

Sailing: Performance Dashboard Version 1.4.3

Sailing: Performance Dashboard (from here on: PD) is a program that receives and processes NMEA-183 records (and converted N2K records) from a multiplexer.

Many, sometimes complex, calculations are done and the resulting information is available in a number of ways.

Inputs.

PD uses at a minimum an RMC-record (from a GPS) and one of the 3 kinds of wind-records (MWV-R, MWV-T or VWR).

Additional other record types make it possible to produce a lot of extra information. NMEA records processed as input in this version are:

VHW,RMB,RMC,HDG,HDT,HDM,MWV,VWR,DBT,DBK,DBS,DPT,HRM,EC-GPatt,ROT.

Next to these NMEA-inputs, some information about the boat is needed.

- A polar, with target boat speeds for a range of true wind speeds at 10 m high and a range of true wind angles. To calculate actual performance against the polar, it helps to have a reasonably accurate polar. You can have an unlimited number of polars: Full Crew, solo, DH, Genua or HA, no-Spi, whatever. Polars are created by saving an Excel spreadsheet as a .CSV file.
- A polar with heel degrees for a range of wind speeds and wind angles. This polar is available in the Speed Guide that can be purchased with an ORC certificate (at www.orc.org) . A default heel polar is available in PD. Also an Excel CSV, this heel polar.
- A deviation table for the electronic compass on board that produces the Heading info (HDx-records). This deviation table can have any number of entries between 0 and 360 degrees. Steps of 15, 22.5 or 45 degrees are often used. At the moment, heel is not included in this table (Heel can influence the compass deviation). May be in a future release. A table with just zero's will also work, but some outputs will then not be as useful as possible. Again, Excel CSV.
- A correction table for the log (water speed) on board. These devices happen to have a varying error, dependent on speed and on bow (SB or BB sailing). Heel can also influence the error. This correction table has separate correction values for SB and BB, and can have any number of speed entries. Steps of 0.5 kts (between 0.0 to 10.0 kts or so) are probably a good start. Here also, zero's will work but not help. No surprise: Excel CSV. In the boatspecifics file there is a Y/N option to select a correction table with heel (separate for SB and PT) included. Heel values of 0,10, 25 and 40 degrees are used. Of

course, interpolation is applied to find the correction for the actual heel value.

The polar (speeds) is really needed; the other 3 (heel, deviation, log speed correction) can be used in a default form. However, the more correct information is provided, the better the results are.

Using only SOG (from RMC) and wind (apparent or true, speed and angle, from MWV or VWR) PD can look up the target speed in the polar and then calculate the actual performance.

N.B: SOG and COG from a VDO message (AIS transponder) are not used; the update frequency (30 seconds or more) is not acceptable.

Sources of NMEA records.

PD can get NMEA records from 2 sources:

- Replay Mode: from a file with raw NMEA records, logged earlier during a trip. It can be very useful to post-process a log, as PD will calculate and show all kinds of interesting information from the raw data. More about this later. PD is fast in Replay: 25.000 NMEA records/second on a simple notebook.

or

- Live Mode: from a live NMEA source with the right combination of records. In most cases, that will be a multiplexer of some kind (as you need GPS-records and wind instrument-records).

Of course it is also possible to use a software program like NavMon PC or Franson GPSgate as an intermediary. PD reads records from a single COM port and writes to the same port, a real one (via USB or old fashioned COM) or a virtual one as presented by Navmon or Franson. Hardware Flow control (via RTS-CTS) is available if needed.

There is an option to use a second COM port for the output of PD instead of the port (also) used to read from. Using this second port, you could route the output (home-made NMEA messages!) directly to an instrument display, bypassing the multiplexer.

Outputs from PD.

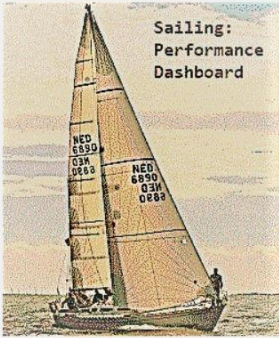
The main output is on screen. PD shows the results of all measurements and calculations on screen. That looks like this:

Sailing: Performance Dashboard Version 1.2.0 for Capolavoro

Wind			
AWA	111°	AWS	5.2 kts
TWA	144°	TWS 10m	8.5 kts
Upwash	4°	TWSavg	9.0 kts
Starboard		TWS +/-	1.3 kts
TWAwP	141°	GEOTWS	7.4 kts
GEO	96°	GEOavg	7.5 kts
SHIFT	132°	GEO +/-	0.9 kts
Current			
Speed of Current	0.8 kts		
Relative to bow	91°		
Over ground, compass	319°		

Course	
WP	107P
DTW	2.2 Nm
ETE	0:30 hm
BTW	237°
COG	238°
HDGc	228°
off	1°
DTLL	0.0 Nm
TTL	0.0 mn
Depth	
Depth	4.5 m
Change	0.1 m

Speed	
SOG	4.3 kts
STWc	4.3 kts
slow	-2.0 kts
VMG	-3.5 kts
VMGwp	4.3 kts
Spd<>	-0.9 kts
CUR-^	0.0 kts
Smart Warnings	
☹	Lifter: Luff Wind Change
☹	Pushed Leeward



Optimum Angles			
t-UA	40.9°	off	103.1°
t-DA	150.5°	off	-6.5°
t-Leeway	21°	Leeway	-13°
t-Heel	9°	Heel	99°
		Pitch	0°
		RoT	0°

Controls							
Display on	Stop				Display off		
Less Current	Less Shifts	More Filter	Faster Replay	View Files	Perf + Filter		
More Current	More Shifts	Less Filter	Slower Replay	View NMEA	Perf - Filter		
5°	Shift 5°	Filter 32 recs	Replay 0.9 sec	Lognr 0	RecLoop 15	FltPerf 2 recs	
Angles On-Off	Wind On-Off	Course On-Off	Speed On-Off	Pict On-Off	Perf On-Off	Cntrl -Off-	

Performance %	
SOG-ex cur	72
SOG-in cur	73
STWc-water	71
VMG-to wind	-73
RMctime	17:35:22

Eight windows for eight different flavours of information, and one window with a nice picture of your own choice. And of course a window with a lot of buttons, 24 in total. Later more about the values in the windows and the buttons.

Colours are important: green is a direct measurement, blue a calculated value, orange asks for action. *Italics* says 'this data is filtered'.

Performance is in black, and filtered separately. The filters can be easily adjusted during processing.

No dials or other fancy pictures, just numbers. The information density per square meter of dials is just below acceptable levels. 95% of the surface they use is full of unused information. They must be a relic from ancient times, such as their predecessor the sundial. So we use numbers.

The second output is the log file.

Every time a combination of an RMC record (with SOG) and a wind record is made, calculations are done and a log record is written in a CSV file that can easily be read by Excel.

In a log file, 40 different values are recorded. This is a piece of a log, in 3 pictures (log is 40 columns wide):

DATE	TIME	GEO	GEOkts	AWS	AWA	S--P	TWS 10m	TWA	tHEEL	HEEL	tLEEWAY	LEEWAY
230819	14:04:19	3	6,1	10,9	22	S	5,4	45	4	99	0	0
230819	14:04:20	7	5,9	10,9	20	S	5,2	41	4	99	1	0
230819	14:04:21	10	5,5	10,9	17	S	5,1	36	2	99	1	0
230819	14:04:22	14	6	10,9	22	S	5,4	45	4	99	1	0
230819	14:04:23	17	5,5	10,9	18	S	5,2	37	2	99	1	0
230819	14:04:24	21	6,3	10,9	23	S	5,5	47	4	99	1	0

COG	HDG	DEV	SOG	SOGADD	SOG90	STW	STWCOR	tSPEED	SOGp-exc	SOGp-inc	STWperf	TO-WP
66	70	0	6	6	0	0	0	4,4	0	27	0	154P
67	70	0	6	0	0,1	6	-0,4	2,9	41	68	38	166P
69	70	0	6	0	0	6	-0,4	0,3	441	468	411	179P
70	72	0	5,9	0	0	6	-0,4	4,4	468	495	437	179P
71	70	0	6	0	0,1	6	-0,4	0,3	868	895	810	163P
71	76	0	6	0	0,1	6	-0,4	3,8	899	899	839	191P

DTW	BTW	OFF	TWAWP	vmgWP	DEPTH	vmgWIND	tVMG	VMGperf	Cur kts	Cur rel	Cur abs	RoT	Pitch
0	0	0	0	0	0	0	-83866,2	0	0	54	288	0	0,4
0	0	0	0	0	0	0	-99025,8	0	0	54	288	-8,1	0,4
0	0	0	0	0	0	0	-96125,2	0	0	54	288	-12,8	0,4
0	0	0	0	0	0	0	-89099,8	0	0	53	286	-13,9	0,4
0	0	0	0	0	0	0	-85715,9	0	0	53	286	-17	0,4
0	0	0	0	0	0	0	-97813,8	0	0	53	286	-18,6	0,4

More on the log later. It has many uses!

The third output: home-made NMEA records.

