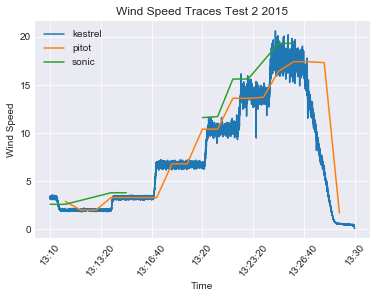
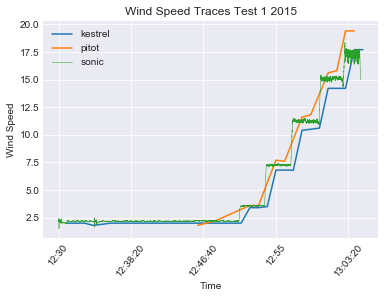
Pearl Ayem – 34404160

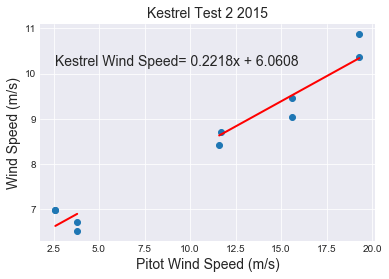
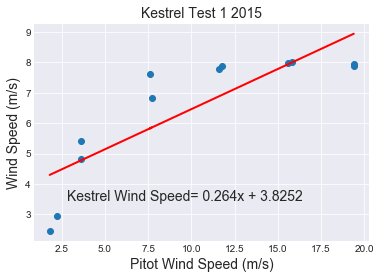
**ATSC 303 LAB 8 – ANEMOMETRY**

Part 1:

1. Wind traces for test 1 and 2 in 2015



1. Calibration with Pitot wind speed
   1. Kestrel:



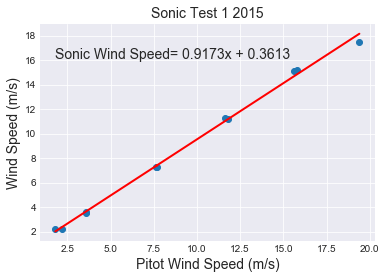
Transfer equation for test 1:

Calibration equation for test 1:

Transfer equation for test 2:

Calibration equation for test 2:

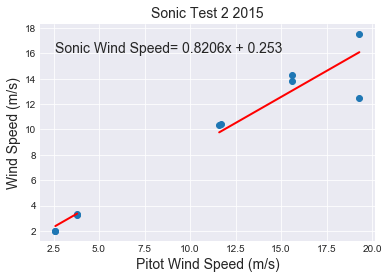
* 1. Sonic Test 1:



Transfer equation for test 1:

Calibration equation for test 1:

* 1. Sonic Test 2:



Transfer equation for test 2:

Calibration equation for test 2:

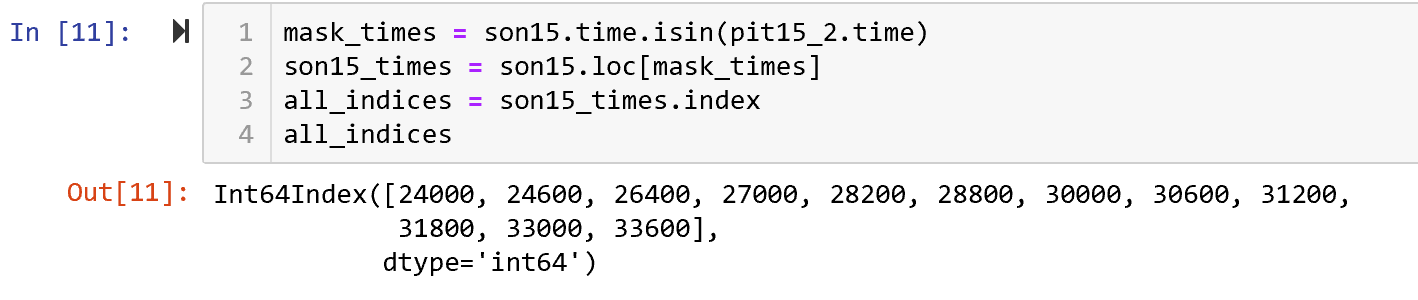
**Averaging all the data:** For each part (a,b, and c) the data was averaged in four steps.

(1) All instantaneous points with the same time as pitot data were selected.

(2) The indices of where these coinciding points occur in the Sonic and Kestrel datasets were stored.

(3) 10 points were picked before and after the indices found in (2)

(4) The 21 datapoints (for each index) were averaged into one datapoint for that time. This gave an average Sonic and Kestrel value of 21 datapoints around the timestamps of the Pitot dataset.

