

```
In [10]: import pandas as pd
import numpy as np
from matplotlib import pyplot as plt
```

Read Data

```
In [11]: module_flatten = pd.read_csv('data/hit_bbgem_484_nocuts/module_flatten.csv')
axis_flatten = pd.read_csv('data/hit_bbgem_484_nocuts/axis_flatten.csv')
strip_flatten = pd.read_csv('data/hit_bbgem_484_nocuts/strip_flatten.csv')
t0_flatten = pd.read_csv('data/hit_bbgem_484_nocuts/t0_flatten.csv')
# t1_flatten = pd.read_csv('data/hit_bbgem_484_nocuts/t1_flatten.csv')
# t2_flatten = pd.read_csv('data/hit_bbgem_484_nocuts/t2_flatten.csv')
# t3_flatten = pd.read_csv('data/hit_bbgem_484_nocuts/t3_flatten.csv')
# t4_flatten = pd.read_csv('data/hit_bbgem_484_nocuts/t4_flatten.csv')
# t5_flatten = pd.read_csv('data/hit_bbgem_484_nocuts/t5_flatten.csv')
```

Transfer data from pandas file to numpy file

```
In [12]: module = (np.array(module_flatten)).astype(int)
axis = (np.array(axis_flatten)).astype(int)
strip = (np.array(strip_flatten)).astype(int)
t0 = np.array(t0_flatten)
# t1 = np.array(t1_flatten)
# t2 = np.array(t2_flatten)
# t3 = np.array(t3_flatten)
# t4 = np.array(t4_flatten)
# t5 = np.array(t5_flatten)
```

```
In [13]: module = module.flatten()
axis = axis.flatten()
strip = strip.flatten()
t0 = t0.flatten()
# t1 = t1.flatten()
# t2 = t2.flatten()
# t3 = t3.flatten()
# t4 = t4.flatten()
# t5 = t5.flatten()
```

```
In [14]: len(module)
```

Out[14]: 301743899

Find unique ID for module, axis, strip

```
In [15]: moduleID = np.unique(module)
axisID = np.unique(axis)
stripID = np.unique(strip)
```

```
In [16]: print(moduleID, '\n', axisID, '\n', stripID)
```

```
[0 1 2 3]
[0 1]
[ 0 1 2 ... 1533 1534 1535]
```

```
In [ ]:
```

Seperate data by the Moudle, Strip and, axis

Module identifies the chamber, axis and strip uniquely identify a channel on that chamber. We need to specify all 3 to choose one channel.

```
In [17]: adcs0 = {}
# adcs1 = {}
# adcs2 = {}
# adcs3 = {}
# adcs4 = {}
# adcs5 = {}
```

```
# widths = {}
# means = {}

for i in range(len(moduleID)):
    for j in range(len(stripID)):
        for k in range(len(axisID)):
            index = 'moduleID : ' + str(moduleID[i]) \
                    +' stripID : ' + str(stripID[j])\
                    + ' axisID : ' + str(axisID[k])

            adcs0[index] = []

            #         adcs1[index] = []
            #         adcs2[index] = []
            #         adcs3[index] = []
            #         adcs4[index] = []
            #         adcs5[index] = []
            #         widths[index] = []
            #         means[index] = []

for m in range(len(module)):#
    if np.mod(m, 10000000) == 0:
        print(m)
        index = 'moduleID : ' + str(module[m]) \
                +' stripID : ' + str(strip[m])\
                + ' axisID : ' + str(axis[m])

        adcs0[index].append(t0[m])
        #         adcs1[index].append(t1[m])
        #         adcs2[index].append(t2[m])
        #         adcs3[index].append(t3[m])
        #         adcs4[index].append(t4[m])
        #         adcs5[index].append(t5[m])

        #         T = np.array([t0[m], t1[m], t2[m], t3[m], t4[m], t5[m]])
        #         dis = np.max(T) - np.min(T)
        #         mes = np.mean(T)
        #         widths[index].append(dis)
        #         means[index].append(mes)
```