PD can send NMEA records filled with data from the program to your instruments. In this version, 10 different types of records can be used for sending messages to your instruments:

```
$PDMTW,$curang,C  
$PDVTG,$sogperf,T,,M,,N,,K,A  
$PDGLL,$shift,N,$twa,E,$tws,A  
$PDRMB,A,$bestup,L,$DAoff,$UAoff,$diffdeg,N,$dtl,E,$ete,$ttl,$vmgwp,A  
$PDBOD,$sogperf,T,$sogperfci,M,$stwperf,$vmgperf  
$PDBWC,$cursog,$orthospd,N,$speedshort,E  
$PDBWR,$twa,$twa,N,$twa,E,$twa,T,$twa,M,$twa,N,$twa,A  
$PDMWV,$twa,R,$twa,N,A  
$PDVHW,$twa,T,$twa,M,$twa,N,$twa,K  
$PDVLW,$twa,N,$twa,N
```

This is just a kind of random example. The last 4 types will send TWA in all data fields, not very useful.

The 10 record types are fixed, but all the data fields in them are up to the user. You!

Data in the fields with \$ can be chosen to fit your needs from 36 variables available in the program. The use of these records will depend on the possibilities of your displays on board. The second record above, \$PDVTG, is a useful one: \$sogperf in a VTG record. This SOG-Performance sits in the field normally used for a COG. If your instrument can display COG from a VTG record, it will now show the actual boat performance (SOG versus polar target for the current TWA and TWS) in 3 digits (as COG has).

The possibilities are virtually endless; there is something for everybody here! You can also choose not to send any NMEA records, or just 1 or 2 types. Be careful not to overload the output with 10 records every one second!

Choose data that fit the field used to ensure correct display.

There is an option for a second COM(USB) port; input then comes via the primary port, all output records (created by PD with your data in them) come out of the second port. This gives the option to avoid a multiplexer on the way out, going directly to one or more instruments with NMEA-IN ports.

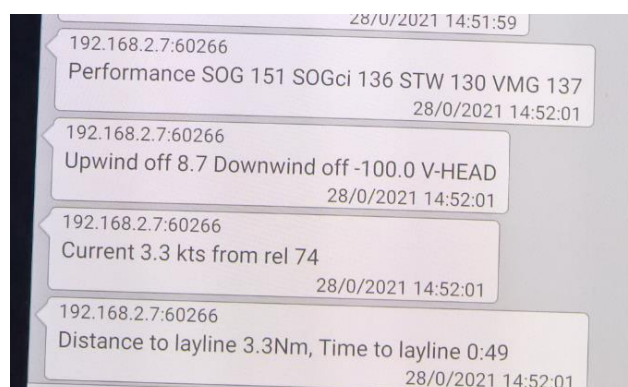
PD will check if any of the records coming in from COM start with PD as the sender. If so, you have created a loop (in the multiplexer). PD will stop then. Loops are killing, especially in this situation with strange NMEA records. Solve the loop in the multiplexer!

The fourth output:

Information over wifi. Some of the most important stuff is broadcast over wifi, by the PC where PD is running. It sends UDP messages to one defined UDP-listener, defined by IP address and port number.

At the moment, four kinds of home made records are sent: performance, current, UA/DA situation and wind shifts and layline info. You can have all 4, less, or nothing.

With just a simple UDP viewer (free) this information will show up on your phone or tablet like this, every second:



The fifth output:

The program can write all of the NMEA records produced and sent also to a .TXT file. In that way, you can see what records the program has produced. May be useful for later analyses, next to the (more complete) log file.

The sixth output:

A copy of incoming NMEA records can be written to a .TXT file. This feature can be used just to log incoming NMEA when live records are used, or to create a selection of the NMEA records during a Replay of another log file. To shrink this file a bit, all those irritating AIS records are skipped.

Control of Sailing: Performance Dashboard.

The behaviour of the program is controlled by 6 files with parameters, read at the start of the program.

The **first** you already saw partly: the templates for putting values into the NMEA records produced by the program. It sits in the directory **sailingpd/systemfiles** and the name is **NMEAtemplates.txt**.

The **second** file lives in the same directory and goes by the name of **processlist.txt**. In it, amongst other things, the font size used in the display, the colors, the record types being processed for input etc. Look at it, may be change the font size (but not the font itself!) and be careful.

The **third** control file is just a picture. Same directory, and the name must be **background.gif**. Without it, PD will not even start up. You can put a picture you like in this directory, on two conditions: it must be a .gif file and it cannot be bigger than 250 by 400 pixels.

The **fourth** control file specifies what and how to send information over wifi. It sits in the directory **sailingpd/systemfiles** and the name is **sendoverwifi.txt**. It looks like this:

```
Y  Send info over WiFi-UDP
perf,wind,current,layline
192.168.1.100
5000
last line do not remove!
```

This file determines if the PC will send information via wifi (UDP) to a listening device.

1st line Y or N send over wifi

2nd line: the text wind,layline,perf,current (max 4 messages, or a few or none)

3rd line: IP address of target: your handheld device?

4st line: port of target

And then the last line.

The **fifth** control file just remembers the start up files you used the last time (boat specifics, polar, heel polar, deviation and log stw correction).

The **sixth** control file is the one that you will need to edit to your likings. The name you choose yourself. This is in it (example):

```
Average White Boat
SOG
17.5
11
VTG,BOD
Y use STW correction with heel included Y/N
Y write a CSVfile with all logged results Y/N
Y copy of all created NMEA output Y/N
N write a copyfile of all incoming NMEA Y/N
Y replay a file with logged NMEA Y/N
Y use color in display, N is Black text
COM1
4800
8
N Parity
1
0
N use a second COM for output only: IF Y 6 extra lines have to be
  created directly here after, before spare1 !!
spare1
spare2
spare3
spare4
spare5
last line do not remove!
```

First line is what you make of it. It is used in window headers and the log.

2nd line: SOG or STW, as preferred choice of speed source. The use is limited: only to show the 'speed shortage' versus the polar on the display and to calculate STW performance.

3rd line: height of the wind sensor above the water (boat upright). Is used to calculate the wind at 10 m high (the norm for polars). Use a period for decimal values, not a comma!

4th line: K-value to calculate the leeway. 7 is for high-performance (windward) racers, 12 and higher for long keelers etc. Pick your own.

5th line: Which of six record types PD has to send to your instruments, here only a VTG and a BOD.

6th to 10th line: speak for themselves

11th to 16th line: COM port for live NMEA, the speed, bytesize, parity, stopbits and flow control with RTS/CTS.

17: N or Y for the use of a second COM port for the output only.
If Y, 6 extra lines are needed like line 11-16, describing this 2nd COM port, which will then be line 18, 19, 20, 21, 22 and 23

Then follow 5 spare lines for later use:

spare1

spare2

spare3

spare4

spare5

and then the last line MUST be:

last line do not remove

Of this file, located in **sailingpd/boatspecifics**, you might want to have several versions. Replay or Live, everything logged or just a display, different COM ports, none or up to ten records being send out, you name it.

In all control files there is text explaining what is what (not in the GIF with the picture). Keep a copy before you edit one; a broken file (missing lines, wrong characters etc) will make the program just stop....
Also, later in this manual, the files are described in detail.

There is a quick start option: with one click you can re-use all 5 control files that you used the last time you used the program.

The polar, heel polar, stw correction and deviation.

All these files are .CSV files, created and written by Excel (save-as-CSV). The name is up to you. With different names you can identify different polars, f.i. Full Crew or Single Handed, HA or GENUA, etc.

The layout of each file has to conform to a number of rules. First a simple one, the **deviation table**.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	deviation																			
2	0	22,5	45	67,5	90	112,5	135	157,5	180	202,5	225	247,5	270	292,5	225	247,5	270	292,5	315	337,5
3	0	0	0	0	0	0	1	1	1	1	1	-1	-1	-1	-1	-1	2	2	2	2
4																				

Cell A1 HAS to have the text deviation in it, in small print.

Row 2 is compass angles, in this case steps of 22,5 degree.

Row 3 is the deviation of the electronic compass on board, just a normal deviation table. Comma's for decimals, as usually in a CSV. These values added to HDG should result in a number equal to COG.

You can choose the steps (and thus the number of columns) yourself. 22,5 or 45 degrees is ok, less gives less accuracy. 15 is better.

Edit the table, give it a nice name, and save it as a CSV file in the folder **sailingpd/deviation**.

There is a post processing program to create a deviation file.

Run SailingPD using a long raw NMEA log from a trip, and then process the SaingPD-log with the postprocessor. It produces a complete deviation table that also tells you how many observations were used for each value in the table. The resolution is set at 15 degrees. Example:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
1	deviation																								
2	0	15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240	255	270	285	300	315	330	345	360
3	4	-27	-18	-3	0	0	-9	0	2	8	6	0	-28	0	-19	-2	2	22	0	19	19	22	0	0	4
4	43	37	474	1588	125	0	241	773	1125	664	57	0	1	0	107	510	3114	390	203	575	466	7	0	8	43
5	Made by SailingPD_Deviation_Builder from PDlog C:/Users/naerc/Documents/Bootdocumenten/sailingpd/PD-logs/AWB-2021-01-08 151112.CSV																								
6																									

The columns with 0 observations (see row 4) could not be filled from the log. Edit them yourself. Or go a day sailing and try again.

Then **STW correction**.

This one is slightly more complicated, it has separate rows for starboard and port sailing (that is: wind from SB or Port). The columns are boat speeds according to STW from the log-instrument.

