Sailing Performance Dashboard Version 1.9.5

Sailing Performance Dashboard (from here on: SPD) is a program that receives and processes NMEA-183 records, including converted NMEA2000-STNG- and Seatalk-records, from a multiplexer or other multiplexing device or application.

Many, sometimes complex, calculations are done and the resulting information is available in a number of ways: home-made NMEA records, on screen, wifi over UDP and sound. Soon, also a browser can be used to receive information over a websocket.

The purpose of SPD is to help you sail faster, reaching the maximum possible speeds from the boat's polar diagram.

Inputs.

SPD uses at a minimum an RMC-record (from a GPS, for SOG and COG) and one of 2 kinds of wind-records (MWV-R or VWR). Records with True wind (MWV-T and the obsolete VWT) are ignored, as SailingPD itself calculates True Wind from Apparent in two different ways. True wind from an MWV-T or a VWT cannot be trusted, as in it often unknown how this true wind is calculated. Also, corrections must be applied to AWA and AWS, for mast height and heel. MWV-T and VWT do not do that and hence deliver faulty TWA and TWS information.

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, FEC-GPatt, ROT and XDR (some kinds: Heel, Pitch and Yaw).

If VHW records are present (with speed thru water, STW) these can be used to calculate True wind instead of using SOG (not just SOG, see later) for True Wind (TWA and TWS).

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, Big Waves, whatever. Polars are created by saving an Excel spreadsheet as a .CSV file.

- A heel polar with heel degrees for a range of wind speeds and wind angles. This heel 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 SPD. Also an Excel CSV, this heel polar.

- A deviation table for the electronic compass on board that produces the Heading info (HDx-records and more modern types. Heading from a

VHW is ignored, as it is often empty). 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 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 or one without heel. 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 (boat 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 and more complete the results of Sailing Performance Dashboard are.

Using only SOG (from RMC) and wind (apparent speed and angle, from MWV-R or VWR) SPD can look up the target speed in the polar and then calculate the actual performance. Alternatively, STW (log speed) from a VHW can provide speed for this calculation.

N.B: SOG and COG from an AIVDO message (AIS transponder) are not used; the update frequency (30 seconds or more) is not acceptable for the purpose of Sailing PD: show accurate performance data every second is impossible then.

Sources of NMEA records.

SPD can process NMEA records from 2 sources, for 2 different purposes:

- 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 SPD will calculate and show all kinds of interesting information from the raw data. More about this later. SPD is fast in Replay: 25.000 NMEA records/second on a simple notebook. The resulting logfile contains a lot of interesting information.

or during sailing:

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

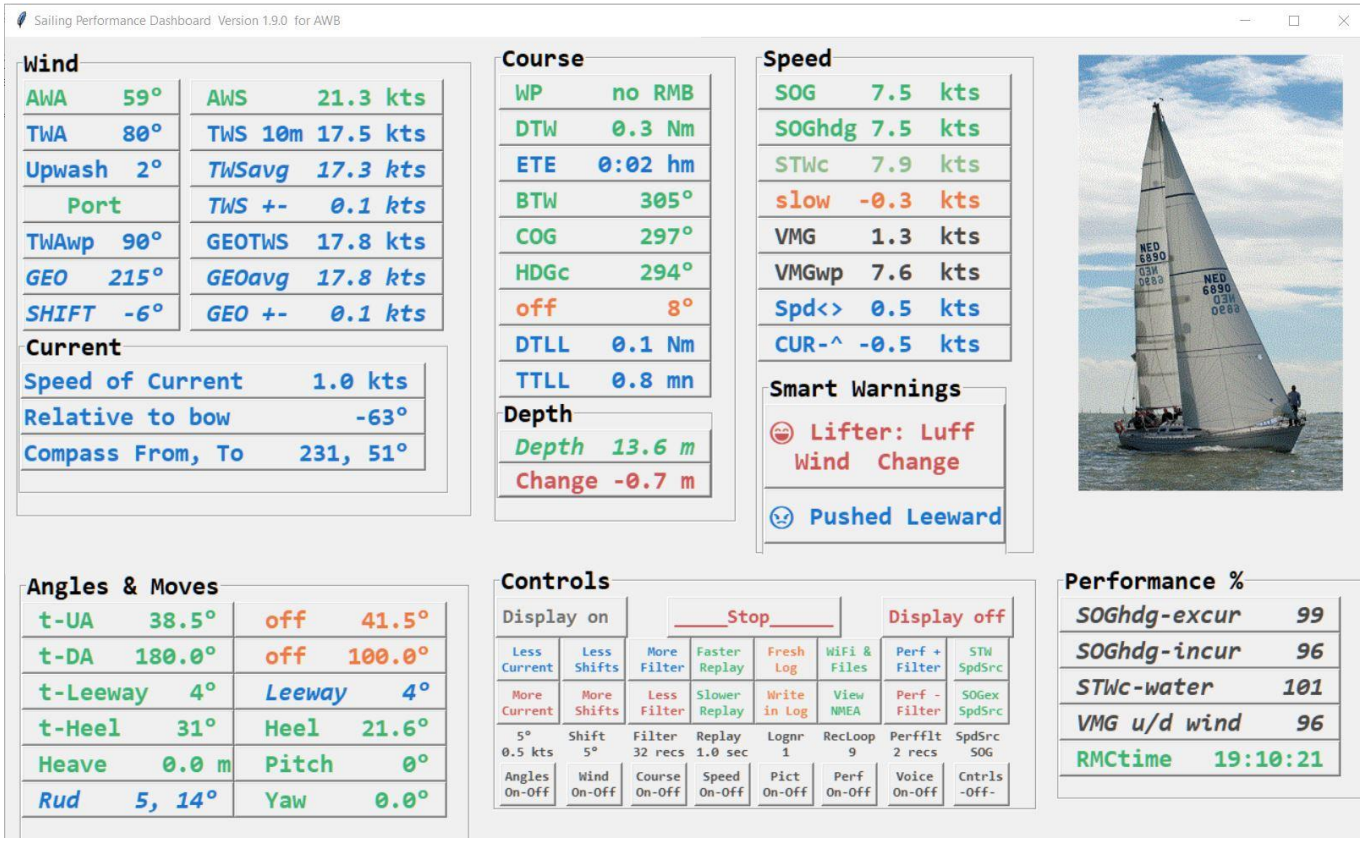
Of course it is also possible to use a software program like NavMonPC, VSPE or Franson GPSgate as an intermediary. SPD normally reads records from a

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. Flow control (via RTS-CTS) is available if needed.

There is an option to use a second COM port for the output of SPD instead of the port 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 SPD.

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



Eight windows for eight different kinds of information, and one window with a nice picture of your own choice, to make you feel at home between all those data. And of course a window with a lot of buttons, 28 in total.

Some buttons are only available during Replay (Faster or Slower), others only during live NMEA processing.

Sailing PD is designed to be used on a touchscreen on a moving boat. So no fancy drop-down menu's, just buttons. Later more about the values in the windows and the buttons. If no touchscreen, a mouse will do.

Colours are important: green is an (almost) 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 up or down during processing with a click on a button.

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 filled with 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, 46 different measurement values are recorded about every second.

More on the log later. It has many uses!

The third output: home-made NMEA records.

SPD can send NMEA records filled with data from the program to your instruments. In this version, 18 different types of records can be used for sending messages to your instruments. The normal layout of NMEA183-records is used, but the data fields (the $-variables) are data from SPD.

```
$VOICE,$sogperf
$SPMTW,$curang,C
$SPVTG,$bestangle,T,,M,$sogperf,N,,K,A
$SPGLL,$xte,N,$dts,E,$tws,A
$SPRMB,A,$xte,$dts,$bestangle,$towp,$dtw,N,$dtw,E,$dtw,$btw,$vmgperf,V,A
$SPBOD,$shiftmsg,T,$sogperfci,M,$stwperf,$vmgperf
$SPBWC,$cursog,$orthospd,N,$speedshort,E,$bestangle,T,$bestangle,M,$sogperf,N,
$SPBWR,$twa,$twa,N,$twa,E,$twa,T,$twa,M,$twa,N,$twa,A
$SPMWV,$twa,T,$tws,N,A
$SPVHW,$twa,T,$twa,M,$twa,N,$twa,K
$SPVLW,$twa,N,$twa,N
$SPRPM,E,1,$sogperf,$sogperf,A
$SPXDR,G,$sogperf,P,SailPerf
$PNKEP,03,$bestangle,$sogperf,$angleOFF
$PSMDPRF,P,,
$PSMDPRW,W,
$SPMVW,$twa,$bow,$tws,N,$twstrend,N,$geo,$gtr,N,$geotwsavg,N,$geotwstrend,N,
         $shift,$bestangle,$angleOFF
$SPMVP,$sogperf,$sogperfci,$stwperf,$vmgperf,$dtl,$ttl
```

This is just a kind of random example. The 2 types with $PSMDPR are not to be used yet. Under development for Shipmodul multiplexers and N2K.