0
10000000
20000000
30000000
40000000
50000000
60000000
70000000
80000000
90000000
100000000
110000000
120000000
130000000
140000000
150000000
160000000
170000000
180000000
190000000
200000000
210000000
220000000
230000000
240000000
250000000
260000000
270000000
280000000
290000000
300000000

```
In [18]: adcs0_len = []
for i in range(len(moduleID)):
    for j in range(0, len(stripID)):
        for k in range(len(axisID)):

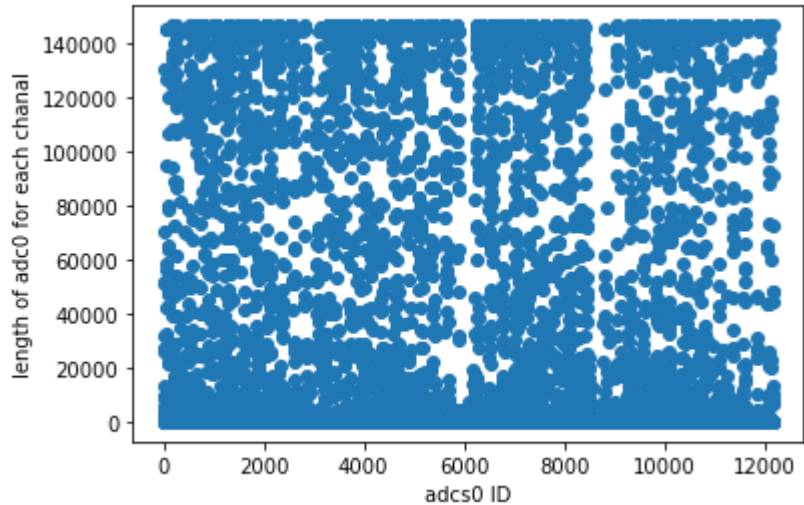
            index = 'moduleID : ' + str(moduleID[i])\
                    +' stripID : ' + str(stripID[j])\
                    + ' axisID : ' + str(axisID[k])
```

```
adc0 = adcs0[index]
adcs0_len.append(len(adcs0))
#     if len(adcs0_len) == 9610:
#         print(index)
#         print(len(adcs0))
```

In [25]: len(adcs0_len)

Out[25]: 12160

```
In [14]: get_ipython().magic('matplotlib inline')
plt.scatter(range(len(adcs0_len)), adcs0_len)
plt.xlabel('adcs0 ID')
plt.ylabel('length of adc0 for each chanal')
plt.show()
```



```
In [47]: max_len = np.where(np.array(adcs0_len) == 146520)
print(len(max_len))
```

Out[47]: True

Plot the data in the same channel

```
In [42]: for i in range(len(moduleID)):
        for j in range(200, 300):
            for k in range(len(axisID)):

                index = 'moduleID : ' + str(moduleID[i])\
                        + ' stripID : ' + str(stripID[j])\
                        + ' axisID : ' + str(axisID[k])

                adc0 = adcs0[index]
                #     adc1 = adcs1[index]
                #     adc2 = adcs2[index]
                #     adc3 = adcs3[index]
                #     adc4 = adcs4[index]
                #     adc5 = adcs5[index]
                #     width = widths[index]
                #     mean = means[index]

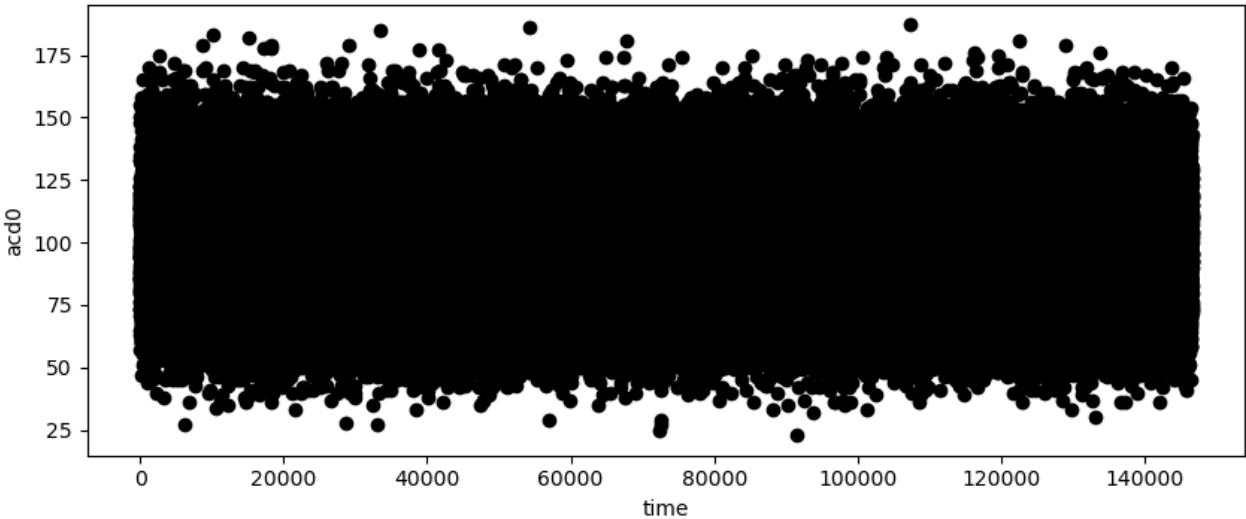
                #     print(i, j, k)
                #     print(len(width))

                if len(adc0) == 146520:
                    get_ipython().magic('matplotlib inline')
                    print(len(adc0))

                    fig=plt.figure(figsize=(10,4), dpi= 100, facecolor='w', edgecolor='k')
                    plt.scatter(range(0, len(adc0)), adc0, color='black')
                    plt.xlabel('time')
                    plt.ylabel('acd0')
                    plt.title('moduleID : {}, stripID : {}, axisID : {}'.format(moduleID[i], stripID[j], axisID[k]), x = 0.5, y = 1)
                    plt.show()
```

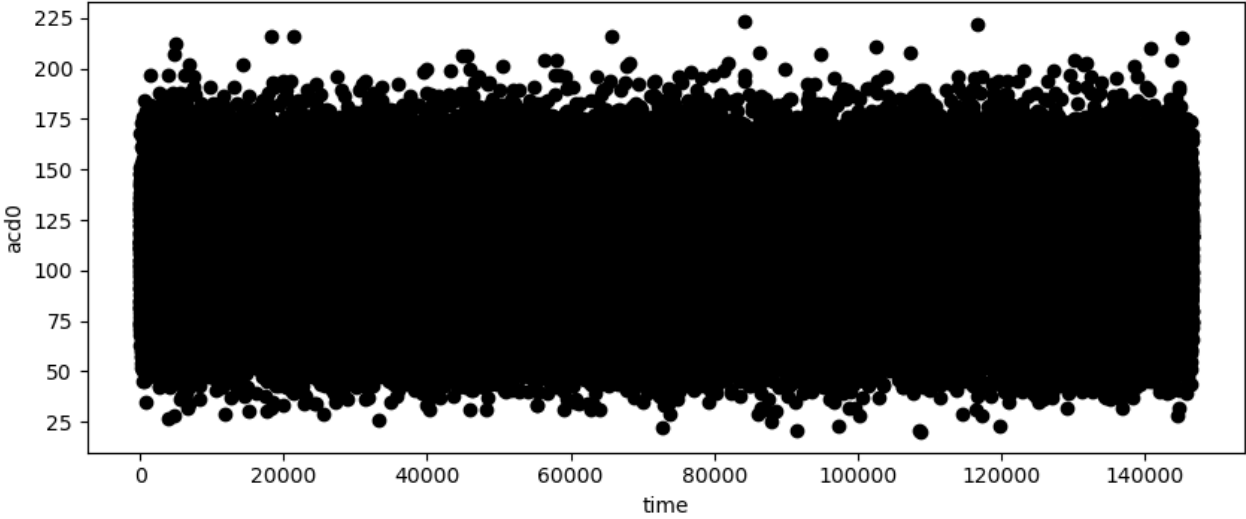
146520

moduleID : 1, stripID : 250, axisID : 0



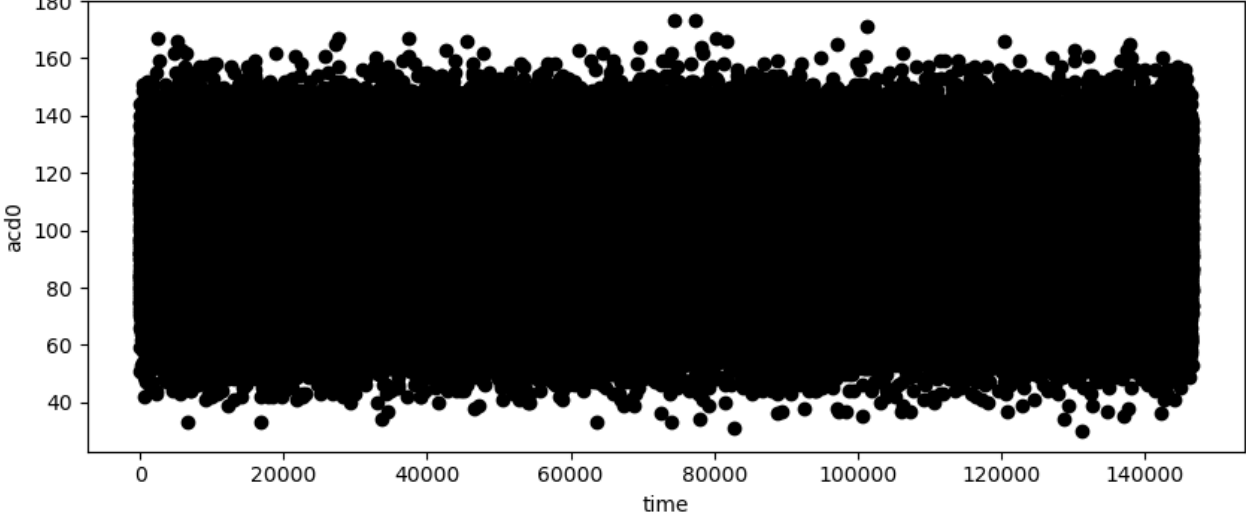
146520