There are two options: a simple correction file with per speed one correction for each bow (SB and PT), and one with 8 rows of corrections for 4 different levels of heel (0, 10, 25 and 40 degrees, all for Port and for Starboard).

The correction has to be the number of kts (x,x) that has to be added to the STW to get to the correct number (equal to SOG). If your log reads a higher speed than the SOG, use a negative correction.

The simple version looks like this:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	
1	stw correction																						
2	stw	0	0,5	1	1,5	2	2,5	3	3,5	4	4,5	5	5,5	6	6,5	7	7,5	8	8,5	9	9,5	10	
3	starboard	0	0,2	0,6	0,9	0,7	0,5	0,4	0,3	0,2	0,2	0,1	0,1	0,1	0	0,1	0,2	0	0	0	0	0	
4	port	0	0,1	0,7	1	1,4	1	0,8	0,7	0,3	0,2	0,1	-0,1	-0,1	-0,2	0	0	0	0	0	0	0	

In cell A1 the text stw correction HAS to be present.

Row 2 is speeds from 0 to 10 kts in 0,5 kts steps.

You can have other steps and a higher or lower max speed.

It should start at 0.

Row 3 and 4: the kts to be added to the STW-reading of your log, for each speed and differentiating between Port and Starboard.

The luxury version with heel included looks like this:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	stw correction 2d																		
2	stw	0	0,5	1	1,5	2	2,5	3	3,5	4	4,5	5	5,5	6	6,5	7	7,5	8	8,5
3	wind from starboard 0 heel	0	0,3	0,7	0,6	1,2	0,8	0,6	0	0,2	0,2	0,1	-0,2	0	0,1	0,3	0	0	0
4	starboard 10	0	0,3	0,7	0,6	1,2	0,8	0,6	0	0,2	0,2	0,1	-0,2	0	0,1	0,3	0	0	0
5	starboard 25	0	0,3	0,7	0,6	1,2	0,8	0,6	0	0,2	0,2	0,1	-0,2	0	0,1	0,3	0	0	0
6	starboard 40	0	0,3	0,7	0,6	1,2	0,8	0,6	0	0,2	0,2	0,1	-0,2	0	0,1	0,3	0	0	0
7	wind from port 0 heel	0	0,3	0,7	0,6	0,4	0,3	0,4	0	-0,1	-0,1	0	-0,4	-0,1	0,2	0,4	0	0	0
8	port 10	0	0,3	0,7	0,6	0,4	0,3	0,4	0	-0,1	-0,1	0	-0,4	-0,1	0,2	0,4	0	0	0
9	port 25	0	0,3	0,7	0,6	0,4	0,3	0,4	0	-0,1	-0,1	0	-0,4	-0,1	0,2	0,4	0	0	0
10	port 40	0	0,3	0,7	0,6	0,4	0,3	0,4	0	-0,1	-0,1	0	-0,4	-0,1	0,2	0,4	0	0	0

Cell A1 HAS to be the text stw correction 2d in small print, including the spaces.

Row 2 is a series of speeds, starting at 0 and ending higher than you will ever sail. The steps are your choice, 0,5 kts used here.

Row 3 is additions for starboard with 0 degrees heel: this is what has to be added to the log speed when compared with SOG from GPS. In this example, cell D3 says 0,7 meaning the SOG is 0,7 kts higher than the log speed. Etc.

Row 4,5 and 6 are for heel of 10, 25 and 40 degrees

Row 7 is for sailing with the wind from port and 0 heel.

Row 8,9, 10 wind from port and heel 10, 25 and 40 degrees.

You can of course keep the rows for heel > 0 the same as the one for 0 heel. All rows have to be filled to the same length as the number of speeds-row is, so in each column that has a speed in Row 2, correction

values HAVE to be filled in. In this example values are the same for each heel angle. That was just laziness on my part.

In case you are wondering how to find these values: just sail with PD active, and the log file will help you finding them! There is a post processor available for this (without the heel, for now.)

Edit the stw correction file to your likings and save it in Excel as CSV in the folder **sailingpd/stwcorrection**.

The Polar.

This one is slightly more complicated.

	A	B	C	D	E	F	G	H	I	J	K
1	number of TWS :	10									
2	number of TWA :	28									
3	1	3	6	8	10	12	14	16	20	24	TWS
4											TWA
5	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	6,6	38,5
7	0	0	0	0	0	0	0	0	6,5	6,67	38,6
8	0	0	0	0	0	0	0	6,4	6,58	6,73	38,6
9	0	0	0	0	0	0	6,4	6,5	6,67	6,8	39
10	0	0	0	0	0	6,1	6,51	6,6	6,75	6,87	40,1
11	0	0	0	0	5,6	6,26	6,61	6,7	6,83	6,93	40,9
12	0	0	0	5	5,84	6,41	6,72	6,81	6,91	7	41,3
13	0	0	4,2	5,29	6,07	6,57	6,83	6,91	7	7,07	43,1
14	0	2	4,6	5,58	6,31	6,72	6,93	7,01	7,08	7,13	45
15	1	2,5	4,99	5,87	6,54	6,88	7,04	7,11	7,16	7,2	52
16	1	2,7	5,27	6,17	6,75	7,04	7,21	7,3	7,37	7,5	60
17	1	2,7	5,38	6,29	6,83	7,11	7,3	7,43	7,56	7,85	70
18	1	2,8	5,48	6,4	6,9	7,18	7,38	7,55	7,75	8,1	75
19	1	2,7	5,45	6,39	6,94	7,23	7,41	7,61	7,9	8,15	80
20	1	2,8	5,41	6,37	6,98	7,27	7,44	7,66	8,05	8,2	90
21	1	2,6	5,38	6,5	7,1	7,45	7,77	8,03	8,33	8,6	110
22	1	2,5	5,24	6,37	7,03	7,41	7,75	8,11	8,67	8,7	120
23	1	2,3	4,77	5,85	6,72	7,18	7,52	7,87	8,62	8,6	135
24	1	2,3	4,49	5,6	6,48	7,04	7,41	7,74	8,47	8,5	140
25	0	0	4,2	5,35	6,24	6,9	7,29	7,62	8,31	8,4	146
26	0	0	0	5,1	6	6,76	7,18	7,49	8,16	8,3	150
27	0	0	0	5,1	5,8	6,67	7,28	7,44	8,1	8,26	150,5
28	0	0	0	0	5,6	6,59	7,03	7,38	8,04	8,23	151
29	0	0	0	0	0	6,5	6,95	7,33	7,98	8,19	156,5
30	0	0	0	0	0	0	6,87	7,27	7,92	8,15	165
31	0	0	0	0	0	0	6,6	7,16	7,8	8,18	175
32	0	0	0	0	0	0	0	7,05	7,67	8,2	180
33	45	43,1	41,3	40,9	40,1	39	38,6	38,6	38,5	38,5	UAlist
34	140	146	150	150,5	151	156,5	175	180	180	180	DAlist

Again an Excel CSV.

Cells A1 and A2 HAVE to contain the text shown, literally.

B1 is the number of wind speeds (TWS) used in this polar. Here it is 10.

B2 the number of wind angles (TWA) used. Here 28.

Both numbers (for TWS and TWA) are your choice. More is better...

Row 3 are the 10 (in this case) wind speeds, from 1 to 24 kts. Remember that a normal polar has TWS from 6 to 20 kts. This one has more, for less and more wind. You can choose as many TWS's as you want.

Column K (in this example with 10 TWS's) has the different wind angles used, from row 5 to row 32. This is 28 wind angles. They HAVE to be in increasing order, from 0 to 180.

In the cells A 5 to J 32 are the boat target speeds according to your polar.

Example: Cell E20 is for 10 kts TWS and 90 TWA, and the target is 6,98 kts.

Row 33 and 34 are special:

Row 33 has the Upwind Angles as mentioned in the ORC Measurement Certificate, the optimal angles for beating against the wind for each TWS in the polar. Example: the optimal UA for 10 kts TWS is 40,1 degree TWA.

Row 34 is the same for downwind sailing: here the optimal DA (Downwind Angle) for 10 kts TWS is 151 degrees.

The UA's and DA's for 6 to 20 kts are on a measurement certificate.

For less and more TWS, you have to come up with values yourself.

These last 2 lines HAVE to be present in the Polar CSV, with values for every TWS-column, and in the last column, last 2 rows, the text as shown, UAlist and DAlist (watch the capitals).

This version of a polar has a special feature: there is a 0 value for every combination of TWS and TWA that is NOT on the measurement certificate.

Let's look at an example for 10 kts TWS.

At 10 kts and 40,9 TWA, the boat has to sail a speed of 5,6 kts.

When you point up another 0,8 degrees, to a TWA of 40,1 degree, the polar says 0 kts.

Of course that is not really the case. What will happen in reality is a very small loss of speed.

The purpose of all these zero's in the polar is this:

When you sail higher than the ideal UA for the actual TWS, PD will use the zero in the polar and calculate a performance of 222. "Too Too Too" high, it shouts at you.

This will show on the Dashboard (and may be on an instrument) and it tells you instantly that you are sailing too high, pinching.

Same for downwind angles: sail too low and the 222 will appear and warn you that you are going too much downwind, sailing too deep.

The Dashboard will tell you how many degrees you sail high or low, in the fields 'off' in the Optimum Angles box.

Of course you can use other values than all those zero's in these TWS-TWA combinations, and have performance normally calculated. But where is using values useful... How fast can you sail with TWA 10 degrees?

The Heel Polar.

This one is similar but has no rows for UAlist and DAList. The rest is the same as the Speed Polar.

The values in it are degrees of heel, from the Speed Guide that comes (at a cost) with a measurement certificate. Zero's have no use here, just fill in values for the data not on the certificate.

number of TWS	10										
number of TWA	28										
	1	3	6	8	10	12	14	16	20	24	TWS TWA
	0	0	0	0	0	0	0	0	0	0	0
	1	2	3,7	6,5	12,4	18,9	21,6	23,1	25,4	26,7	38,5
	1	2	3,7	6,5	12,4	18,9	21,6	23,1	25,4	26,7	38,6
	1	2	3,7	6,5	12,4	18,9	21,6	23,1	25,4	26,7	38,6
	1	2	3,7	6,5	12,4	18,9	21,6	23,1	25,4	26,7	39
	1	2	3,7	6,5	12,4	18,9	21,6	23,1	25,4	26,7	40,1
	1	2	3,7	6,5	12,4	18,9	21,6	23,1	25,4	26,7	40,9
	1	2	3,7	6,5	12,4	18,9	21,6	23,1	25,4	26,7	41,3
	1	2	3,7	6,5	12,4	18,9	21,6	23,1	25,4	26,7	43,1
	1	2	3,7	6,5	12,4	18,9	21,6	23,1	25,4	26,7	45
	1	2	3,8	6,8	12,7	18,7	24,4	26,3	27,3	28,7	52
	1	2	3,7	6,6	12,2	17,4	22,7	27,8	29,2	30,7	60
	1	2	3,3	5,5	10	14,8	20,1	24,7	30,5	32	70
	1	1,5	3,3	5	8,7	13	17,9	22,8	31,2	32,8	75
	1	1,5	3,1	4,6	7,3	11,1	15,3	20,1	28,9	30,3	80
	1	1,3	2,6	3,7	17,1	22,1	10,2	13,8	22,7	23,8	90
	1	5	11,3	12,5	14,3	15,8	17,4	21,7	22,3	23,4	110
	1	5	10,5	11,5	12,3	13,3	15,2	16,4	21,9	23	120
	1	4	8,3	9,6	10,7	11,4	12	12,7	15,4	16,2	135
	1	4	8,3	9,6	10,7	11,4	12	12,7	15,4	16,2	140
	0	3,5	6,9	7,5	8,3	9,2	10,2	10,9	11,9	12,5	146
	0	3,5	6,9	7,5	8,3	9,2	10,2	10,9	11,9	12,5	150
	0	3,5	6,9	7,5	8,3	9,2	10,2	10,9	11,9	12,5	150,5
	0	3,5	6,9	7,5	8,3	9,2	10,2	10,9	11,9	12,5	151
	0	3,3	6,6	7,1	8	8,2	9,1	9,5	11,3	11,4	156,5
	0	3,2	6,4	6,7	7	7,3	7,8	8,4	9,8	10,3	165
	0	3,1	6,2	6,3	6,3	6,4	6,5	6,6	6,9	7,2	175
	0	3,1	6,2	6,3	6,3	6,4	6,5	6,6	6,9	7,2	180

This example has the same number of TWS and TWA as the Speed Polar. There is no need for that, you can use any number of TWS's and TWA's .

The values and buttons on the display.

Sailing: Performance Dashboard Version 1.4.2 for Capolavoro

Wind

AWA	135°	AWS	2.8 kts
TWA	156°	TWS 10m	4.5 kts
Upwash	4°	TWSavg	3.3 kts
Starboard		TWS +/-	1.0 kts
TWAwP	166°	GEOTWS	4.8 kts
GEO	101°	GEOavg	3.5 kts
SHIFT	15°	GEO +/-	1.1 kts

Current

Speed of Current	0.7 kts
Relative to bow	150°
Over ground, compass	108°

Course

WP	094P
DTW	10.9 Nm
ETE	4:57 hm
BTW	295°
COG	318°
HDGc	318°
off	23°
DTLL	0.0 Nm
TLL	0.0 mn

Depth

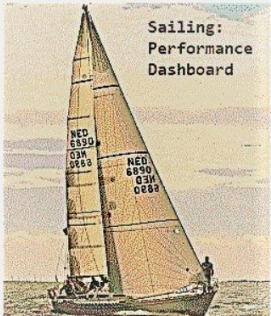
Depth	2.9 m
Change	0.0 m

Speed

SOG	2.4 kts
STWc	1.9 kts
slow	-0.4 kts
VMG	-2.2 kts
VMGwp	2.2 kts
Spd<>	0.1 kts
CUR-^	0.6 kts

Smart Warnings

- Velocity Lifter: Luff
- Pushed Forward



Optimum Angles

t-UA	41.3°	off	114.7°
t-DA	150.0°	off	6.0°
t-Leeway	8°	Leeway	1°
t-Heel	7°	Heel	0°
		Pitch	0°
		RoT	0°

Controls

Display on		Stop		Display off		
Less Current	Less Shifts	More Filter	Faster Replay	Fresh Log	View Files	Perf + Filter
More Current	More Shifts	Less Filter	Slower Replay	Write in Log	View NMEA	Perf - Filter
5°	Shift 5°	Filter 32 recs	Replay 0.4 sec	Lognr 1	RecLoop 12	Perffilt 2 recs
Angles On-Off	Wind On-Off	Course On-Off	Speed On-Off	Pict On-Off	Perf On-Off	Cntrl -Off-

Performance %

SOG-ex cur	53
SOG-in cur	71
STWc-water	53
VMG-to wind	-70
RMctime	17:21:22

There are 7 boxes in the display, 3 of them with a sub-box. We take them one by one. Remember, green are measurement values, blue is a complex calculation, orange asks for action. And *Italics* is filtered values.

Wind and Current box.

Wind

AWA	135°	AWS	2.8 kts
TWA	156°	TWS 10m	4.5 kts
Upwash	4°	TWSavg	3.3 kts
Starboard		TWS +/-	1.0 kts
TWAwP	166°	GEOTWS	4.8 kts
GEO	101°	GEOavg	3.5 kts
SHIFT	15°	GEO +/-	1.1 kts

Current

Speed of Current	0.7 kts
Relative to bow	150°
Over ground, compass	108°

Left box is wind angles. TWA is calculated from AWA or comes from a True-Wind NMEA record (MWV-T) and in that case the AWA is calculated.

Upwash is calculated with a formula from Arvel Gentry. It is mainly dependent on the lift coefficient of the sails, on boat type (an average used here) and on TWA and TWS (which determine max coefficient of lift). It is an approximation only, not used in any of the calculations.

TWAwp is the TWA to the active waypoint. If you enter a new waypoint into your navigation device (GPS, Plotter, PC), the TWA to that waypoint (from current position) is shown.

GEO is the wind over ground, as measured by a non-moving measurement station. More about the calculations later.

SHIFT is the change in wind direction between first and second half of a series of measurements (seconds). The length of the series can be changed with a button (see later).

The right box is wind speeds.
AWS is wind speed at the wind sensor.

TWS 10m is True wind speed, corrected to 10 m high (using your mast height!) and also for heel.

TWSavg is a moving average over a series of measurements (length of series can be changed).

TWS+- is the change between first and second half of the series, like *SHIFT* is the change in direction.
Keep in mind these values are relative to a moving boat, that is always blown to leeward by the wind!

The three GEOTWS, *GEOavg* and *GEO+-* are the real (not on a moving boat) wind speed, moving average and change. Notice the difference with the green values above the blue ones: slightly more wind! The difference is caused by leeway....

Then there is the Current sub-box.

It shows the speed of the current (in the direction of the current).
Second line is the current angle relative to the boat. Negative values is current from the left, -45 f.i. is from left 45 degrees from bow (just like wind angles).
Third line is current direction over ground, direction (compass) where the current is going.

Next is the Course-Depth box.

Course	
WP	175P
DTW	5.0 Nm
ETE	0:50 hm
BTW	50°
COG	60°
HDGc	60°
off	10°
DTLL	3.5 Nm
TLL	35.0 mn
Depth	
Depth	5.2 m
Change	-0.1 m

Active Waypoint, Distance to Waypoint.

Next is ETE: Estimated Time Enroute: how long to the waypoint with the actual closing speed (VMG to Waypoint)

Bearing to Waypoint and Course over Ground.

HDGc is Heading including Correction from your deviation table.

Off is degrees between BTW and COG: we steer 10 degrees off the course to the waypoint.

DTLL: Distance to Layline, only active when going to windward. 3.5 Nm to go before we need to tack.

TLL: Time to Layline. 35 minutes to go to the tack.

You could use this for a start as well: pick your point on the start line, make it the active waypoint and you know distance and time to the start line.

The Depth sub box:

Depth is a moving average over the last 10 measurements (NMEA records, probably seconds).

Change is the difference between first 5 and second 5 measurements.



The 10 seconds filter is fixed in PD.

Depth from a DBT, DBK, DBS or DPT record is shown as collected from the record (there is no offset in those records, just one value).

If Depth comes out of a DPT record there is an offset; the values shown in that case is depth below the offset value.

The Speed box and the Warnings sub box.

