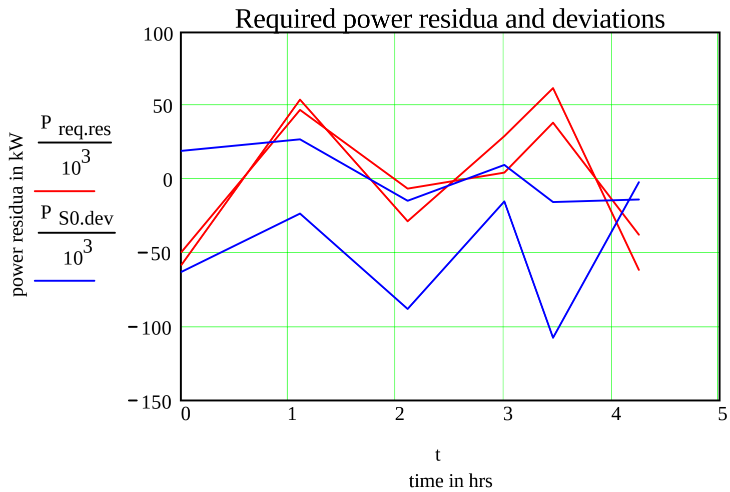
Analysis of powers required at no wind

$P_{S0.dev}^{\langle n \rangle} := P_{S0.req}^{\langle n \rangle} - P_{S0}$

$$\frac{P_{S0.dev}}{10^3} = \begin{bmatrix} 19.82 & -62.54 \\ 27.78 & -22.64 \\ -14.27 & -87.81 \\ 10.14 & -14.68 \\ -14.80 & -106.98 \\ -13.11 & -1.68 \end{bmatrix}$$

There are systematic differences up to 1 % at the higher wind velocity!

Analysis of residua and deviations



The pattern exhibited by the residua is an indication, that the generation of the test data has been based on another wind power law than the one in my evaluation.

Altogether the inconsistencies make me stop here and request more information about the data.

Preliminary analysis only!!!!

Runs at 10 kn wind velocity

$j := 0 .. ni - 2$

$Res_{req_j} := Required\left(V_{S0.rat}^{<j+1>}, P_{S}^{<j+1>}, V_{WindR.x}^{<j+1>}, V_{WindR.y}^{<j+1>}, X_{req.3}\right)$

$\left[P_{req.res}^{<j>} \; P_{AWind}^{<j>} \; P_{S0.req}^{<j>} \; X_{req}^{<j>}\right] := Res_{req_j}$

$$X_{req} = \begin{bmatrix} 3.85\cdot10^6 & 3.84\cdot10^6 & 3.65\cdot10^6 & 3.85\cdot10^6 & 4.44\cdot10^6 \\ -1.07\cdot10^6 & -1.07\cdot10^6 & -1.03\cdot10^6 & -1.08\cdot10^6 & -1.24\cdot10^6 \\ 90519.95 & 90397.38 & 87776.00 & 90667.05 & 100390.53 \\ 206.89 & 346.56 & 343.37 & 886.25 & 2843.05 \end{bmatrix}$$

$k := 0 .. 3$

$X_{req.mean_k} := mean\left[\left(X_{req}^{T}\right)^{<k>}\right]$ $\qquad X_{req.mean} = \begin{bmatrix} 3.926\cdot10^6 \\ -1.098\cdot10^6 \\ 9.195\cdot10^4 \\ 9.252\cdot10^2 \end{bmatrix}$

Runs at 20 kn wind velocity

$j := 0 .. ni - 2$

$Res_{req_j} := Required\left(V_{S0.rat}^{<j+7>}, P_{S}^{<j+7>}, V_{WindR.x}^{<j+7>}, V_{WindR.y}^{<j+7>}, X_{req.3}\right)$

$\left[P_{req.res}^{<j>} \; P_{AWind}^{<j>} \; P_{S0.req}^{<j>} \; X_{req}^{<j>}\right] := Res_{req_j}$

$$X_{req} = \begin{bmatrix} 3.59\cdot10^6 & 3.64\cdot10^6 & 4.06\cdot10^6 & 3.27\cdot10^6 & 2.61\cdot10^6 \\ -1.01\cdot10^6 & -1.02\cdot10^6 & -1.13\cdot10^6 & -953826.38 & -893061.80 \\ 87160.33 & 87395.61 & 94323.70 & 82859.86 & 77298.06 \\ 287.58 & 443.41 & 553.63 & 1103.11 & 4956.94 \end{bmatrix}$$

$k := 0 .. 3$

$X_{req.mean_k} := mean\left[\left(X_{req}^{T}\right)^{<k>}\right]$ $\qquad X_{req.mean} = \begin{bmatrix} 3.434\cdot10^6 \\ -1.004\cdot10^6 \\ 8.581\cdot10^4 \\ 1.469\cdot10^3 \end{bmatrix}$

The second parameter of the wind law does not look correct.

Some comments

The scrutinity of the data would not have been possible without the intermediate results
as obtained in the preceeding studies EVEREST_04 to _07.

The first observation is that the velocity values are not in accordance with the power law assumed. If the power values are assumed to be correct and the velocity values are corrected accordingly, the resulting current and power laws coincide with the data, on which the simulation was based. These results do not confirm that the values of power are consistent with other assumptions.

Rounding noise has been introduced to study the sensitivity of the rational procedure.
The result of this study concerning the power supplied or delivered is, that the values of the velocity and the frequuency in SI units need to be precise to three decimal places as can easily be obtained from sampled data of 'time histories'.
This confirms my earlier, repeated statement that a large number of problems in the evaluation of trials is due to ill-defined mean values, rounded to two decimal places.

In the next step the power values provided have been scrutinized. The analysis of the power required has been started with the cases of wind from ahead or behind. The results exhibit so many unexplained effects that I need to know more about the data, before I continue the analysis. Dr. Kataoka's files contain courses for the runs, which are not contained in the data provided by Prof. Tamura. At least this problem needs to be resolved before I can reasonably continue.

I have of course already done some preliminary tests and seen that the variability concerning the wind data is in some cases extremely small. Consequently the identification of an additional parameter for a more fancy wind law is running into the problem of singularity, at least with the data at hand. My routine has been adapted to cope with that problem. Again most problems arise from ill-defined mean values. These problems can be avoided by proper analysis based on sampled values of 'time histories'.

END Analysis of EVEREST constructed data