The $SPMVW and $SPMVP are specially designed for the new Multiview MK II from Star-tracking. The $values in these 2 should not be changed, the Multiview assumes these data are in these field!

The 18 record types themselves 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 69 variables available in the program. The use of these records will depend on the possibilities of your displays on board. The third record above, $SPVTG, is a useful one: $sogperf in a VTG record. This SOG-Performance sits in the

field normally used for a COG: 3 digits. If your instrument can display COG from a VTG record, it will now show the actual boat performance (speed versus polar target for the actual TWA and TWS) in 3 digits (as COG has). The other field used is a speed-field. It now shows $bestangle: the actual best UA or DA for the current polar and TWS.

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 a 4800 bps a COM becomes overloaded. 2 or 3 should be possible at 4800 bps.

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

The $SPRPM record is a special case. It is not displayed directly by any NMEA 183 instrument; it is meant for a Miniplex 3 or other device that converts NMEA183 into NMEA2000. It will be converted to a NMEA2000 PGN for Engine Revolutions. This way, performance and other data can show up on N2K displays! This will also work via Signal K; conversion of RPM to the correct PGN can be done there.

The $PNKEP,03 is for NKE displays only, and the 2 $PSMDPR types will be used in a Miniplex3 to send data to NMEA2000 displays in a future version.

There is an option for a second COM(USB) port; input then comes via the primary port, all output records (created by SPD 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. Can be handy when you use a real RMB for the AP to steer the boat and an $SPRMB to display some information. The AP would not like two very different RMB’s every second!

SPD will check if any of the records coming in from a live COM start with itself, $SP, as the sender. If so, you have created a loop (in the multiplexer). SPD 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 more important stuff is broadcast over wifi, by the PC where SPD is running. It sends UDP messages to a UDP-listener, defined by IP address and port number. Can be a broadcast also, by using 255.255.255.255 for IP address. Sender (PC with SPD) and Listeners have to be connected to the same wifi network (a router, a hotspot, a multiplexer).

At the moment, five kinds of home made records are sent: performance, current, wind and wind shifts, layline and info on rudder angle, leeway and heel. You can have all 5, less, or nothing. When no current seen, no message. Not going upwind, no layline message.

With just a simple UDP viewer (like UDPMonitor on Android, free) this information will show up on your phone or tablet like this, every second or less frequently if you so specify:

In the second message, there is shift information: R-HEAD is real header, V-HEAD is velocity header. Same for lifters…

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 your program has produced. May be useful for later analyses, next to the (more complete) log file. Also handy for debugging while you try to get SPD to do what you want!

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 not included in the log.

The seventh output:

Voice! SPD can tell you (in a clear gender-age-neutral voice) what the actual performance is. The frequency can be set by a parameter in the boatspecifics file: 0 is no speech output, 5 is every 5 seconds, etc.

The variable to be spoken is defined in the NMEAtemplatesfile, between the nmea-records composed there. It looks like this when you want to hear performance:

$VOICE,$sogperf

All variables available for the NMEArecords (all $-variables) are also available for $VOICE. Only one variable, since speaking the voice output takes time and SPD has other things to do!

The eighth output:

SailingPD is ready to send all available data over a websocket to listening browsers. The HTML etc needed for the browser is yet to be developed, so this feature cannot be used yet.

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**. See later.

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. See later.

The **third** control file is just a picture. Same directory, and the name must be **background.gif**. Without it, SPD 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 in UDP. It sits in the directory **sailingpd/systemfiles** and the name is **sendoverwifi.txt**. See later.

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).No reason to look into it.

The **sixth** control file is the one that you definitely will need to edit to your likings. The name you choose yourself. More description on the last pages.

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 !!
5
10
```

```
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 important: True Wind will be calculated based on STW or SOG, and the 'speed shortage' versus the polar on the display also depends on this choice. Of course there is a button to toggle between STW and SOG as speed source later!

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. And learn from the SPDLog: it has actual leeway and target-leeway (which depends on K). These two should not differ too much. Change your K if needed.

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

6th to 11th line: speak for themselves

12th to 17th line: COM port for live NMEA, the speed, bytesize, parity, stopbits and flow control with RTS/CTS.

18: 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 19, 20, 21, 22, 23 and 24

19 (or 25): seconds between voice messages. 0 is no voice at all.

20 (or 26): seconds between sending UDP wifi messages.

Then follow 3 spare lines for later use:
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 more records being send out, you name it.

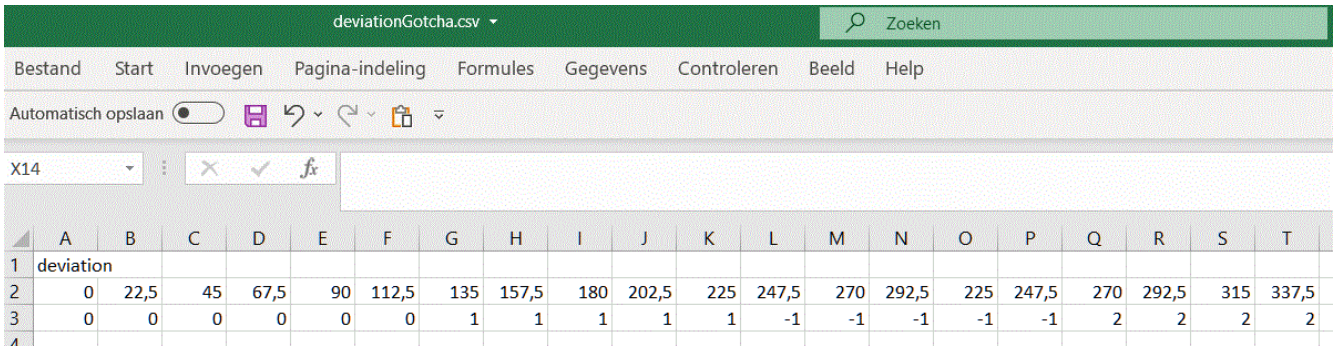
In all control files there is text explaining what is what (not in the GIF with the picture). Keep a copy before you edit one; a broken file (missing lines, wrong characters etc) will make the program just stop…..
Also, later in this manual, the files are described in detail.

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 file.

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, Big Waves, etc. Separator in the CSV can be a semi-colon ; or a comma ,
With ; the decimal sign is a comma, with , the decimal sign is a .
Selection of comma-separated CSV is done on line 2 of the file processlist.

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

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. 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.**

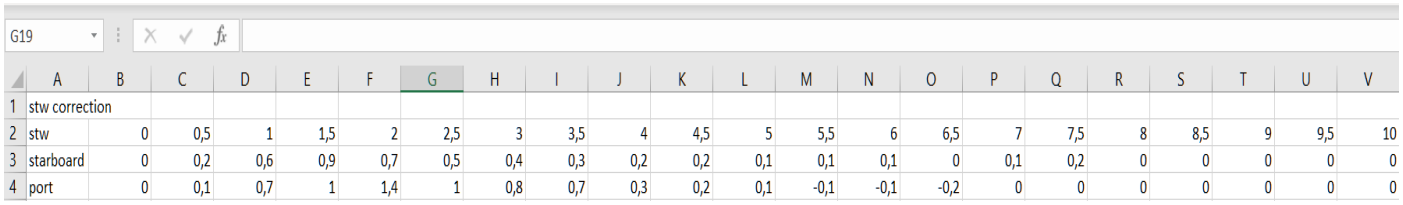
There is a post processing program to create a deviation file.
Run SailingPD to replay a long raw NMEA log from a trip, and then process the SaingPD-log with the postprocessor. Or post-process the PD-Log directly. This produces a complete deviation table that also tells you how many observations were 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																								

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.