Speed		
SOG	2.4	kts
STWc	1.9	kts
slow	-0.4	kts
VMG	-2.2	kts
VMGwp	2.2	kts
Spd<>	0.1	kts
CUR-^	0.6	kts

Smart Warnings	
	Velocity Lifter: Luff
	Pushed Forward

SOG is SOG from a GPS.

STWc is corrected speed from the log, with the corrections from the stw correction table applied, possibly with heel influences included. Here there was a correction of 0,0 kts...

Fast is how much faster or slower you are than the polar target speed. This is the only value where the choice between SOG and STW (in the Boat specifics file) is applied. You are short or fast compared to STW or SOG. SOG here is in faint green, STWc is bright here. This shows that in this Boatspecifics file STW was given as choice. Fast is thus STWc compared with target from polar.

VMG is Velocity made good to windward, straight into the wind.

VMGwp is velocity to the waypoint. As we steer 10 degrees besides the BTW, this VMGwp is a little lower than boat speed.

In the Wind box, you can see we sail a 45 degrees TWA, so going upwind. That causes the VMG to be 4.2 kts into the wind.

Then a complex one:

SPD<> is the speed to leeward (or, with a current from lee, to luff). It is how fast you are going sideways, 90 degrees to the axis of the boat

CUR-^ is how much of the actual SOG is caused by the current: it is the current component in the length axis of the boat. A negative value means current slows you down by the indicated amount of kts.

Smart Warnings sub box.

In this box warnings show up when wind changes or current is apparent. PD can show warnings for headers and lifters, differentiating between velocity headers and real ones, etc. There are current warnings as well. More warnings will be developed after some real life experience.

Optimum angles box.

Optimum Angles			
t-UA	43.1°	off	109.9°
t-DA	146.0°	off	7.0°
t-Leeway	0°	<i>Leeway</i>	-8°
t-Heel	3°	Heel	16.2°
		Pitch	0.4°
		Rot	-13.9°

In green, left, the target UA and DA for the actual TWS, from the polar.

In orange, right, how much we are off that angle. In this case, we should steer a little deeper, 7 degrees.

t-Leeway is calculated based on standard formula from ORC, using the K-value from Boatspecifics file.

t-Heel comes straight from the heel polar, for the actual TWS and TWA.

Then in blue *italics*, Leeway. This is the actual leeway calculated from a number of inputs (see later). Negative means a move to luff (current!)

Heel is a measurement of real heel, from a HRM record from a heel sensor or an RM EV computer, in an EC,GPatt record. ('Roll' in that record.)

Pitch comes also from that record out of the RM EV computer.

Rate of Turn (RoT, degrees per minute) from a ROT record, also send by the RM EV computer.

The Performance box.

Performance %	
<i>SOG-ex cur</i>	72
<i>SOG-in cur</i>	73
<i>STWc-water</i>	71
<i>VMG-to wind</i>	-73
RMctime	17:35:22

SOG-in cur (second line) is SOG performance against the polar. Current effect is included, so if you go extra fast with help from the current, this percentage shows that. This value is what most other performance software will show.

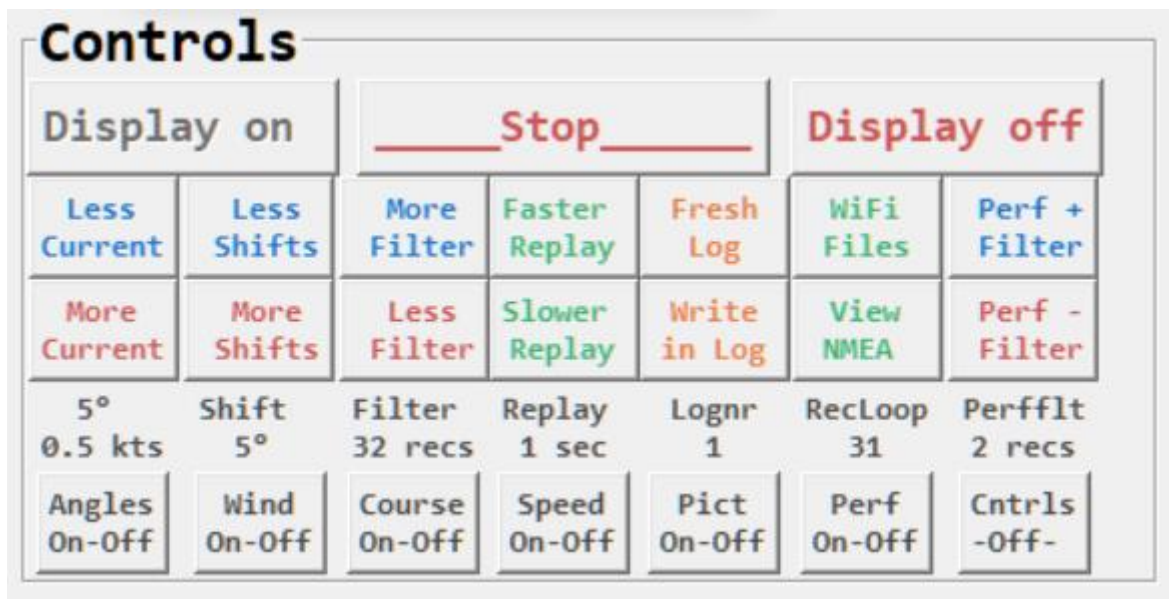
In the first line, SOG-ex, the extra speed from the current (in the length axis of the boat) is not used in the calculation. It is subtracted from SOG before calculating performance. This gives you a realistic performance, without the push (or slowdown) from current.

STW-water is the performance according to the log speed. It uses corrected STW, and current is never included in STW.

VMG-to wind: performance of VMG while beating. Negative here, going downwind. Is calculated with SOG, so in situations with current this VMG is very useful to determine the optimum TWA for best VMG; pinch a bit with current from behind, as we all know, but how much... Now VMG performance will tell you!

Last: RMctime from the GPS.

The Controls box.



The last row has 7 buttons to hide or show the other boxes. If you only want to see Performance, just click the other 5 buttons and these boxes will disappear. Also click Cntrls Off. Then shrink the window to a size of your liking and put only Performance in a corner of your navigation screen. So, the Control box itself can be hidden. In that case, a single button will show up, to be able to restore the Control box.

Second row from below are not buttons but values.

From left to right:

- Threshold for detection of current. Here 5 degrees and 0.5 kts means: if there is more than 5 degrees difference between Heading and COG, OR more than 0.5 kts difference between water speed (STW) and SOG, then Current will show on the PD Dashboard (and in records and log)
- Shift 5 degrees: more than 5 degrees wind shift (between first and second half of moving average of *GEO*) is seen as a shift.
- Filter 32 recs: the number of records from NMEA to go into a moving average calculation. Minimum 2, maximum 512 (about 9 minutes).
- Replay 0 sec : in Replay, time between reading NMEA records from file.
- Log nr 1: how many logfiles have been opened during the run of PD
- RecLoop 17: number of NMEA records read before a pair of SOG and Wind records has been found.
- Perfflt 2 Recs: last 2 performance-values used to calculate moving average.

The four buttons for log and replay will not be there when not logging and/or not replaying.

Buttons for less and more, blue and red:

These buttons change the detection values for thresholds for Current and Shift. You will see the new values on the second row from below.

Less and more filter change the number of records used in a moving average calculation (many of the *Italics* values in the PD Dashboard). Minimum is 2 records (so 2 seconds), maximum is 512 records, 9 to 10 minutes.

Faster and Slower Replay: these buttons are only available during replay of a NMEA log. They make Replay speed minimal (0 sec) or as slow as you want.

Perf-Filter (at the right side) will change the filtering of Performance. Minimum 1 (raw Performance).

Fresh Log button:

One click will start a new log file. No questions asked.

Convenient f.i. in racing: start a new log for every race, or at every buoy in a long race. Not available when logging=N in the boatspecifics.

Write in Log:

Opens a small window to enter some text into the active log file. Things like sail change, MOB, whatever. Only available when logging.

Wifi Files:

Shows some info of the active polar file and other files in use.

Important: also reads the sendoverwifi.txt file again. You can edit this file (in /systemfiles/) when PDis running and then click the button. This way you can change the UDP address of the wifi target and also the information that will go over wifi.

View NMEA:

Shows what is received (or read from file) and what has been sent out.

Stop:

Will stop current processing. You can still continue by answering "no" to the quit-question. Then this is like Pause.