moduleID : 1, stripID : 252, axisID : 0



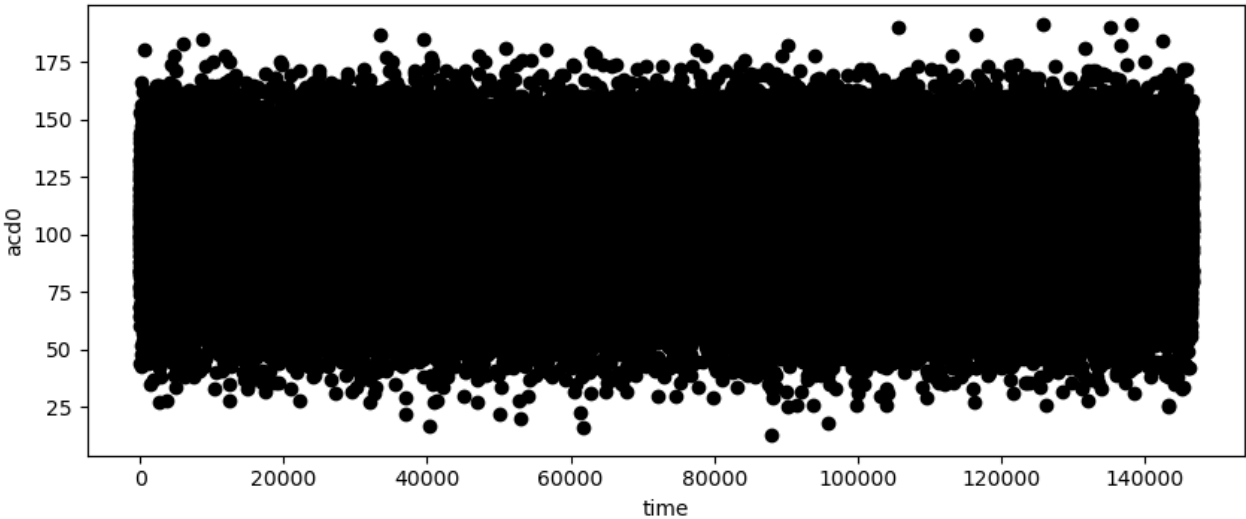
146520

moduleID : 1, stripID : 254, axisID : 0



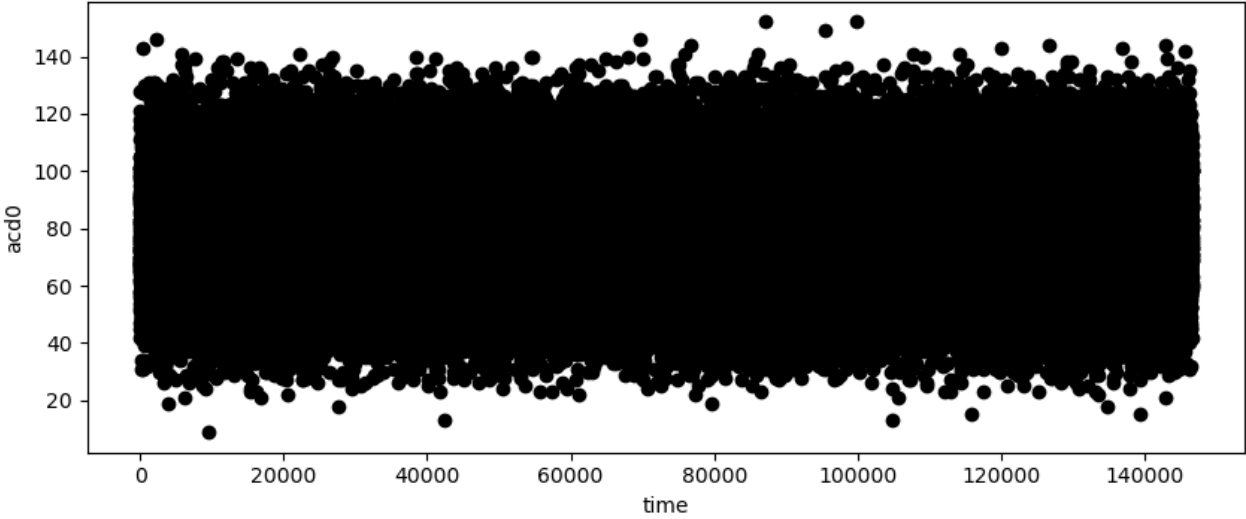