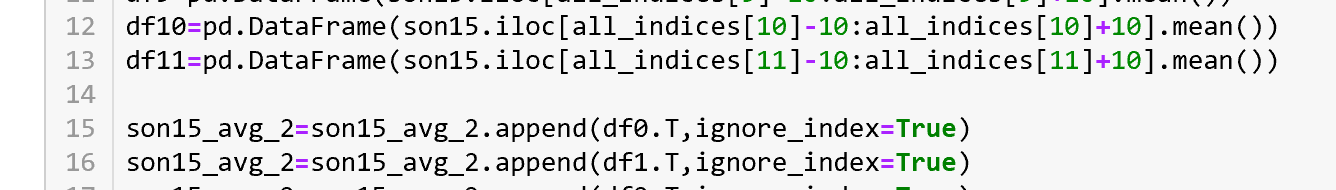


Sample code for steps (1) and (2) with the sonic data.

Line 1 🡪 mask\_times creates a Boolean mask for coinciding timestamps between the Pitot and Sonic data.

Line 2 🡪 Applies the mask to sonic data to filter only those rows with matching timestamps

Line 3 🡪 Finds the indies of the rows with the matching timestamps as they occur in the original dataset



Sample code for steps (3) and (4) with the sonic data (Test 2)

Lines 12 and 13 🡪 Select 10 rows before and after the index selected in (2). Find an average of the 21 rows and convert it into a row in a pandas dataframe.

Lines 15 and 16🡪 Append multiple such rows to a final dataframe that stores the averaged values at matching timestamps as the Pitot dataset.

1. Bias calculations



* 1. Kestrel Average Bias
     1. Test 1: 0.8931 ~0.89
     2. Test 2: 0.2597 ~0.26
  2. Sonic Average Bias Test 1

0.2298 ~ 0.23

* 1. Sonic Average Bias Test 2

0.90998 ~ 0.91

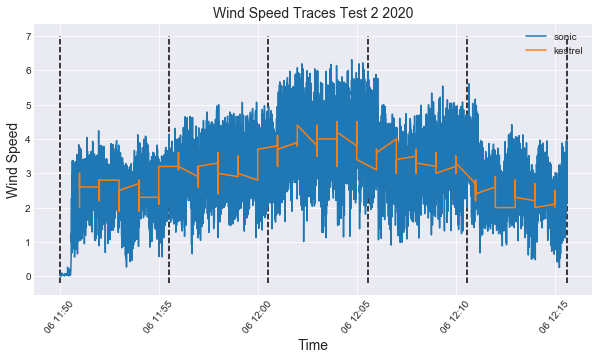
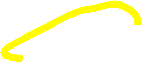
1. \_\_\_\_\_\_
2. \_\_\_\_\_\_
3. Considering an amplification factor of 5 on the barometer measurements, the following equation was used to calculate the windspeed:



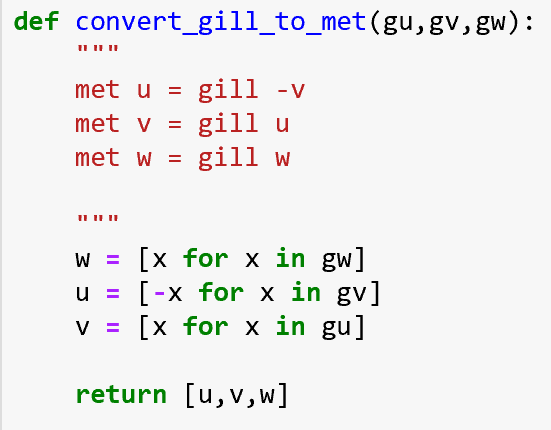
These results differ from those found in the spreadsheet because

Part 2:

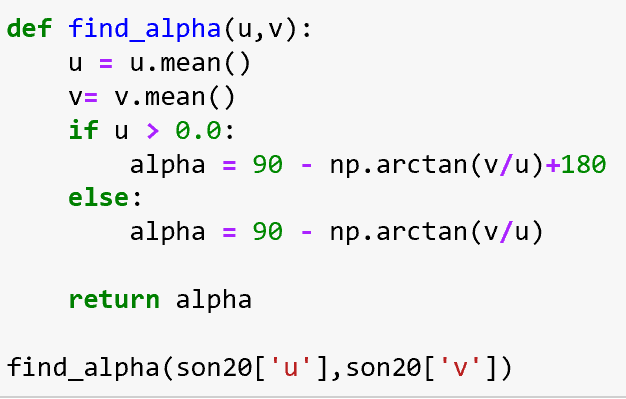
1. Wind Traces for Kestrel and Sonic (Only Test 2 plotted because Test 1 did not have good data)



1. The code used to convert Gill measurements to Meteorological ones is as follows:

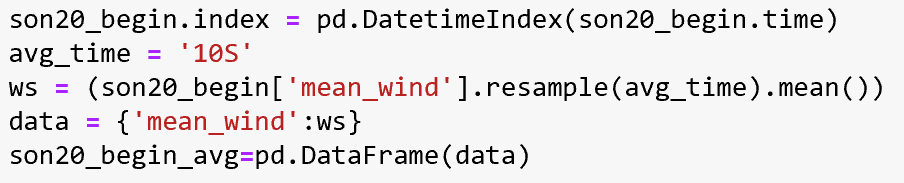


The code used to calculate the wind direction is as follows:



The final wind direction using these was 89.80°

1. To find the time constant I tried to calculate the time takes to reach 63% of the change in wind speed. I did this in the following steps:
2. I averaged the Sonic data for every 10 seconds, and Kestrel every minute between the times the fan went from Off to Low. This is because the Kestrel data was provided already averaged at 1 min intervals, and so I left that as is. The Sonic however was at 10Hz meaning 10 points per second, and 600 per minute which would be too many. So I chose 10 seconds to account for 100 points to average.