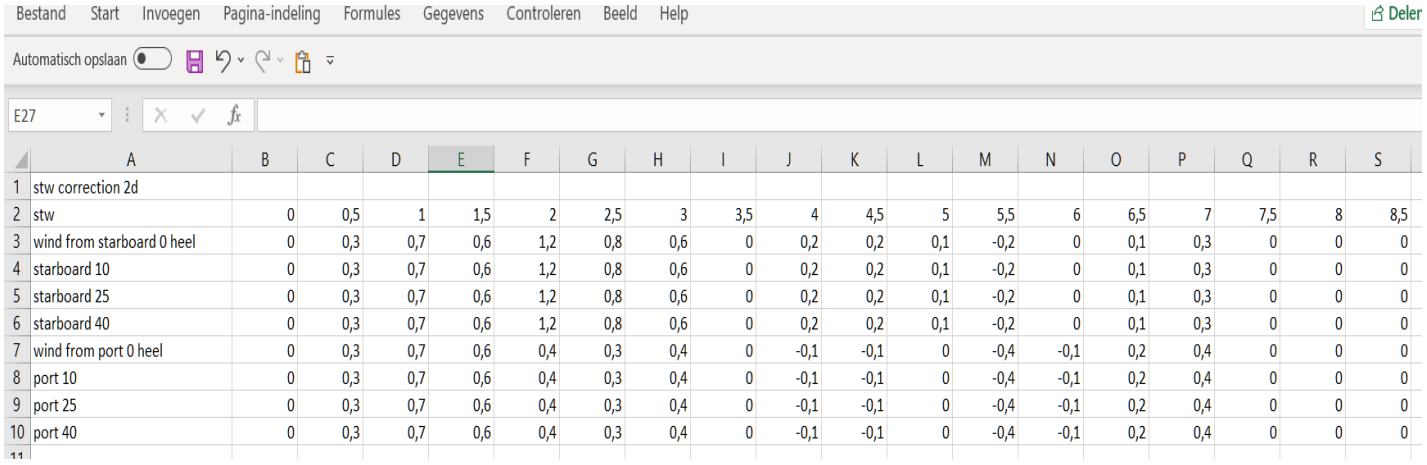
The simple version looks like this:



	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 SPD 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 that the ideal UA for the actual TWS, SPD will use the zero in the polar and display 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 with not enough VMG.
Dashboard will tell you how many degrees you sail high or low, in the fields 'off' in the Optimum Angles box. There is also a $angleOFF for in the NMEA records; it can show on your displays how far you are away from or past the ideal DA or UA.

Of course you can use other values than all those zero's in these TWS-TWA combinations, and have performance normally calculated.

A nice use of the polar can be the following:

- Create a few rows for upwind angles between the official UA and 0, f.i. 10, 20, 30, 35 degrees TWA.
- Calculate the speed (for each TWS column) that is the speed at the UA for that TWS. This speed is NOT on your measurement certificate: that has the Beat VMG and the Run VMG for each TWS. Use a Cosinus 😉
- Now calculate the Boat Speed for each TWS/UA (and DA) combination. (yes, use a cosinus on the Beat VMG for each TWS/TWA combination). Fill the rows with narrow TWA's, even TWA=0.
- The VMG@UA is the best VMG that you can really sail upwind at this TWS; it is the best upwind possibility: this combination of TWS and UA. So it can be used as performance reference when sailing narrower TWA's.
- At TWA = 0, the boatspeed you calculated will be about equal to the Beat VMG.
- Of course you can never sail a TWA=0 in reality, but filling the cells in the polar this way will give you a performance calculation when sailing above the UA (or past the DA) that is comparable to best optimum UA, the official best one. Now you can see if pointing is a good idea: the performance percentage will show you every second.
- Make sure you fill all cells of the polar this way, also the empty (or zero) downwind ones.

Your polar will now look like this:

number of TWS : 10
number of TWA : 32

1	3	6	8	10	12	14	16	20	24	TWS TWA
0,76	1,51	3,17	3,78	4,23	4,61	4,84	4,84	4,91	4,99	0
0,77	1,54	3,22	3,84	4,30	4,68	4,91	4,91	4,99	5,07	10
0,80	1,61	3,38	4,02	4,50	4,91	5,15	5,15	5,23	5,31	20
0,87	1,75	3,67	4,36	4,89	5,32	5,59	5,59	5,67	5,76	30
0,92	1,85	3,88	4,61	5,17	5,63	5,91	5,91	6,00	6,09	35
0,97	1,93	4,06	4,83	5,41	5,89	6,18	6,18	6,28	6,60	38,5
0,97	1,93	4,06	4,84	5,42	5,90	6,19	6,19	6,50	6,67	38,6
0,97	1,93	4,06	4,84	5,42	5,90	6,19	6,40	6,58	6,73	38,6
0,97	1,95	4,08	4,86	5,45	5,93	6,40	6,50	6,67	6,80	39
0,99	1,98	4,15	4,94	5,53	6,10	6,51	6,60	6,75	6,87	40,1
1,00	2,00	4,20	5,00	5,60	6,26	6,61	6,70	6,83	6,93	40,9
1,01	2,01	4,23	5,00	5,84	6,41	6,72	6,81	6,91	7,00	41,3
1,04	2,07	4,20	5,29	6,07	6,57	6,83	6,91	7,00	7,07	43,1
1,07	2,00	4,60	5,58	6,31	6,72	6,93	7,01	7,08	7,13	45
1,00	2,50	4,99	5,87	6,54	6,88	7,04	7,11	7,16	7,20	52
1,00	2,70	5,27	6,17	6,75	7,04	7,21	7,30	7,37	7,50	60
1,00	2,70	5,38	6,29	6,83	7,11	7,30	7,43	7,56	7,85	70
1,00	2,80	5,48	6,40	6,90	7,18	7,38	7,55	7,75	8,10	75
1,00	2,70	5,45	6,39	6,94	7,23	7,41	7,61	7,90	8,15	80

1,00	2,80	5,41	6,37	6,98	7,27	7,44	7,66	8,05	8,20	90
1,00	2,60	5,38	6,50	7,10	7,45	7,77	8,03	8,33	8,60	110
1,00	2,50	5,24	6,37	7,03	7,41	7,75	8,11	8,67	8,70	120
1,00	2,30	4,77	5,85	6,72	7,18	7,52	7,87	8,62	8,60	135
0,92	2,30	4,49	5,60	6,48	7,04	7,41	7,74	8,47	8,50	140
0,85	2,13	4,20	5,35	6,24	6,90	7,29	7,62	8,31	8,40	146
0,82	2,03	4,02	5,10	6,00	6,76	7,18	7,49	8,16	8,30	150
0,81	2,02	4,00	5,10	5,80	6,67	7,18	7,44	8,10	8,26	150,5
0,81	2,01	3,98	5,08	5,60	6,59	7,03	7,38	8,04	8,23	151
0,77	1,92	3,80	4,84	5,34	6,50	6,95	7,33	7,98	8,19	156,5
0,73	1,82	3,60	4,60	5,07	6,17	6,87	7,27	7,92	8,15	165
0,71	1,77	3,50	4,46	4,92	5,98	6,60	7,16	7,80	8,18	175
0,71	1,76	3,48	4,44	4,90	5,96	6,57	7,05	7,67	8,20	180
45	43,1	41,3	40,9	40,1	39	38,6	38,6	38,5	38,5	UAlist
140	146	150	150,5	151	156,5	175	180	180	180	DAlist

With this type of polar, you will not be warned by seeing 222 when pointing too high (or deep). You will see performance decreasing when pinching of sailing too deep.
This type of polar obviously is not to be used for routing; it would tell you to sail straight into the wind. Only to be used for performance measurement!

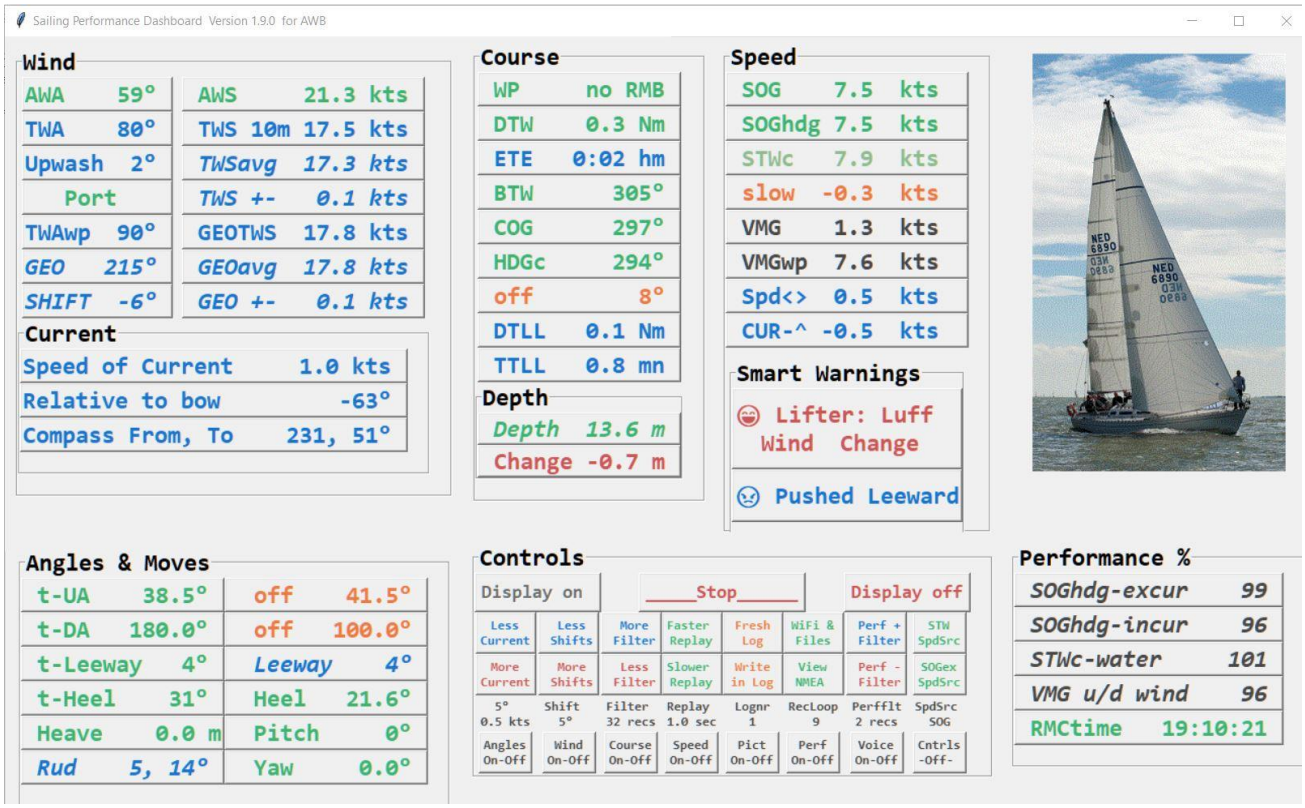
The Heel Polar.

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

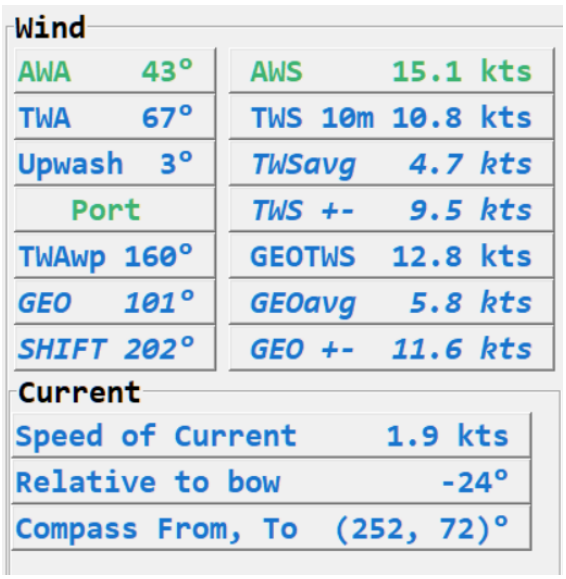
This example has the same number of TWS and TWA as the first Speed Polar. There is no need for that, you can use any number of TWS's and TWA's .

The values and buttons on the display.



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

Wind and Current box.



Left box is wind angles. TWA is calculated from AWA and a speed: SOG or STW.
AWA and AWS can be filtered by using a moving average. Default is to average over 4 cycles (seconds), to reduce the influence of pitching in waves. Another filter value can be specified in the processlist file (see later).
AWA and AWS both are corrected for heel: AWA gets narrower with heel, and AWS gets lower. Both are corrected by SPD.

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 AWA and AWS (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 hand column is wind speeds.
AWS is wind speed at the wind sensor, corrected for heel.

TWS 10m is True wind speed, corrected to 10 m high (using your mast height) and also for heel, including the fact that wind cups turn slower when not horizontal.

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!

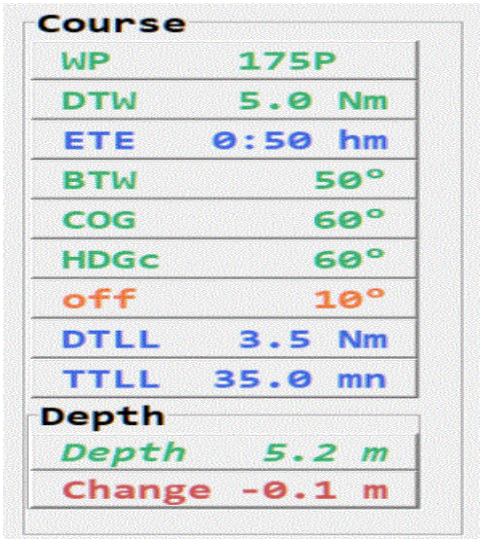
The three GEOTWS*, GEOavg and GEO+-* are the real (not on a moving boat) wind speed, moving average and change. Notice the difference with the green values above the blue ones: slightly more wind! The difference is caused by leeway….

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 coming from and going to.

In this case, the boat is going against a 1.0 kts current coming in from the left at -63 degrees.

Next is the Course-Depth box.



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.

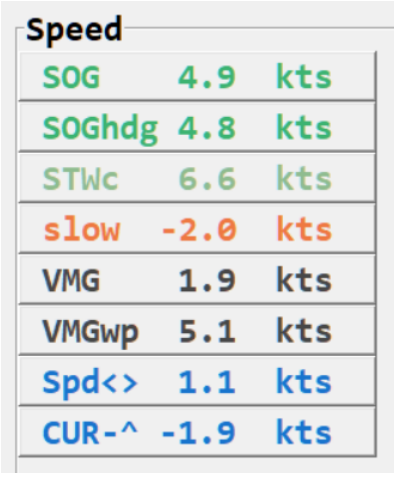
DTLL: Distance to Layline, only active when going to windward. Nm to go before we need to tack.

TTLL: Time to Layline. 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.



SOG is SOG straight from a GPS.

SOHhdg is the part of SOG that is in the length axis of your boat, so excluding the part of the current that sets you sideways.

STWc is corrected speed from the log, with the corrections from the STW correction table applied, possibly with heel influences included.
Fast or Slow 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 preferred choice. Fast is thus STWc compared with target from polar.

VMG is Velocity made good to windward (TWA< 90) or downwind, when TWA is 90 or greater.

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 67 degrees TWA, so going upwind.
Also, there is current slowing us down.
Together that causes the VMG to be 1.9 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.

Angles and Moves box.

In green, left, the target UA and DA for the actual TWS, from the polar. Values from the Measurement Certificate are interpolated for the actual TWS.

In orange, right, how much we are off that ideal angle.

t-Leeway is calculated based on standard formula from ORC, using the K-value from Boatspecifics file.
Next to it, in blue *italics*, Leeway. This is the actual leeway calculated from a number of inputs (see later).

t-Heel comes straight but interpolated from the heel polar, for the actual TWS and TWA.
Heel is a measurement of real heel, from a HRM record from a heel sensor or an RM EV computer, in an FEC,GPatt record or in an XDR. ('Roll' in the last 2 records.). Also, NKE-XDR and miniplex3 XDR-records with ROLL are used here.

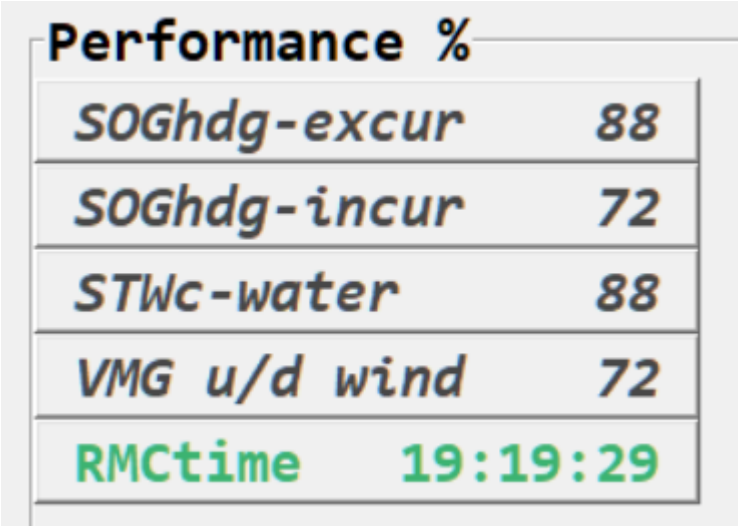
Heave is the vertical movement of the whole boat. Waves, for instance. Also from RM-EV and other records that contain Heave. Can be from an XDR via Miniplex 3, converted from a N2K PGN.

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

Rud is rudder angle from a sensor of the autopilot. First value is an average over the number of records also used to filter wind etc (the buttons change this filter). Second value is the highest rudder angle during the filtering cycle.

Then there is Yaw: short-lasting direction changes from the average heading. It means the boat is turning around its vertical axis. Measured by EV or other smart sensor. Arrives in an XDR from a Miniplex3.
Yaw is displayed relative to HDGc: small variations from the actual Heading.

The Performance box.



SOGhdg-incur (second line) is SOG performance in the length axis of the boat against the polar, and Current effect is included, so if you go extra fast with help from the current, this percentage shows that. This is almost SOG as you know it. In this example, current is against us.