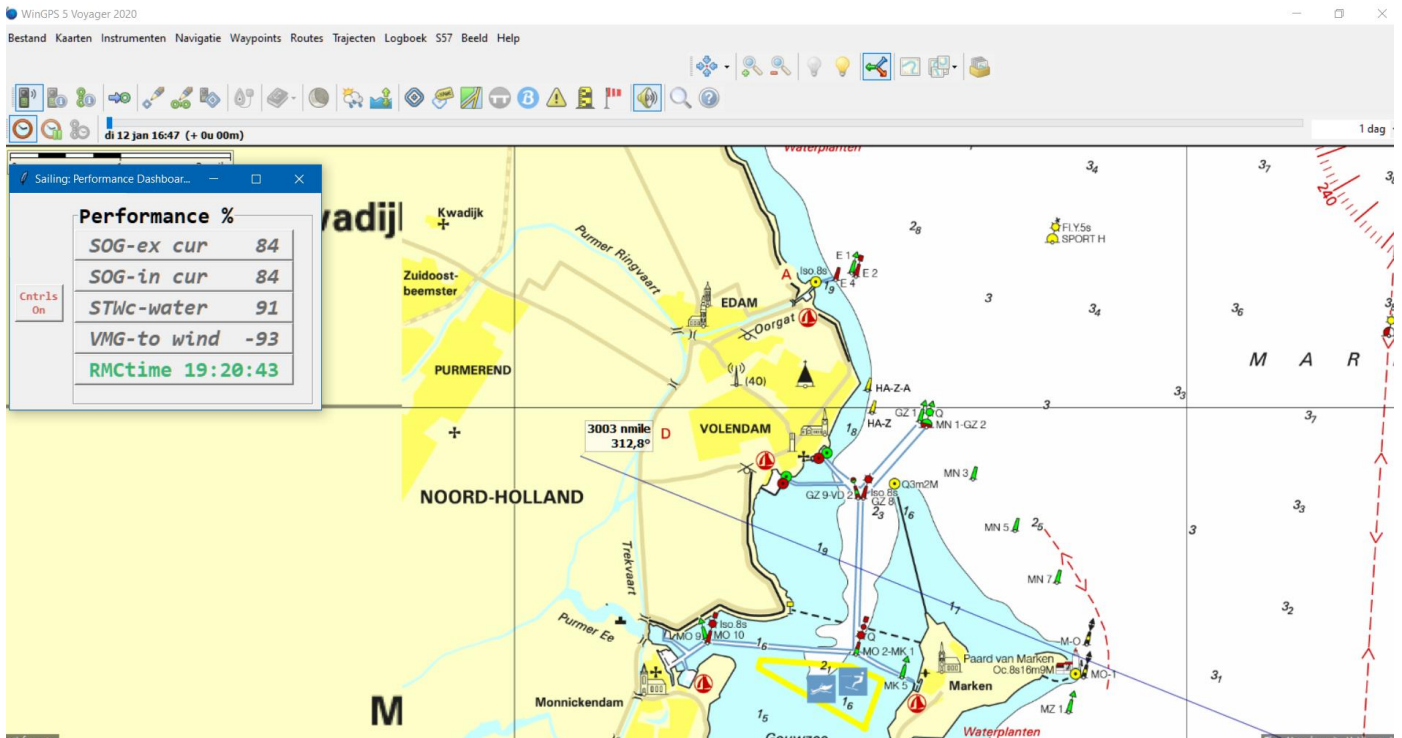
Display off:

Stops values being displayed, but processing will continue. Display off will speed up Replay enormously. It has no real use during live NMEA. Use it when in Replay to produce a smart PDlog from a raw NMEA log very fast.

Display on:

Resumes displaying. When you close all windows except Performance you can create a screen like this example, in your nav program. One button to restore things.

The result of hiding all boxes except Performance could be something like this, your Nav app with a Performance box overlay:



Data in the log file.

We take this column by column.

In the first rows of a log some identifying info is written (not shown here): the boat specifics used, the polar, heel polar, stw correction, deviation table name and (if applicable) the name of the replay input.

DATE	TIME	GEO	GEOkts	AWS	AWA	S--P	TWS 10m	TWA	tHEEL	HEEL	tLEEWAY	LEEWAY
230819	14:04:19	3	6,1	10,9	22	S	5,4	45	4	99	0	0
230819	14:04:20	7	5,9	10,9	20	S	5,2	41	4	99	1	0
230819	14:04:21	10	5,5	10,9	17	S	5,1	36	2	99	1	0
230819	14:04:22	14	6	10,9	22	S	5,4	45	4	99	1	0
230819	14:04:23	17	5,5	10,9	18	S	5,2	37	2	99	1	0
230819	14:04:24	21	6,3	10,9	23	S	5,5	47	4	99	1	0

First series of columns:

Date and time (live or from replay)

GEO and GEOkts: wind direction and speed over ground (i.e. not on the moving boat).

AWS and AWA from the windset, S--P from Port or Starboard.

TWS 10m: PD normalises the wind at the mast head sensor to the speed at 10 meters high, the value used for TWS in a polar. Heel (calculated heel) is also used to adjust the height of the wind!

TWA is calculated TWA (from AWA and corrected SOG). In a rare case, TWA comes from the wind set in a MWV-T record. In that case, STW will probably be used for TWA and TWS. What a pity 😊

tHEEL is target Heel from the Heel Polar.

HEEL is actual Heel from a heel sensor, if available.

tLEEWAY is theoretical leeway according to ORC formula, using K from Boat Specifics file. K should be set at 9 for a windward racer, at 16 for a slow longkeeler, in your boatspecifics files.

LEEWAY is calculated, filtered actual leeway. More about the calculation later.

Next set of columns from the log:

COG	HDG	DEV	SOG	SOGADD	SOG90	STW	STWCOR	tSPEED	SOGp-exc	SOGp-inc	STWperf	TO-WP
143	140	2	1,1	-0,3	0,3	0,4	0	2,2	60	46	14	071P
144	138	2	1,1	-0,2	0,3	0,3	0	2,2	61	50	15	071P
145	138	2	1,1	-1,3	0,4	0,2	0	2,4	79	47	10	071P
146	138	2	1,1	-1,3	0,3	0,2	0	2,2	104	47	8	071P
147	136	2	1,1	-1,3	0,3	0,2	0	2,2	109	50	9	071P
148	136	2	1,1	-1	0,3	0,3	0	2,1	104	51	11	071P

COG from the GPS.

HDG is Heading excluding the Deviation Correction, straight from the compass.

DEV is the correction for HDG. To get real HDG, just add DEV to HDG.

SOG as measured by the GPS, so including current effects.

SOGADD is the kts added into SOG by current. To get 'real' SOG, subtract SOGADD from SOG.

SOG90: the boat speed to the left (negative) or right, caused by leeway and/or current.

STW is the raw water speed as measured by the log.

STWCOR is how much the log shows less or more than SOG, from your correction table.

tSpeed: Target Speed from polar.

SOGp-exc: Performance based on SOG without current effects.

SOGp-inc: Performance based on raw SOG.

STWperf: Performance based on log including the STW correction

TO-WP: the active waypoint from last RMB NMEA record.

The last columns of the log:

DTW	BTW	OFF	TWAWP	vmgWP	DEPTH	vmgWIND	tVMG	VMGperf	Cur kts	Cur rel	Cur abs	RoT	Pitch
12,1	297	154	142	-1,1	2,9	0,1	0,2	45	1,1	75	217	0	0
12,1	297	153	141	-1	2,9	0,1	0,2	50	1,1	78	218	0	0
12,1	297	152	141	-1	2,9	0,4	1	45	1,3	4	144	0	0
12,1	297	151	140	-1	2,9	0,3	0,7	41	1,3	3	143	0	0
12,1	297	150	139	-1	3	0,3	0,7	42	1,3	1	139	0	0
12,1	297	149	139	-1	3	0,6	1,2	46	1,3	43	181	0	0

DTW: Distance to waypoint

BTW: Bearing to waypoint

Off: how many degrees you are not steering to the waypoint. Ideally zero all the time.

TWAWP: the True Wind Angle to the active waypoint. When you activate a new waypoint just before turning around a buoy, you will see the TWA for the next leg.

vmgWP: VMG towards the waypoint. Should be the same as SOG, unless you are going upwind to the WP.

DEPTH: a moving average over 10 measurements of actual depth from the sensor. No changes (depth of keel or sensor), just raw NMEA data.

vmgWIND: the VMG to windward.

tVMG: target VMG calculated from polar.

VMGPerf: performance percentage of vmgWIND versus tVMG

Cur kts: current speed in direction of current.

Cur rel: current direction relative to boat axis.

Cur abs: current direction in compass degrees. Note: direction the current is going to, not coming from (as on maps).

RoT: Rate of Turn, degrees per minute, negative for anti-clockwise.

Pitch: diving after a wave and climbing up the next one... Degrees, every record.

Uses of the log are many.

Analyse race performance with your notebook is one, but you can also use the log for creating a deviation table, for instance. Just go sailing for a number of hours with PD logging, and then look in the logfile at the differences between COG and HDG for each compass course. Before you know it, you can produce a deviation table with Excel from a log. Same for a correction for your log: sail, log and investigate the differences between STW and SOG (avoid currents when doing this 😊) and you have an STW correction table for many speeds. Wind set errors (not aligned with boat) will show as differences in TWA between Port and Starboard, etc etc.

The calculations inside.

PD looks for an RMC record and a wind record (MWV and/or VWR) in the NMEA stream (from file or live). After both are found (and a number of other NMEA types coming in also, while waiting for wind and SOG in RMC) the calculations start. First AWA and AWS are corrected for the influence of heel. The AWA tends to become narrower with heel, and also the cups of a wind sensor measure less wind when there is heel. After this correction, calculation of TWA and TWS is done from the new AWA and AWS. SOG is used here (from the RMC), as SOG is more accurate than STW and also, the measured AWA and AWS are influenced by an eventual current and leeway. Current from the lee side gives you more apparent wind, current against wind will increase your apparent wind, etc. These effects are included in AWA and AWS. Hence the use of SOG to calculate True wind from Apparent. Outcome is True Wind Angle and True Wind Speed. TWS is then normalised to 10 m high (using both mast length and actual or target Heel). So TWS is the TWS as used in your polar!