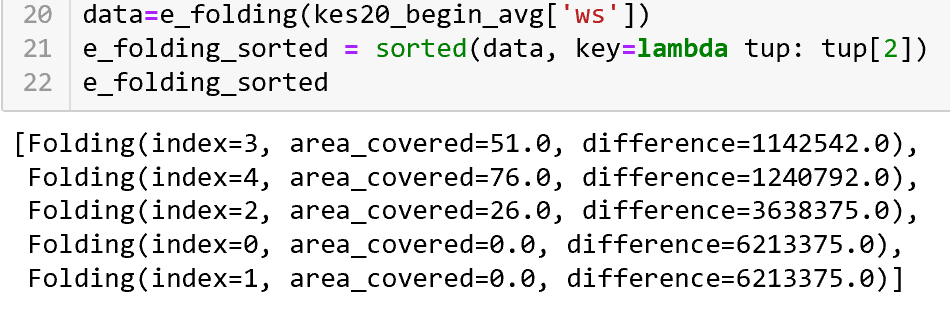
This code snippet shows how the sonic data was averaged for every 10s.

1. A screenshot of a cell phone

   Description automatically generated Function was written to find the area under the curve at each timestep (10s for Sonic, 1minute for Kestrel).

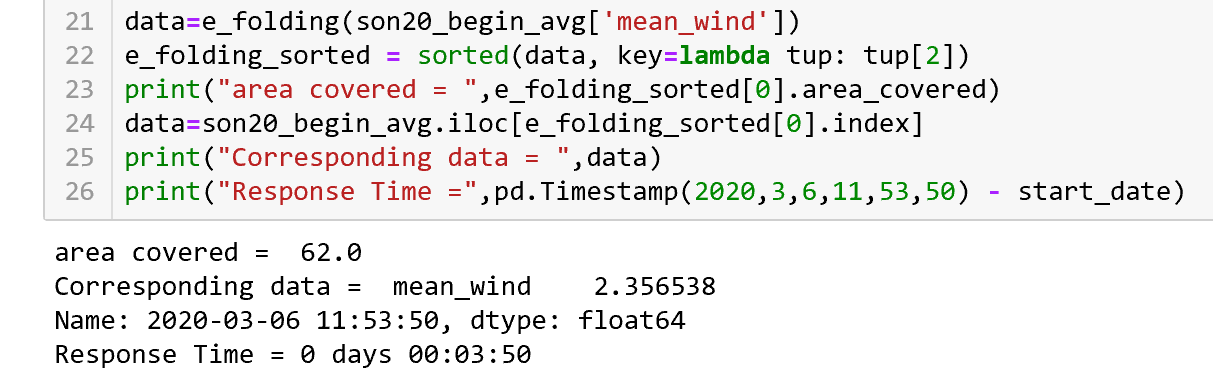
The function written to find the area under the curve. A tuple was created that stores the index, area under the curve and difference for 63% for each timestep.

1. The areas under the curve were sorted from the biggest to smallest difference from 63% of the total area. That is, the times at which the area under the curve was closest to 63% was shown first in the list.



The output list shows the areas sorted from lowest difference to largest difference. Here the index refers to the row index (which is analogous to the timestep), the area\_covered is the area under the curve covered by this timestep, and difference is the difference from 63%. Since 63-51 is the smallest absolute difference, index 3 shows up first in the list.

1. The times were retrieved using the index, and the start time was subtracted from it to find the response time.



Here line 23 prints out the area covered by a timestep. In this case it is 62%. The index of this output is used to find the corresponding time. In the case of Sonic data, it is at 11:53:50. The time difference is calculated and to be found at 3 minutes and 50 seconds for the response time.

1. Steps 1 to 5 were repeated for the fan setting from Low to Off.

Using these steps, the following response times were found:

Off to Low:

* Kestrel: The Kestrel data did not have a perfect time that was close to 63% of the data. This could be because it was averaged at a much larger interval. At 11:53 51% of the change was accounted for and at 11:54 76%. So I approximated 63% to be at a halfway time at 11:54:30. The response time is thus 4 mins 30 secs
* Sonic: 3 mins 50 sec at about 62%

Low to Off:

* Kestrel: Similar to the Kestrel data from Off to Low, the Kestrel at 12:14 accounted for 52% of the change, and at 12:15 76%. So I approximated the time at 12:14:30 and the response time would be 3 mins 55 secs
* Sonic: 02 mins 55 sec at about 62%

1. \_\_\_\_\_
2. \_\_\_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_\_\_
5. The non-zero data values can be present when the fan is off due to eddies and turbulence in the ambient air. There is airflow in the room and when it hits surface it creates small eddies and/or turbulence which could cause the non-zero values.
6. \_\_\_\_\_\_\_\_\_

Further Questions: