Three-way_timestamps_win10

October 12, 2019

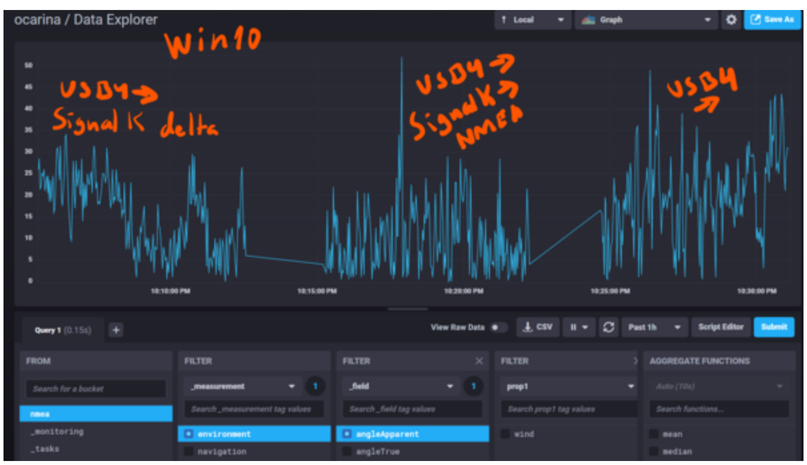
1 Comparison of timestamps in three alternative NMEA data paths

1.0.1 Windows 10 - OpenCPN v5.0.0 - Signal K v1.17.0 - DashT v.0.5.2

We observe a five minute sampling period stored in InfluxDB database for each of the use case for single value of Apparent Wind Angle:

1. data via Signal K delta TCP channel with Signal K timestamps at its own reception
2. data via Signal K to NMEA-0183 via TCP channel timestamps at reception at the InfluxDB instruments
3. data directly from USB to OpenCPN

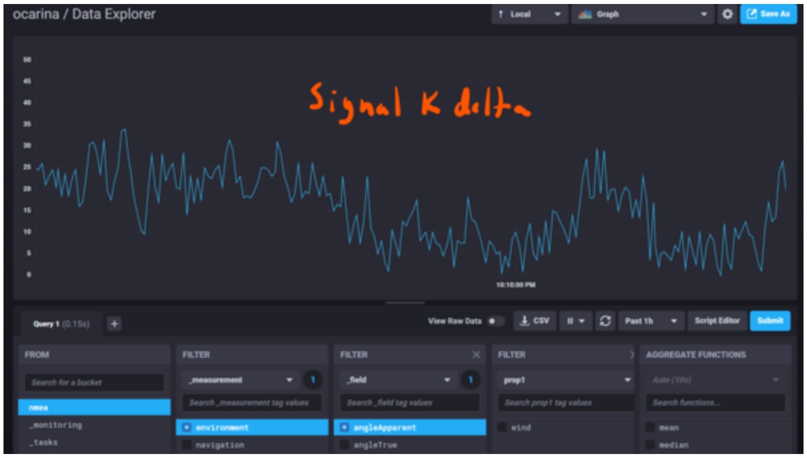
In all above cases the USB is set to 115200 baud at reception on Win10 (Surface 3 i7) running OpenCPN v5.0.0. Data is originated from Raymarine SeaTalk (4800 baud) and converted to USB in MiniPlex II multiplexer - about 40 values per second are transmitted through this channel but only Apparent Wind Angle timestamp behaviour is observed.



(zoom)

```
[1]: import numpy as np
     import pandas as pd
```

1.1 1. Data via Signal K delta TCP channel



(zoom)

[2]:
```python
df = pd.read_csv("2019-10-05_224308_SignalK_delta_zoom.csv", sep=',', header=3)
```

[3]:
```python
df.head()
```

[3]:
```
   Unnamed: 0  result  table                 _start                 _stop  \
0         NaN     NaN      0  2019-10-05T20:06:00Z  2019-10-05T20:11:00Z
1         NaN     NaN      0  2019-10-05T20:06:00Z  2019-10-05T20:11:00Z
2         NaN     NaN      0  2019-10-05T20:06:00Z  2019-10-05T20:11:00Z
3         NaN     NaN      0  2019-10-05T20:06:00Z  2019-10-05T20:11:00Z
4         NaN     NaN      0  2019-10-05T20:06:00Z  2019-10-05T20:11:00Z

                     _time  _value          _field _measurement prop1
0  2019-10-05T20:06:00.969Z    16.0  angleApparent  environment  wind
1  2019-10-05T20:06:02.904Z    17.0  angleApparent  environment  wind
2  2019-10-05T20:06:04.841Z    23.0  angleApparent  environment  wind
3  2019-10-05T20:06:06.775Z    30.5  angleApparent  environment  wind
4   2019-10-05T20:06:08.71Z    31.0  angleApparent  environment  wind
```

[4]:
```python
df._value.describe()
```

[4]:
```
count    158.000000
mean      16.382911
std        8.111321
min        0.500000
25%        9.500000
50%       17.250000
75%       23.000000
max       34.000000
Name: _value, dtype: float64
```

[5]:
```python
df1 = pd.to_datetime(df['_time'])
```

[6]:
```python
df1.describe()
```

[6]:
```
count                               158
unique                              158
top       2019-10-05 20:09:49.403000+00:00
freq                                  1
first     2019-10-05 20:06:00.969000+00:00
last      2019-10-05 20:10:58.127000+00:00
Name: _time, dtype: object
```

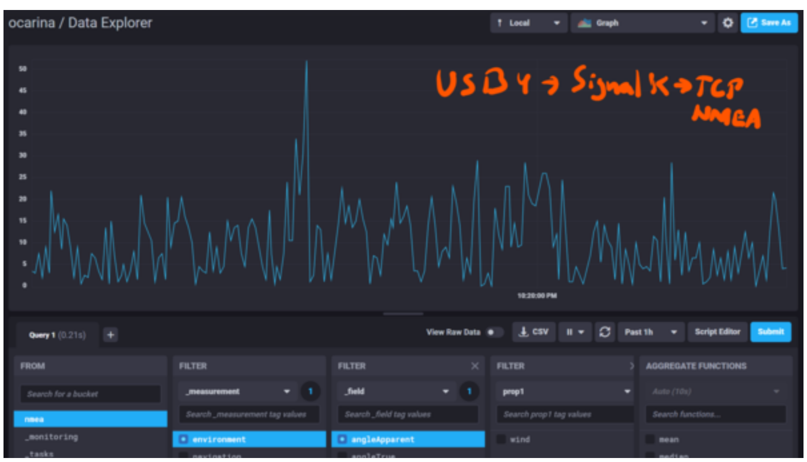
[7]:
```python
df2 = df1.astype(np.int64).div(1e6)
```

[8]:
```python
df3 = df2.diff()
```

[9]:
```python
df3.describe()
```

[9]:
```
count     157.000000
mean     1892.726115
std       188.331733
min      1001.000000
25%      1925.000000
50%      1935.000244
75%      1940.000000
max      2058.000244
Name: _time, dtype: float64
```

1.2 2. Data via Signal K to NMEA-0183 converter TCP channel



(zoom)

[10]:
```python
nf = pd.read_csv("2019-10-05_224509_SignalK_NMEA_TCP_zoom.csv", sep=',',␣
↪header=3)
```

[11]:
```python
nf.head()
```

[11]:
```
   Unnamed: 0  result  table                 _start                  _stop  \
0         NaN     NaN      0  2019-10-05T20:16:00Z  2019-10-05T20:21:00Z
1         NaN     NaN      0  2019-10-05T20:16:00Z  2019-10-05T20:21:00Z
2         NaN     NaN      0  2019-10-05T20:16:00Z  2019-10-05T20:21:00Z
3         NaN     NaN      0  2019-10-05T20:16:00Z  2019-10-05T20:21:00Z
4         NaN     NaN      0  2019-10-05T20:16:00Z  2019-10-05T20:21:00Z

                      _time  _value         _field _measurement prop1
0  2019-10-05T20:16:01.101Z     1.5  angleApparent  environment  wind
1  2019-10-05T20:16:03.041Z    13.5  angleApparent  environment  wind
2  2019-10-05T20:16:04.981Z     0.5  angleApparent  environment  wind
3  2019-10-05T20:16:06.015Z    15.0  angleApparent  environment  wind
4  2019-10-05T20:16:07.881Z     7.0  angleApparent  environment  wind
```

[12]:
```
nf._value.describe()
```

[12]:
```
count    159.000000
mean      10.710692
std        8.320781
min        0.000000
25%        3.500000
50%        9.500000
75%       15.000000
max       52.000000
Name: _value, dtype: float64
```

[13]:
```
nf1 = pd.to_datetime(nf['_time'])
```

[14]:
```
nf1.describe()
```

[14]:
```
count                                 159
unique                                159
top       2019-10-05 20:16:01.101000+00:00
freq                                    1
first     2019-10-05 20:16:01.101000+00:00
last      2019-10-05 20:20:58.255000+00:00
Name: _time, dtype: object
```

[15]:
```
nf2 = nf1.astype(np.int64).div(1e6)
```

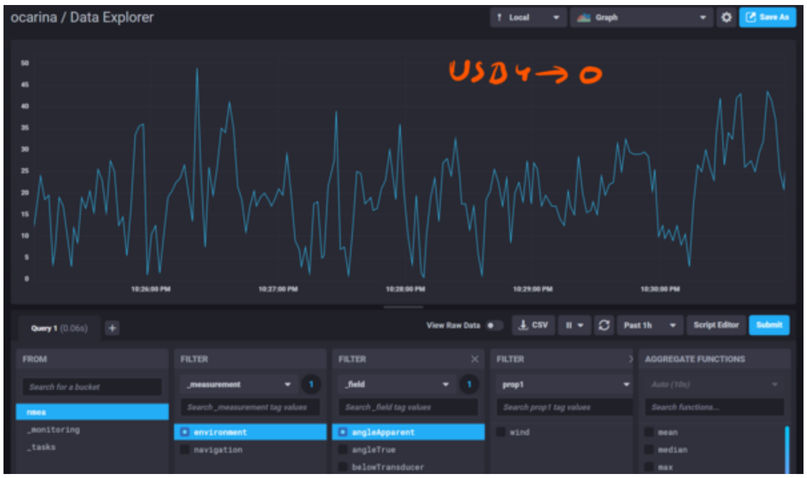
[16]:
```
nf3 = nf2.diff()
```

[17]:
```
nf3.describe()
```

[17]:
```
count     158.000000
mean     1880.721519
std       212.353998
```

```
min       1004.999756
25%       1917.500000
50%       1935.000000
75%       1944.000000
max       2046.999756
Name: _time, dtype: float64
```

1.3 3. Data without Signal K directly from USB



(zoom)

[18]:
```python
of = pd.read_csv("2019-10-05_224657_USB_to_0_zoom.csv", sep=',', header=3)
```

[19]:
```python
of.head()
```

[19]:
```
   Unnamed: 0  result  table                 _start                  _stop  \
0         NaN     NaN      0  2019-10-05T20:25:00Z  2019-10-05T20:30:00Z
1         NaN     NaN      0  2019-10-05T20:25:00Z  2019-10-05T20:30:00Z
2         NaN     NaN      0  2019-10-05T20:25:00Z  2019-10-05T20:30:00Z
3         NaN     NaN      0  2019-10-05T20:25:00Z  2019-10-05T20:30:00Z
4         NaN     NaN      0  2019-10-05T20:25:00Z  2019-10-05T20:30:00Z

                      _time  _value         _field _measurement prop1
0  2019-10-05T20:25:00.249Z     3.5  angleApparent  environment  wind
1  2019-10-05T20:25:02.189Z     8.5  angleApparent  environment  wind
2  2019-10-05T20:25:04.106Z     9.0  angleApparent  environment  wind
3  2019-10-05T20:25:06.051Z    17.0  angleApparent  environment  wind
4   2019-10-05T20:25:07.99Z    24.0  angleApparent  environment  wind
```

[20]:
```python
of._value.describe()
```

[20]:
```
count    165.000000
mean      18.845455
std        8.896015
min        0.500000
```

```
25%        13.500000
50%        19.000000
75%        24.500000
max        49.000000
Name: _value, dtype: float64
```

[21]:
```
of1 = pd.to_datetime(of['_time'])
```

[22]:
```
of1.describe()
```

[22]:
```
count                                 165
unique                                165
top       2019-10-05 20:25:11.876000+00:00
freq                                    1
first     2019-10-05 20:25:00.249000+00:00
last      2019-10-05 20:29:59.340000+00:00
Name: _time, dtype: object
```

[23]:
```
of2 = of1.astype(np.int64).div(1e6)
```

[24]:
```
of3 = of2.diff()
```

[25]:
```
of3.describe()
```

[25]:
```
count     164.000000
mean     1823.725610
std       299.438559
min      1000.000000
25%      1896.000000
50%      1931.500122
75%      1944.000000
max      2757.000244
Name: _time, dtype: float64
```

1.4 Summary of results

data path	timestamp	standard deviation	maximum time difference
1 Signal K delta	at source	188 ms	2058 ms
2 Signal K NMEA TCP	at reception	212 ms	2047 ms
3 USB to OpenCPN	at reception	299 ms	2757 ms

1.5 Conclusion

Judged by a human eye there is no difference between the three methods - the needles and values are jumping back and forth as always!

The difference will come apparent when we want to eliminate that jumping by applying some statistical and continuous algorithms on the received time series data. The accuracy of the time stamps is, of course important for any time series analysis.

1. It is not surprising that the direct TCP connection to the Signal K emitted delta values is the most efficient what comes to the accuracy of the timestamps - they are set at the reception, *i.e.* at the closest possible position to the source. Although this method is penalized having to transmit also information in its payload to which we are not necessarily willing to be subscribed, the fact that the timestamp travels with the data compensates that inconvenience.
2. The fact that there is so little difference between the timestamp accuracy through the Signal K to NMEA conversion and its actual delta channel is a proof of the excellent quality and effiency of Signal K and npm. Also, the TCP method of OpenCPN is the preferred one since apparently well implemented.
3. There is nothing to gain by eliminating Signal K to allow the OpenCPN to connect directly to the USB channel: this is the clearly the less desirable configuration for any algorithm which analyzes time series.

Finally, the best improvement in this particular case would be to increase the sampling rate, which is, admittely, ridicuosly slow.