Some instrument systems deliver wind records with True wind . MWV-T for instance. How this calculation is done? Probably based on STW (not SOG) and thus wrong in current and also the STW often is not linear and does not include leeway. Nothing we can do about it. Hope you never find these NMEA records.

Many calculations are just a table lookup or use of a standard formula. STW correction, Deviation, target speed, target heel, optimal UA, DA, target leeway all go like this.

The calculation of geowind speed and compass angle are next. Into the formulas go AWS and AWA, Port or Starboard, HDG, COG and SOG). After some good-old Pythagoras and a few goniometric functions the real wind speed and direction (over the earth, not over a moving boat that is blown to leeward) come out as a results. A correct HDG is important here, much depends on it. Hence the need for an accurate deviation table.

Next are the calculations of current (kts, relative and absolute direction) from HDG, STWc, COG minus theoretical Leeway and SOG). STWc is corrected log speed, again showing the importance of a good stw correction table. Current is only calculated when it comes above the thresholds (for angle and kts) active at that moment. Errors in measurement (HDG with a swinging Fluxgate!) can cause the detection of non-existing currents! That is where

the threshold comes in. Heading from an electronic compass (f.i. RM-EV) is much better.

Then the effect of current on SOG is calculated, with the help of current kts and current relative angle (to boat axis). Now we know how much of our SOG comes from current, and how much SOG we produced ourselves, sailing as good as we can.

The difference is important when calculating performance.

At this point in the process, we have all ingredients for the 4 performance calculations:

Corrected STW, SOG with and without Current effect, and VMG. Targets come from the polar. Four performance percentages result.

If you steer higher than the optimum UA or deeper than the DA and you have a polar with zero's in the corners (where TWA and TWS are outside the official polar) the performance calculation will deliver '222', for 'Too Too Too' high or deep. If you don't want that, use a polar with target speeds in every cell. Then performance will show, but as you made up the target speeds yourself, you are just looking at your fantasy Performance...

Then come DTLL and TTLL. In the formula, TWA, leeway, DTW and SOG go in, and out come DTLL and TTLL. Next, ETE is just a matter of DTW and vmgWP.

Now it is time to do some filtering, to get rid of noise in the signals (HDG and STW are noisy, and HDG goes into GEOwind and STW into current calculations).

A moving average (over a number of records to be chosen by the user) is calculated for the geowind direction, the geowind TWSavg, and the board TWSavg.

Out of these moving average filterings also come trend results: shifts in wind direction, changes in wind speeds (geo and on board). These trends are derived from differences between first and second half of the record series in the moving average length.

Then Depth gets a filtering treatment, also delivering a trend result: depth getting more or less.

Performance is next: all 4 performance results are filtered with a short moving average. Just to get a quieter presentation. Cycle can be adjusted with buttons.

Nexttwa is next, based on geowind and BTW the TWA to the waypoint is determined.

Actual Leeway comes then. For this, we use filtered values for board TWS avg, GEO TWS avg, actual SOG and TWA). The result is degrees leeway, including those caused by current. A negative Actual Leeway means going against the wind sideways thanks to the current!

Also, the kts boatspeed to the left or right results from this calculation. Combination of leeway and, if present, current.

Finally, the value of actual Leeway is moving-average-filtered, filter is user-controlled by buttons.

Of course leeway can also be calculated from HDG and COG. These are visible in the Course window; the difference can be derived there by just looking at these values.

Last but not least, some data are investigated to find embedded warnings. Wind shifts can be caused by a real shift or can be a velocity header or lifter. PD notices the difference. Your reaction to them should also be different.

Some warnings for current are also included.
More to come, after live trials!

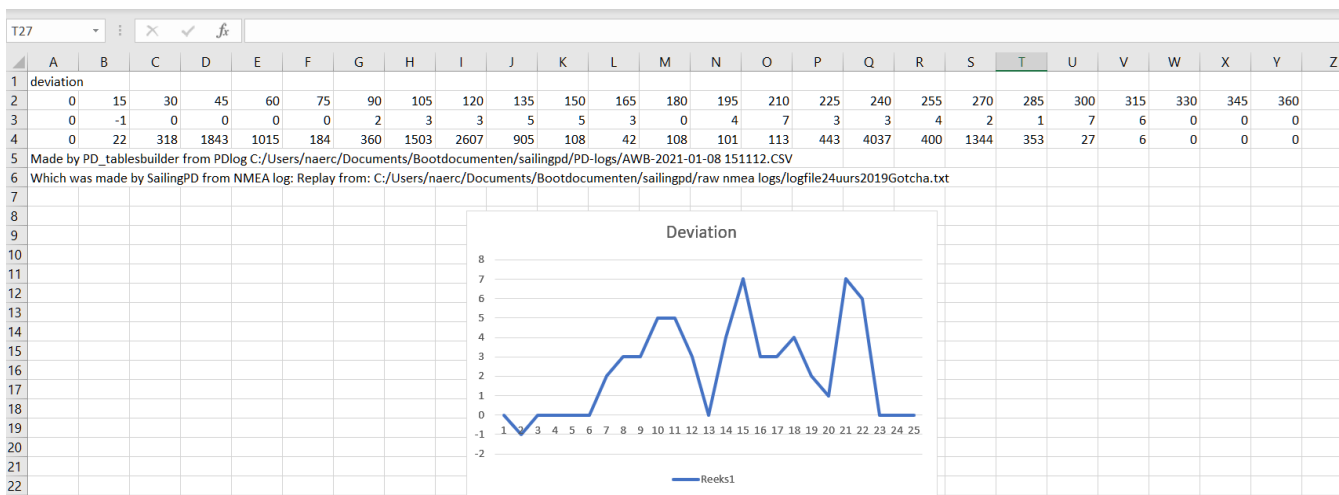
Post processing the PD-log.

Currently, there are 2 postprocessors for a PD Log file.

One will read a PD log and then write a Deviation table and a simple STW Correction table (no heel), both in the CSV format that can be read by SailingPD. This way, you can create both files by just sailing for a few hours (making sure you cover all courses and the full speed range on each bow) and then post-process the PDLog in a minute or so.

Deviation:

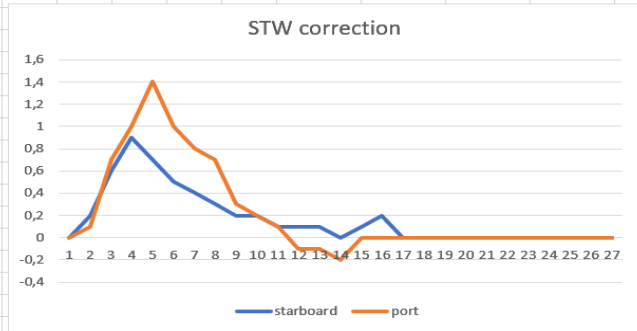
- First row is geo-course (COG)
- Second is deviation (to be added to HDG)
- Third row is number of observations used for this column



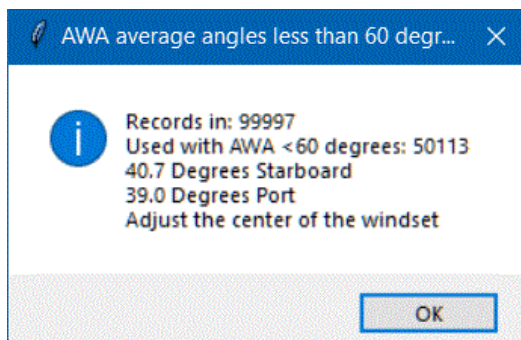
STW Correction is separate for SB and Port.

- First row is SOG, in 0.5 kts steps
- Second and third row: correction, to be added to STW
- Fourth and fifth row: observations used, SB and Port.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1	stw correction																					
2	stw	0	0,5	1	1,5	2	2,5	3	3,5	4	4,5	5	5,5	6	6,5	7	7,5	8	8,5	9	9,5	10
3	starbo	0	0,2	0,6	0,9	0,7	0,5	0,4	0,3	0,2	0,2	0,1	0,1	0,1	0	0,1	0,2	0	0	0	0	0
4	port	0	0,1	0,7	1	1,4	1	0,8	0,7	0,3	0,2	0,1	-0,1	-0,1	-0,2	0	0	0	0	0	0	0
5	Obs S		820	323	263	60	107	128	334	926	1400	1266	581	1042	2689	743	6	0	0	0	0	0
6	Obs P		3561	173	83	2	24	15	10	35	61	145	850	3083	1456	0	0	0	0	0	0	0
7	Made by PD_tablesbuilder from PDlog C:/Users/naerc/Documents/Bootdocumenten/sailingpd/PD-logs/AWB-2021-01-08 151112.CSV																					
8	Which was made by SailingPD from NMEA log: Replay from: C:/Users/naerc/Documents/Bootdocumenten/sailingpd/raw nmea logs/logfile24uurs2019Gotcha.txt																					
9																						
10																						
11																						
12																						
13																						
14																						
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25																						



The second post processor reads the log and looks at the AWA's for Port and Starboard tacks. Then the difference between these 2 is calculated and displayed, to help you align the wind set with the boat. When ready, it just shows this little window:



Many other possibilities in the log:

- Leeway as result of TWA and TWS
- Impact of Heel on Leeway
- Actual Heel compared to theoretical heel, f.i. while Dual Handed
- Impact of Pitch on Performance
- RoT in daylight or at night
- Etc. You name it. You calculate it in Excel.