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

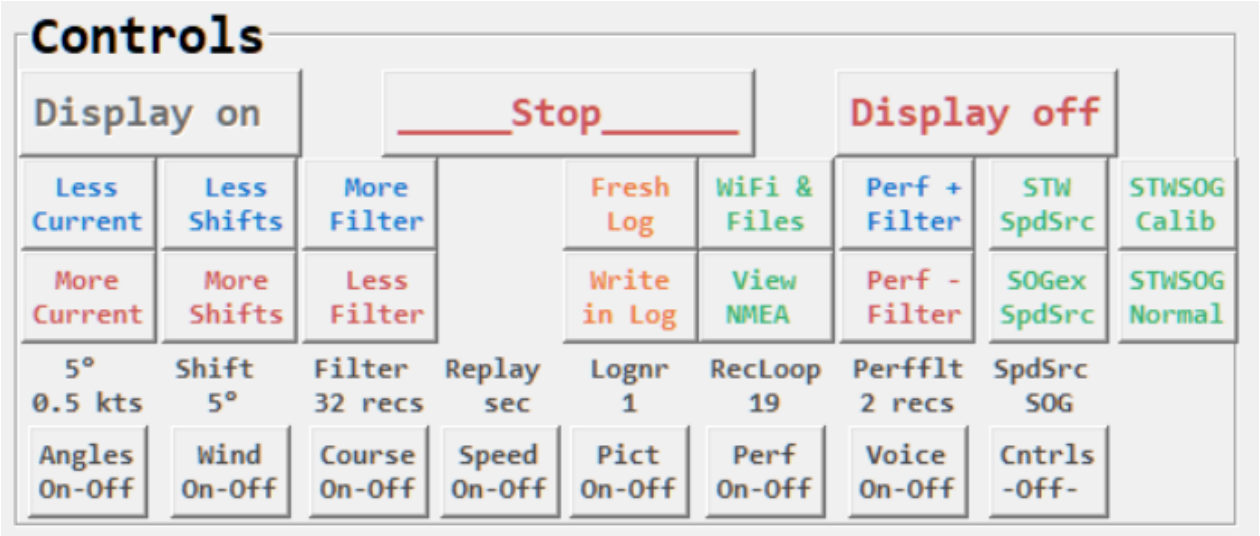
There is no display of how well your sideways performance is in current 😉

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

VMG u/d wind: performance of VMG while beating (TWA<90) or going downwind, TWA > 90. It is calculated with raw SOG, so in situations with current this VMG performance 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! Downwind also! Go for max VMGperf!

Last: RMCtime from the GPS.

The Controls box.



The last row has 8 buttons to hide or show the other boxes and to switch on or off the voice messages. If you only want to see Performance, just click the other 5 windows-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.
During Replay, switching Voice off and Display off will speed up the replay enormously.

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. Replay buttons are not there: live usage!
- Log nr 1: how many logfiles have been opened during the run of PD
- RecLoop 21: number of NMEA records read before a next pair of SOG and Wind records has been found.
- Perfflt 2 Recs: last 2 performance-values used to calculate moving average.
- The actual Speed Source for True Wind and Short/Fast calculations

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, good for showing an unfiltered 222-warning. If set at 2, chances are a 111 will show before the 222.

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 is activated.

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 SPD is running and then click the button. This way you can change the UDP address of the wifi target and also what information will go over wifi.
After showing this info, a question will pop up, asking if you want to use another polar. If yes, just load another polar in SailingPD and continue. A nice feature if you do a headsail change, or blow up your spinnaker. From then on, the performance will be measured against the new polar. You can do this as often as you like. In the SPDLog, a record is written with the name of the new polar, so there is a trace of what you did.

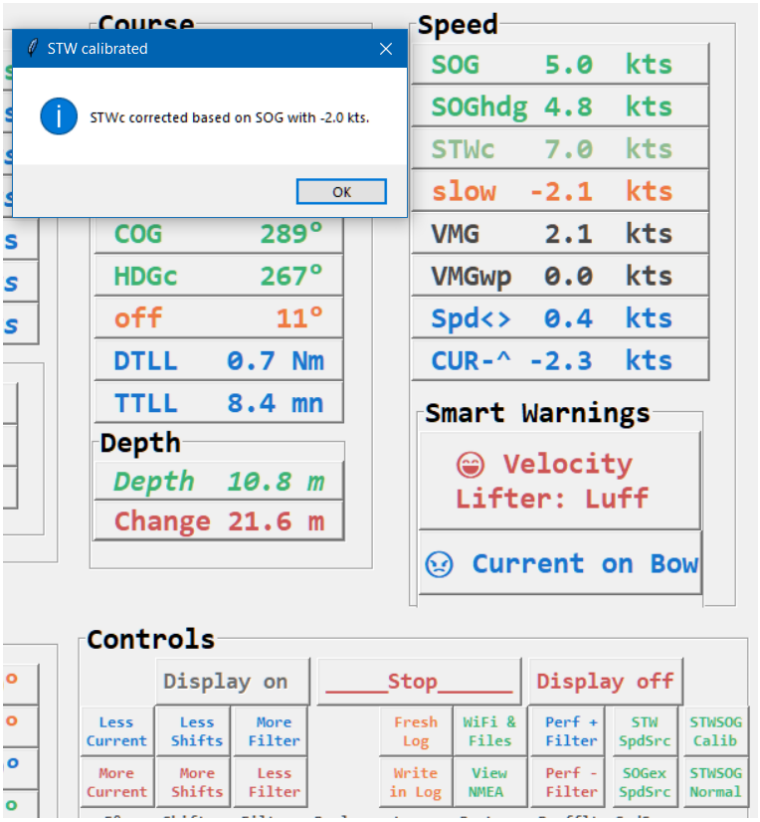
This button can also be used to re-read the boatspecifics file and/or the processlist file while SPD just runs on. Handy when you want to change something (output types, awa filtering, etc) without stopping the program.

View NMEA:
Shows what is received (or read from file) and what has been sent out. During Replay, nothing is really send out. The counters stay at 0.

STW SpdSrc: sets the speed source for calculating True Wind to STW. Also sets the actual speed used to calculate Speed Shortage (‘slow’ or ‘fast’ on the dashboard) to STW. Works only when a VHW record with water speed is available in the input (live or replay).

SOGex SpdSrc: sets the speed source for calculating True Wind to SOG excluding current. Also sets the actual speed used to calculate Speed Shortage (‘slow’ or ‘fast’ on the dashboard) to SOG. Since an RMC with SOG is needed anyway for SailingPD to work, this button will always set the speed source to SOG.

STWSOG Calib and Normal: these two buttons can be used to set STWc (corrected STW) equal to SOG. Might be useful when your log suddenly has an error. Not to be used when sailing in current, and not available in replay mode.
Pushing the STWSOG Calib button will show an info window with the new correction value. Pushing the Normal button will remove that extra correction and again only use the calibration table.



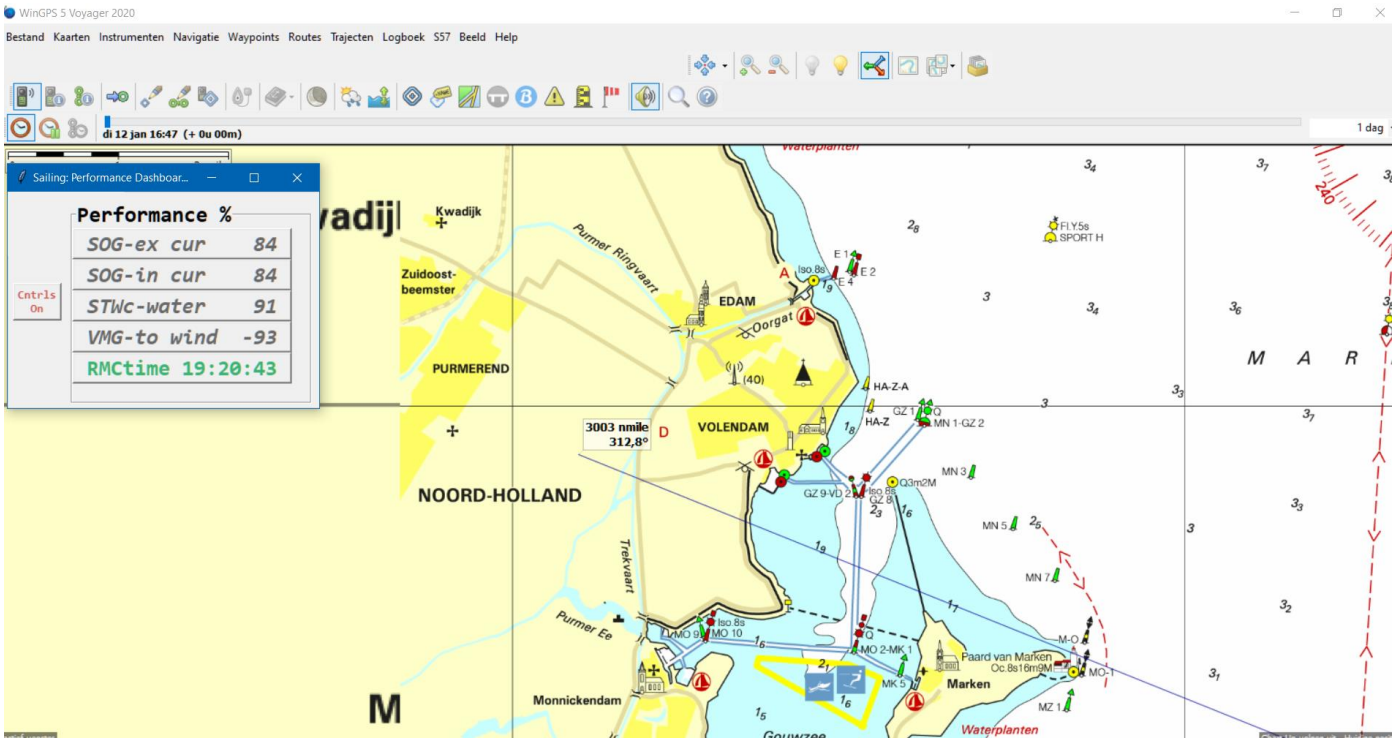
Stop:
Will stop current processing. You can still continue by answering “no” to the quit-question. Then this is like Pause.

Display off:
Stops values being displayed, but processing will continue. Display off will speed up Replay enormously. During live NMEA processing, you can use it to reduce cpu utilisation; is about 50% without the display being refreshed all the time.
Use it when in Replay to produce a smart SPDlog 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.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	DATE	TIME	GEO	GEOkts	AWS	AWA	S--P	TWS 10m	TWA	UPWASH	tHEEL	HEEL	tLEEWAY	LEEWAY-inc
2	220819	18:55:52	4	2,2	3,6	10	P	2	163	4	3	9,4	0	0
3	220819	18:55:55	10	3,7	6,2	27	P	2,7	101	3	3	9,4	2	0
4	220819	::	16	6,8	8,8	44	P	5,7	93	3	4	9,5	2	0
5	220819	::	22	10,2	11,1	61	P	9,1	98	2	12	8,9	2	0
6	220819	18:56:08	28	9,6	9,8	69	P	9,1	109	1	16	12,9	2	0
7	220819	18:56:15	33	9,5	9,4	71	P	8,9	112	1	13	8,3	3	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.
Both are corrected for heel. AWA tends to get narrower with heel, and AWS gets less: the sensor comes down and the cups are not horizontal.

TWS 10m: SPD normalises the wind at the mast head sensor to the speed at 10 meters high, the value used for TWS in a polar.

TWA is calculated TWA (from AWA and corrected SOG or STW, depending onyour choice).

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.

LEEWAY inc is leeway including the influence of current.

Next set of columns from the log:

O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
COG	HDG	DEV	SOG	SOGhdg	SOGADD	SOG90	STW	STWCOR	tSPEED	SOGp-exc	SOGp-inc	STWperf	TO-WP
287	274	-1	5,1	5	-1,8	0	6,7	0,1	0,67	507	373	507	none
287	273	-1	4,9	4,8	-2	0,1	6,7	0,1	1,9	685	499	685	no RMB
289	276	-1	4,8	4,7	-2,1	0,1	6,7	0,1	3,21	284	199	284	none
294	279	-1	4,8	4,6	-2,1	0,1	6,6	0,1	6,61	156	107	156	none
289	276	-1	4,7	4,6	-1,9	0,1	6,5	0	6,94	97	67	97	none
293	279	-1	4,7	4,6	-2	0,1	6,5	0	6,63	96	67	95	none

COG from the GPS.

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

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 next columns of the log:

AC	AD	AE	AF	AG	AH	AI	AJ	AK
DTW	BTW	OFF	TWAWP	vmgWP	DEPTH	vmgWIND	tVMG	VMGperf
1,8	300	13	64	5	2,6	4,9	-0,6	408
1,8	300	13	70	5	5,3	0,9	-0,4	520
1,8	300	11	76	5	7,9	0,3	-0,2	187
1,8	300	6	82	4,7	10,5	0,7	-0,9	113
1,8	300	11	88	4,7	13,2	1,5	-2,3	71
1,8	300	7	93	4,6	15,8	1,8	-2,5	68

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 (on your GPS or Navigation) 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

The last columns:

AL	AM	AN	AO	AP	AQ	AR	AS	AT
CUR kts	CUR rel	CUR abs	RoT	PITCH	YAW	HEAVE	RUDANG	FILTRUD
2,1	-30	65	0	0	0	0	1	0
2,4	-32	62	0	0	0	0	1	0
2,4	-28	69	0	0	0	0	0	0
2,5	-32	68	0	0	0	0	-3	0
2,2	-30	67	0	0	0	0	-2	0
2,4	-33	67	0	0	0	0	0	0

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.

Yaw: turning movements of the boat along its vertical axis(say, the mast). A bit to the left, a bit to the right. Degrees.

Heave: vertical movements of the whole boat, such as caused by bigger waves. In meters.

Rudang: rudder angle in degrees

Filtrud: filtered rudder angle (filtered with 2 to 512 recs, like wind)

More data will be added to the log when available. The modern AP-computers produce a lot of (undocumented) measurements. These are used to maximise steering performance; luckily N2K-multiplexers capture them and can convert them in useful information for us!

Uses of the log are many.
Analyse race performance with your PC 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 SPD 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.

SPD looks for a speed record (an RMC record and eventually a VHW) and a wind record (MWV-R and/or VWR) in the NMEA stream (from file or live). After speed and wind are found (and a number of other NMEA types coming in also, while waiting for wind and COG/SOG in RMC) the calculations start. This we call a cycle: 1 wind and 1 speed combined. 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. AWS correction can be changed with a parameter in the processlist file. The calculation uses target heel, calculated from the ship’s characteristics. Not everybody has a heel sensor….

AWA and AWS can be slightly filtered by averaging; how much is determined by a value in processlist.
After this correction, calculation of TWA and TWS is done from the heel-corrected, filtered AWA and AWS. SOG or STW is used here (from the RMC or the VHW record), depending on the choice between SOG and STW in the boatspecifics file or the buttons SpdSrc.
It is not just SOG that is used in the calculation of True Wind, however. If you chose SOG, the value of SOG (from RMC) is corrected to take out the speed you pick up or loose in your heading direction from current. So, the SOG used for True Wind is SOG without current and only in the direction of the heading! This way, you can use SOG even to calculate True Wind when sailing in currents!
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! Good for performance calculations.

Many calculations are just a table lookup and interpolation or the 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 strong but 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 ourselfs, sailing as good as we can.
The difference is important when calculating performance.

At this point in the process, we have all ingrediënts 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….
Unless you used the VMG@UA and @DA to calculate speed targets.

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 short filtering treatment, also delivering a trend result: depth getting more or less. This filter is fixed at 10 cycles.

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.
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. SPD 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 SPD-log.
Currently, there are 4 postprocessors for an SPD Log file.

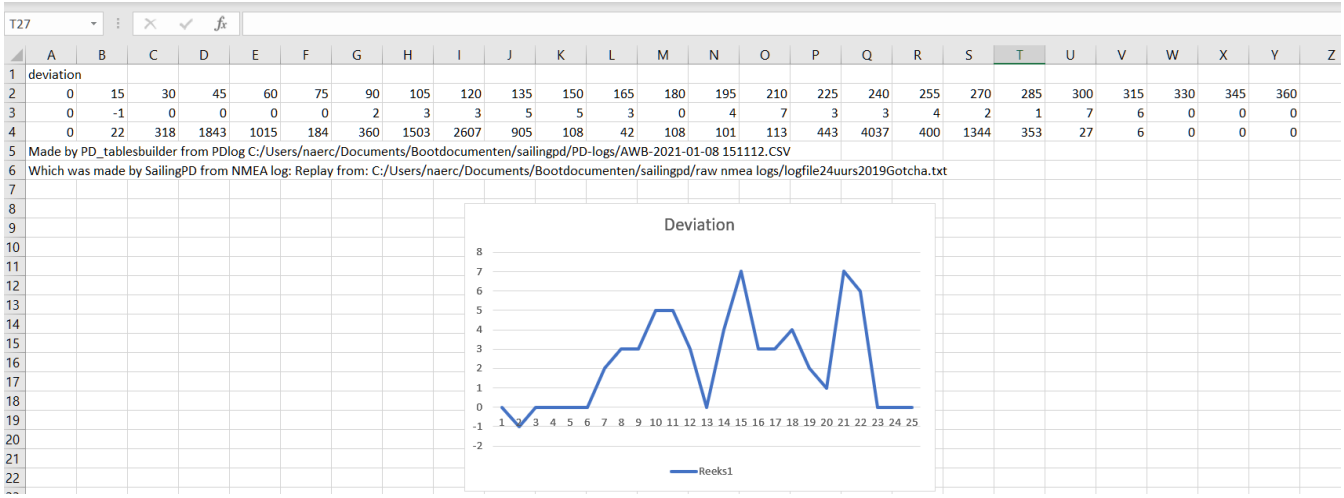
You can start them by using a special boatspecifics file, with on the first line the name of the processing you want.

See the paragraph on boatspecifics file for the keywords.

One will read a SPD 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 SPDLog 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

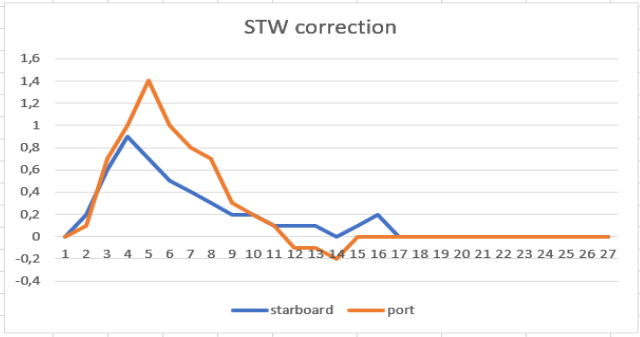


	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1	deviation																									
2	0	15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240	255	270	285	300	315	330	345	360	
3	0	-1	0	0	0	0	2	3	3	5	5	3	0	4	7	3	3	4	2	1	7	6	0	0	0	
4	0	22	318	1843	1015	184	360	1503	2607	905	108	42	108	101	113	443	4037	400	1344	353	27	6	0	0	0	
5	Made by PD_tablesbuilder from PDlog C:/Users/naerc/Documents/Bootdocumenten/sailingpd/PD-logs/AWB-2021-01-08 151112.CSV																									
6	Which was made by SailingPD from NMEA log: Replay from: C:/Users/naerc/Documents/Bootdocumenten/sailingpd/raw nmea logs/logfile24uurs2019Gotcha.txt																									

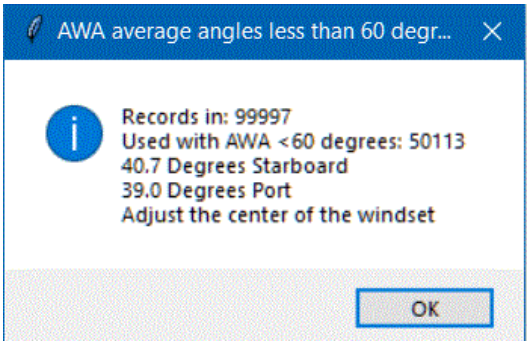
STW Correction is separate for SB and Port.

- 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.

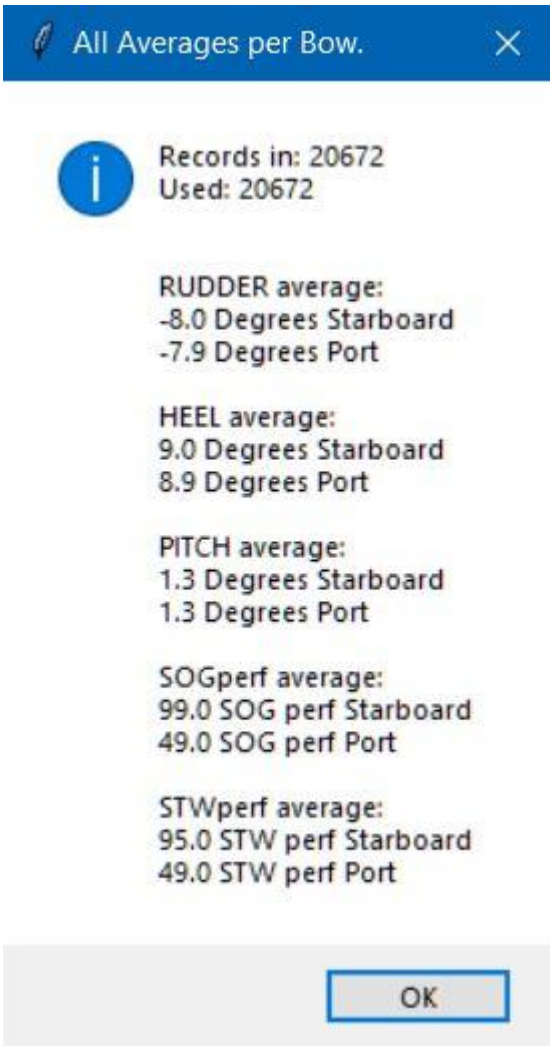
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1	stw correction																					
2	stw	0	0,5	1	1,5	2	2,5	3	3,5	4	4,5	5	5,5	6	6,5	7	7,5	8	8,5	9	9,5	10
3	starbo	0	0,2	0,6	0,9	0,7	0,5	0,4	0,3	0,2	0,2	0,1	0,1	0,1	0	0,1	0,2	0	0	0	0	0
4	port	0	0,1	0,7	1	1,4	1	0,8	0,7	0,3	0,2	0,1	-0,1	-0,1	-0,2	0	0	0	0	0	0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



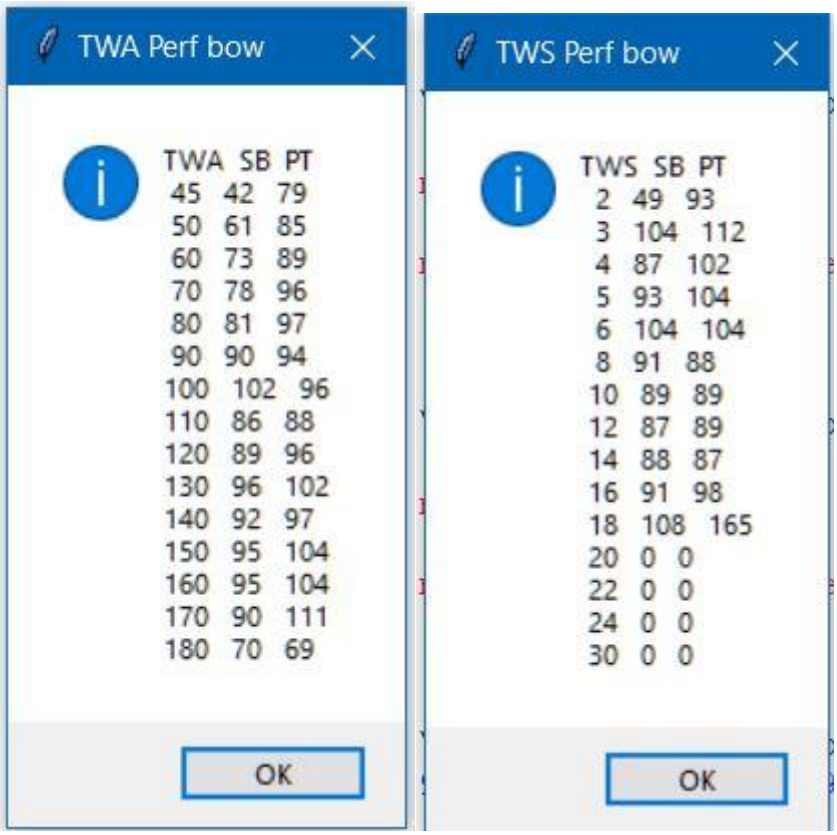
The second post processor reads the log and looks at the AWA's for Port and Starboard tacks. Then the difference between these 2 is calculated and displayed, to help you align the wind set with the boat. When ready, it just shows this little window:



The third post processor will calculate all kinds of average values for starboard and port sailing. It checks symmetry!



Post processor number 4 will check performance (SOGperformance) against a series of wind angles and wind speeds, for each bow. This way, you can check your weaker points…



Many other possibilities for data analysis in the log:

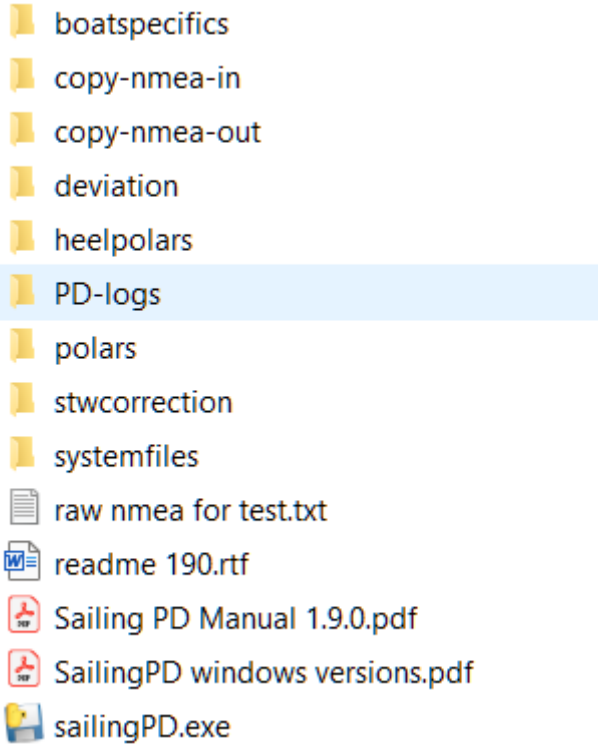
- Leeway as result of TWA and TWS
- Impact of Heel on Leeway
- Actual Heel compared to theoretical heel, f.i. while Dual Handed
- Impact of Pitch on Performance
- RoT and YAW in daylight or at night
- Etc. You name it. You calculate it in Excel.
- From a PDlog, you can create a polar if you want. Just sail enough at max speeds and then sort the log on TWS and TWA!

The folder and sub-folders for SPD.

When you download Sailing Performance Dashboard you will store the folder somewhere on your drive, and give it a place and name of your liking.

However, Sailing PD expects a number of sub-folders to be present; their names are hard-coded in the program. This is done to open and store files where SPD writes into in places (folders) that are present without your actions needed.

After downloading and unzipping, you will have these sub-folders and the program:



Do not change their names. It will prevent problems with not-found directories.

The controlling files. Boatspecifics.

First the one you have to really use, describing your boat and the NMEA installation. It should sit in folder boatspecifics. The filename is up to you.

```
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!!
5
10
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
Next (line 19 or 25) is speech freq: 0 is no speech, otherwise seconds between speech
Line 20 or 26: cycles (seconds) between UDP-text is send out
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 of boatspecifics 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

For the symmetry check, specify

checkbowsym

And for performance check, use

checkperfwind

So, 4 keywords possible at this point:

checkbowsym
checkperfwind
checkwindset
createtables

More postprocessing to come!

The controlling files. NMEAtemplates.

Next file is NMEATemplates. It sits in folder systemfiles.

It contains the empty templates for 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

```
$VOICE,$sogperf
$SPMTW,$angleOFF,C
$SPVTG,$bestangle,T,,M,$sogperf,N,,K,A
$SPGLL,$xte,N,$dts,E,$tws,A
$SPRMB,A,$xte,$dts,T,$towp,$destlat,N,$destlon,E,$dtw,$btw,$vmgperf,V,A
$SPBOD,$shiftmsg,T,$sogperfci,M,$stwperf,$vmgperf
$SPBWC,$cursog,$orthospd,N,$speedshort,E,$bestangle,T,$bestangle,M,$sogperf,N,
$SPBWR,$twa,$twa,N,$twa,E,$twa,T,$twa,M,$twa,N,$twa,A
$SPMWV,$twa,R,$tws,N,A
$SPVHW,$twa,T,$twa,M,$twa,N,$twa,K
$SPVLW,$twa,N,$twa,N
$SPRPM,E,1,$sogperf,$sogperf,A
$SPXDR,G,$sogperf,P,SailPerf
$PNKEP,03,$bestangle,$sogperf,$angleOFF
$PSMDPRF,P,,
$PSMDPRW,W,
$SPMVW,$twa,$bow,$tws,N,$twstrend,N,$geo,$gtr,N,$geotwsavg,N,$geotwstrend,N,$shift,$b
estangle,$angleOFF
$SPMVP,$sogperf,$sogperfci,$stwperf,$vmgperf,$dtl,$ttl
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!
DO NOT CHANGE SP (THE SENDER ID). IT IS USED TO SIGNAL LOOPS!

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.
Good luck and have fun!

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!

$rmctime          Time from latest GPS RMC record

$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 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
$bestangle	Degrees for UA or DA depending on actual TWA. TWA>90 shows DA
$angleOFF	Degrees away from or past actual UA or DA depending on TWA
$yaw	Degrees yaw
$pitch	Degrees pitch
$heave	Meters heave
$rsa	Rudder Angle degrees
$filtrsa	Filtered Rudder Angle degrees
$rota	Rate of Turn in degrees per minute
$cog	Course over ground from gps
$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	Actual Cross Track Error
$dts	Actual Direction to Steer
$hdgc	Heading after application of deviation table
$dts	Direction to steer
$dtw	Distance to waypoint
$btw	Bearing to waypoint
$towp	Name of to-waypoint
$destlat	Latitude of destination
$destlon	Longitude of destination
$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
$sogperf1	Actual speed as % of polar target calculated with SOG excl current in HDG-dir in x.xx format
$sogperfci1	Performance of SOG including added speed by current, in x.xx
$stwperf1	Performance versus STW in x.xx
$vmgperf1	Actual VMG as % of polar target in x.xx format
$sog	Speed over ground from gps
$cursog	Speed in kts added by current to boatspeed (by wind)
$orthospd	Speed 90 degrees on boat axis, by leeway and current
$soginhead	SOG in the direction of HDG
$speedshort	Speed shortage kts vs target
$targetspeed	Polar target kts
$targetvmg	Target VMG
$vmg	Velocity made good into the wind kts
$stwc	water speed after correction from table
$dbxavg	Depth average over last 10 records
$dbalert	Trend in depth, increasing or decreasing
$bow	Wind from Port or Starboard

$awa	Apparent wind angle
$aws	Apparent wind speed kts
$geo	Wind in degrees over ground (the real wind!)
$gtr	Geo True wind: kts wind over the earth as seen from a steady position
$geotwsavg	Average Geo True average over number of filtered records
$geostwstrend	Trend in Geo True kts during filtering period
$nexttwa	TWA to active waypoint
$shift	Degrees windshift in geo wind
$twa	True wind angle as seen on the boat.
$tws	True wind speed at 10 m above water, and taking heel into account, kts on board.
$twsavg	True Wind speed at 10 meter, averaged over number of records in filter
$twstrend	True Wind change during length of filtering
$shiftmsg	Head or Lift, True or Velocity
$upwash	Calculated degrees of upwash

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.
Good luck and have fun!

The controlling files. processlist.

Then we have the file processlist. Also in folder systemfiles.

Better not touch it, or only very carefully.

```
VHW,RMB,RMC,HDG,HDT,HDM,MWV,VWR,DBT,DBK,DBS,HRM,ROT,ECD,DPT,XDR,VTG,RSA,VBW,
;   CSV files delimiter. Default ; unless you specify a comma ,
Consolas
18
medium sea green
IndianRed3
DodgerBlue3
sienna2
gray28
dark sea green
5
5
0.5
0.001
N dummywind
N start without questions and showinfo
4
0.4
spare4
spare5
last line!


This file is read during start up, together with the background picture.
Folder name should be: systemfiles
Filename should be: processlist.txt

line 1:
These record types are used by 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:
CSV files delimiter. Default ; unless you specify a comma , Decimal delimiter
in the CSV's with ; is , and with , is .

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. All font colors must be known in Python
```

```
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. Can be changed with a button.

line 12
currtresh, default 5. currtresh is difference between cog and hdg. > currtresh
can be a sign of current. A button for changes.

line 13
currtreshkts, default 0.5. This is difference between sog and stw. May be a
sign of current.... A button fort changes.
So the values in line 11,12 can 13 can be adjusted with buttons during
execution

line 14
pause between sending the different NMEA-output records in one program cycle.
Can help to prevent flooding a 4800 bps instrument.

line 15
Dummywind Y of N. For testing purposes only, when no wind equipment is
connected, just a GPS

line 16
Y or N for a quick start. If Y, only question is for the sailingpd folder.

line 17
filter for raw AWA and AWS. Default 4 recs, unless another value specified
here. 1 is minimum.

line 18
percentage to increase AWS per degree of heel. Default should be 0.4  Use zero
for ultrasonic wind sensors, probably

line  19, 20: spare for later use.
```

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 SPD 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. Pushing the buttons is easier.

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 0.001 sec value, but results are unsure…. Don't make it too big. It slows down all processing.

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).

Line 16: When N, you will be asked if all parameters are correct etc etc. With Y, you only might need to answer the question of which folder SailingPD sits in. All other questions and info-windows are skipped, for a quick start with no control over what happens… Some users like that.

Line 17: if a value is specified here it will be used to average a number of AWA and AWS measurements. The 4 in this example will cause 4 measurements (4 seconds, probably) of AWA and AWS to be averaged and used in further calculations. Minimum is 1. Just a low number will help to reduce the impact of pitching in waves on AWA and AWS.

Line 18: the AWS correction for heel. 0.4 will do, unless you have an ultrasonic wind sensor

The controlling files. sendoverwifi.

The remaining control file is sendoverwifi.txt.

```
YY  Send standard messages over WiFi-UDP (first Y) and send over websocket
to browser (second Y).  YY NY YN and NN allowed

layline,perf,wind,current,angles

255.255.255.255

5000

last line do not remove!


This file determines if the PC will send information via wifi (UDP) to a
listening device, the first Y/N on line 1

The second Y/N on line 1 determines if websocket is used to send info to a
browser.

PC and listening devices have to be connected to the same wifi router or
hotspot

1st line YY or NN or NY or YN  send over UDP and send over websocket

2nd line: wind,layline,perf,current,angles(or part of that) over UDP

3rd line: IP address of UDP target 255.255.255.255 is broadcast UDP to all

4st line: port of UDP target
```

It should sit in folder systemfiles.

With the wifi & files button you can, with SPD running:

- Read another polar, handy when circumstances or sails change.
- Re-read an edited sendoverwifi.txt, to change kinds of messages and target for UDP
- Re-read NMEAtemplates.txt, when you have changed $-variables on the fly.
- Re-read boatspecifics.txt, to activate changes you may have made there.