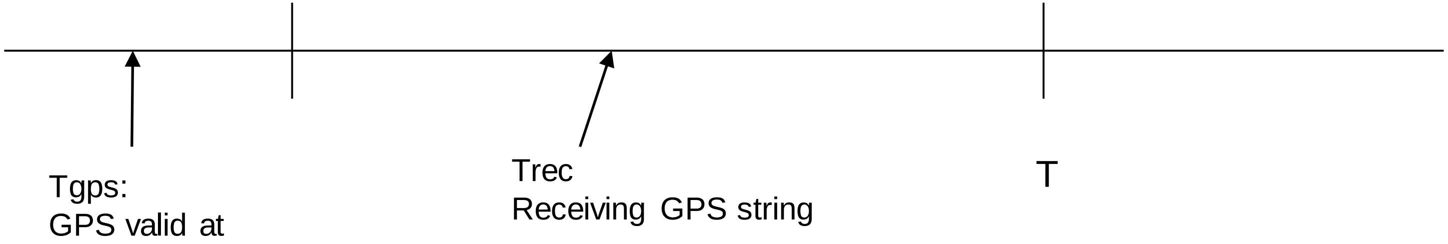
NaviPac

Deskew Position Data

03/04/2020

Challenge

- NaviPac starts a data cycle at time T, but the position data (GPS, etc) used for calculation are much older:



What can the software do to compensate for this?

- Calculate the position corresponding to time Tgps
- Estimate what the GPS values will be to time T based on this calculation

Calculate the position corresponding to time Tgps

The best solution, as you do not introduce artificial data (artificial data = potential error). However,….

What if you need to combine multiple data sources?

- 2 or more GPSs
- Range/range systems
- Range/bearing systems
- A combination of the above

What if you want to make a direct comparison (primary/secondary) of 2 GPSs?

- They could be from different GPS cycles

What if the systems receiving data from NaviPac cannot handle ‘old’ data?

- Online display will give mixed time information
- The vessel position must be combined with other sensors – e.g. USBL

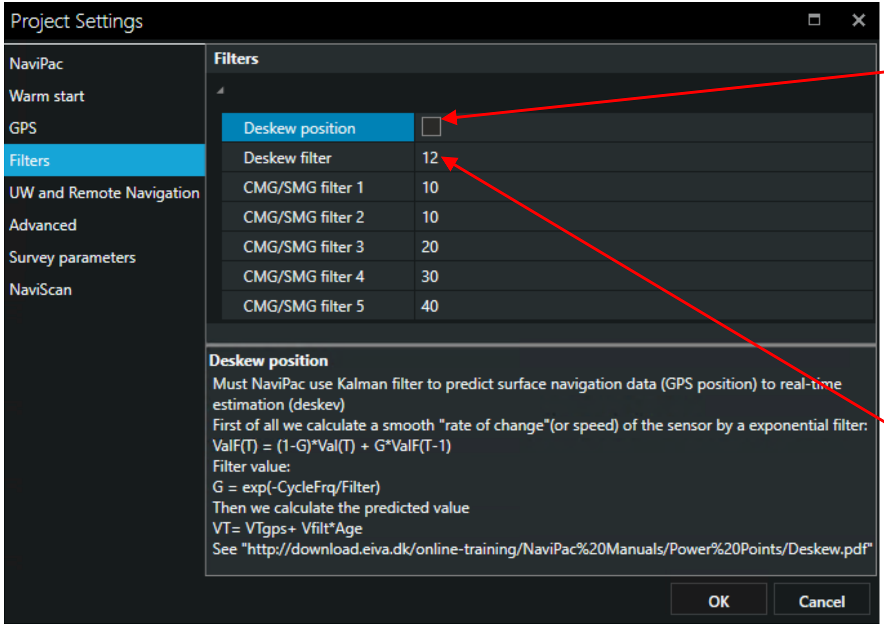
How to deskew data

Based on historical data (trends of the sensor data), estimate what the sensor will give at time T.

How can you do that?

- First, calculate the smooth rate of change (speed) of the sensor using an exponential filter:
  - ValF(T) = (1-G)*Val(T) + G*ValF(T-1)
  - Where G = exp(-Cycle Frequency/Filter)
- Using **ValF**, you can calculate the smooth rate of change of each sensor value (LOP) in use and thereby correct for any delay and ages.
- The value **G** should be set on the basis of the size of the vessel – that is, how fast the vessel can change course or speed.

Controlling deskewing



Should NaviPac use deskewing?

Filter	Cycle time	Gain in %
1	1	36.78794
5	1	81.87308
12	1	92.00444
20	1	95.12294
40	1	97.53099
50	1	98.01987
100	1	99.00498
12	2	84.64817
20	2	90.48374
40	2	95.12294
12	0.5	95.91895
20	0.5	97.53099
40	0.5	98.75778

Filter value:
Gain G = exp(-CycleFrq/Filter)

Estimating the new value

Having calculated a smooth rate of change for each LOP, you can now compensate the data V for the delay/age using:

- VT = VTgps + ValF(T)*Age

Problem: How accurately can you estimate ValF?

- If the rates of change are smooth, then the estimations are good
- We have been able to reproduce charts with small objects (< 1 metre) on surveys at 6–8 knots on the coast of Jutland within a few centimetres
- This was done with GPS age up to 1.5 seconds – that is, deskew would be around 4–6 metres

How accurate/inaccurate deskewing is

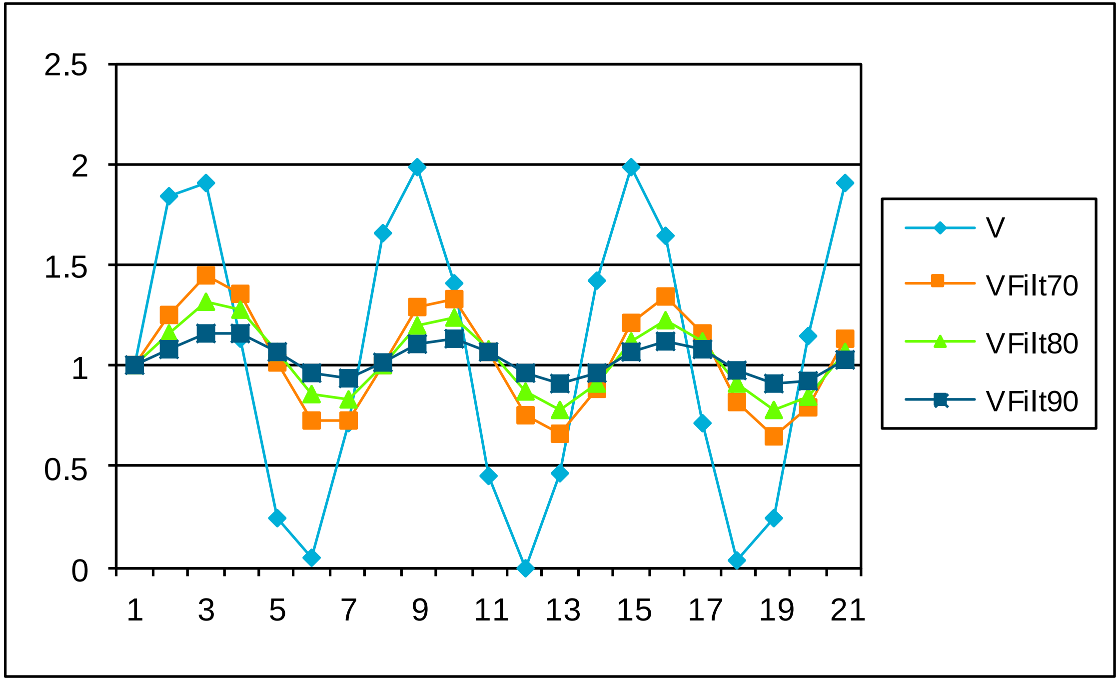
However, what if the movement is very slow and changing a lot?

The primary change is perhaps due to weather and slow movement.

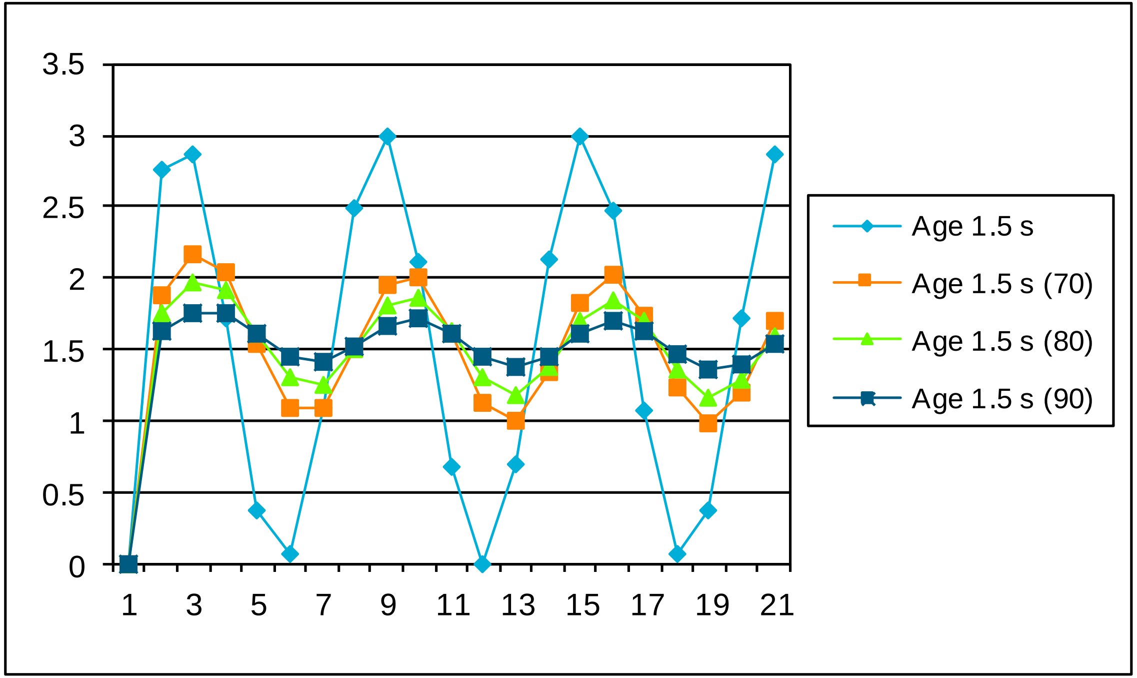
For example, assume that you are moving 2 knots per second, but at the same time have 1 knot of movement due to weather…

Time	Val	V	VFilt70	VFilt80	VFilt90
0	100	1	1	1	1
1	101.8415	1.841470985	1.2524413	1.168294	1.084147
2	103.7508	1.909297427	1.4494981	1.316495	1.166662
3	104.8919	1.141120008	1.3569847	1.28142	1.164108
4	105.1351	0.243197505	1.0228485	1.073775	1.072017
5	105.1762	0.041075725	0.7283167	0.867235	0.968923
6	105.8967	0.720584502	0.725997	0.837905	0.944089
7	107.5537	1.656986599	1.0052939	1.001722	1.015379
8	109.5431	1.989358247	1.3005132	1.199249	1.112777
9	110.9552	1.412118485	1.3339948	1.241823	1.142711
10	111.4112	0.455978889	1.07059	1.084654	1.074038
11	111.4112	9.79345E-06	0.749416	0.867725	0.966635
12	111.8746	0.463427082	0.6636193	0.786866	0.916314
13	113.2948	1.420167037	0.8905836	0.913526	0.966699
14	115.2854	1.990607356	1.2205907	1.128942	1.06909
15	116.9357	1.65028784	1.3494999	1.233211	1.12721
16	117.6478	0.712096683	1.1582789	1.128988	1.085699
17	117.6864	0.038602508	0.822376	0.910911	0.980989
18	117.9354	0.249012753	0.650367	0.778532	0.907791
19	119.0853	1.14987721	0.8002201	0.852801	0.932
20	120.9982	1.912945251	1.1340376	1.06483	1.030094

Smooth rate of change estimation



Deskew data 1.5 seconds



Summary

Deskewing a bumpy vessel track (weather conditions) or a vessel that performs sudden course or speed movements will introduce errors.

The errors will look different, based on kind:

- Change in speed: Errors along track
- Change in course: Errors off track (depending on +/-)
- Bumps: Arbitrary errors across and along the tracks

Conclusion

- Use deskewing if you need to combine two or more data sources
- If you use a single data source or run NaviPac in prioritised mode, there is no benefit from deskewing

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