The controlling files.

First the one you have to use, describing your boat and the NMEA installation.

```
My Boat
SOG
17.5
11
VTG,RMB,BWC,BOD,MTW,GLL
Y use STW correction with heel included
Y write a CSVfile with all logged results Y/N
Y copy of all created NMEA output Y/N
N write a copyfile of all incoming NMEA Y/N
Y replay a file with logged NMEA Y/N
Y use color in display, N is Black text
COM1
4800
8
N Parity
1
0
N use a second COM for output only: IF Y 6 extra lines are needed
here after!!
Spare1
Spare2
Spare3
Spare4
Spare5
last line do not remove

line 1 Boat name or what
line 2 SOG or STW to be used for speed
line 3 wind sensor height above water in meters
line 4 K constant for leeway calculation, 7 for racer, 12 for slow
boat
line 5 record types to be used in output to display. Default is
VTG,RMB,BWC,BOD,MTW,GLL,BWR,MWV,VHW,VLW
separated by comma. Capital letters. Remove the ones you don't want.
Do NOT use other rec-types,they will be ignored
line 6 Y/N use a STW correction file with heel included.
line 7 Y/N create a CSV logfile
line 8 Y/N copy file of all NMEA records created by program
line 9 Y/N write a copyfile of all incoming NMEA
line 10 Y/N play a replay file
line 11 color or b/w
line 12 COM1 or higher
line 13 speed BPS of COM, f.i. 4800
line 14 bytesize
line 15 parity Y or N
line 16 stopbits
line 17 is RTSCTS on 1 off 0
line 18 extra COM to send to? Y N
```

If yes:
line 19 COM1 or higher
line 20 speed BPS of COM, f.i. 4800
line 21 bytesize
line 22 parity Y or N
line 23 stopbits
line 24 is RTSCTS on (1) or off (0
Spare1
Spare2
Spare3
Spare4
Spare5
last line do not remove

This file you have to edit with Wordpad (not Word!) and save as .txt file.
You will probably end up with more than one file: Replay or Live, different
COM ports, etc etc.

SPECIAL VERSIONS for post processing a PD-log:

Post processing is controlled by using (in SailingPD) a special
boatspecifics file.

If the first line contains
checkwindset

then... a wind set check will be done on a selected PD logfile

For STW and DEV production, the first line in the boatspecifics file should
read

createtables

More to come!

Next file is NMEATemplates.

It creates the NMEA records to be sent to your instruments.
Precision is key here. One wrong name, comma or capital letter will prevent the program from working. Edit with Wordpad, save as .txt

```
$PDMTW,$curang,C
$PDVTG,$sogperf,T,$sogperf,M,,N,,K,A
$PDGLL,$xte,N,$dts,E,$tws,A
$PDRMB,A,$bestup,L,$DAoff,$UAoff,$diffdeg,N,$dtl,E,$ete,$ttl,$vmgwp,A
$PDBOD,$shiftmsg,T,$sogperfci,M,$stwperf,$vmgperf
$PDBWC,$cursog,$orthospd,N,$speedshort,E,$targetspeed,T,$targetvmg,M,$vmg,N,$aws
$PDBWR,$twa,$twa,N,$twa,E,$twa,T,$twa,M,$twa,N,$twa,A
$PDMWV,$twa,R,$twa,N,A
$PDVHW,$twa,T,$twa,M,$twa,N,$twa,K
$PDVLW,$twa,N,$twa,N
last line here, DO NOT REMOVE OR CHANGE!!!!
DO NOT ADD OTHER RECORD TYPES!
DO NOT REMOVE ANY OF THE TYPES!
DO NOT CHANGE RECORD TYPES!
DO NOT REMOVE THE COMMA IN THE LAST POSITIONS!
```

Only things you must do is fill in the \$variables you want.
Choose from the list below and put your choices in records you can display.

Important to use a value in a field that can be correctly shown on your display
\$targetperf and \$sogperf need 3 digits, f.i., so use a (numeric) COG or Heading-field.
etc.

Variables to be used in one or more of the above records:

- \$-sign has to be present for each value to be displayed.
- Only replace fields with \$ in example, leave A, T,M, K, N and E in place!
- Make sure you have the right number of , , , , for a valid NMEA record of your own!

\$curang	Current angle relative to boat axis
\$curgeo	Current angle over ground, compass
\$curkts	Current kts
\$targetheel	Heel for this TWS and TWA, calculated from heelpolar from Speedguide
\$heel	Actual heel from a HRM NMEA record
\$actleeway	Actual leeway
\$leeway	Leeway according to standard formula for leeway
\$bestdown	Best wind angle given tws for running downwind
\$bestup	Best wind angle given tws for beat upwind
\$DAoff	Degrees above or below best UA
\$UAoff	Degrees above or below best DA
\$diffdeg	Degrees steered away from bearing to waypoint
\$dtl	Distance to layline (tack) when beating
\$ete	Time enroute, to WP, HH:MM
\$ttl	Time to layline in minutes,minutes
\$vmgwp	Actual VMG to Waypoint kts
\$xte	Cross track error
\$dts	Direction to steer
\$sogperf	Actual speed as % of polar target calculated with SOG excl current in HDG-dir
\$sogperfci	Performance percentage of SOG including added speed by current
\$stwperf	Performance percentage versus STW
\$vmgperf	Actual VMG as % of polar target
\$cursog	Speed in kts added by current to boatspeed (by wind)

\$orthospd	Speed 90 degrees on boat axis, by leeway and current
\$speedshort	Speed shortage kts vs target
\$targetspeed	Polar target kts
\$targetvmg	Target VMG
\$vmg	Velocity made good into the wind kts
\$awa	Apparent wind angle
\$aws	Apparent wind speed kts
\$geo	Wind in degrees over ground (the real wind!)
\$nexttwa	TWA to active waypoint
\$shift	Degrees windshift in geo wind
\$twa	True wind angle
\$tws	True wind speed at 10 m above water, and taking heel into account, kts

Important to use a value in a field that can be correctly shown on your display
 \$targetperf and \$speedperf need 3 digits, f.i., so use a COG or Heading-field. etc.

Some record types require an FAA Mode Indicator at the end of the record.
 An example is the VTG above. It ends with A, to signal it has valid data, required
 since NMEA 2.30 in March 1998.

The older versions of NMEA do not require this Mode Indicator.

Some multiplexers and also some instruments require this Indicator and will refuse to
 process a VTG without the A at the end.

The other record types that might need the A at the end are BWC, RMB and GLL.

If you instruments refuse to show one of these, try adding the capital A at the end of
 them in the NMEATemplates file. VTG already has it.

Good luck and have fun!

Then we have the file processlist. Better not touch it.

```
VHW,RMB,RMC,HDG,HDT,HDM,MWV,VWR,DBT,DBK,DBS,HRM,ROT,ECD,DPT,  
empty  
Consolas  
18  
medium sea green  
IndianRed3  
DodgerBlue3  
sienna2  
gray28  
dark sea green  
5  
5  
0.5  
0.2  
N  
last line!
```

This file is read during start up, together with the background picture and may be the last startup file.

Folder name should be: systemfiles

Filename should be: processlist.txt

line 1: These record types are used in the program. Not all are needed.

As long as there is wind (VHW and/or MWV) and Speed (RMC) things will work.

A nice minimum is an MWV and an RMC.

DO NOT EVER CHANGE THE FIRST LINE!

line 2: empty

line 3: font type. Must be a font with all elements of same width, monospaced. Default Consolas

line 4: font size, default 18

line 5 color gr, default medium sea green

line 6 color rd, default IndianRed3

line 7 color bl, default royal blue

line 8 color ora, default sienna2

line 9 color blk, default dim gray

line 10 color lg, default light grey

line 11 shiftdev, default 5. A shift is found if the average of second half of geomemory differs more than 'shiftdev' with the average over first half of geomemory

line 12 currtrsh, default 5. currtrsh is difference between cog and hdg. > currtrsh can be a sign of current

line 13 currtrshkts, default 0.5. This is difference between sog and stw. May be a sign of current....

line 14 pause (0.2 sec) between different NMEA records sent over COM.

line 15 Y or N to use dummy wind records, for test purposes only (GPS, but no windset)

The font size you can change, although there are minimum sizes in the program. You can ruin the display.

The font itself, Consolas, is an Equal-Width font: all characters and numbers have the same size. That is necessary for a quiet, non-jumping display.

You could try to change it, under 2 conditions:

- It has to be Equal-Width
- It has to be available in Python! (the language in which PD is written)

Line 5 to 10 are color names used in Python. May be you could try to change if you do not like the colors. It have to be Python-recognised colors!

Line 11 to 13: Just starter-values for some thresholds. Changing them is easy with the buttons in the Controls box. If you want different values to start with, change them in the txt file.

Line 14: before sending a record out the COMport, a short pause happens, to not flood the (4800 bps?) port with too much output records. You could change this 0.2 sec value, but results are unsure.

Line 15: Should be N during normal use. If set to Y the program will produce random wind records just by itself and also will use real ones (if available).