146520

moduleID : 1, stripID : 260, axisID : 1



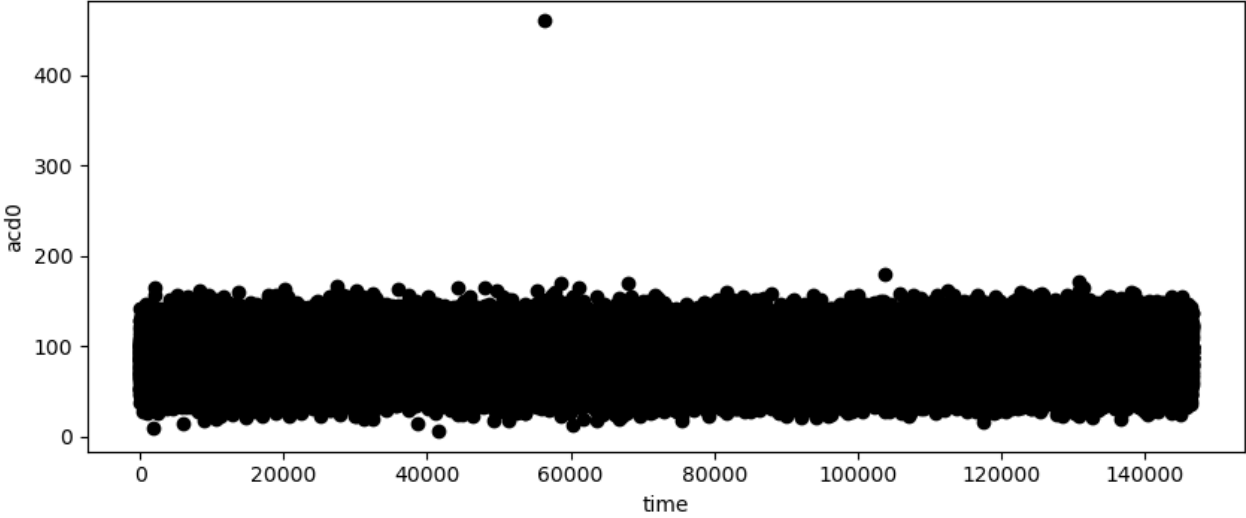
146520

moduleID : 2, stripID : 242, axisID : 0



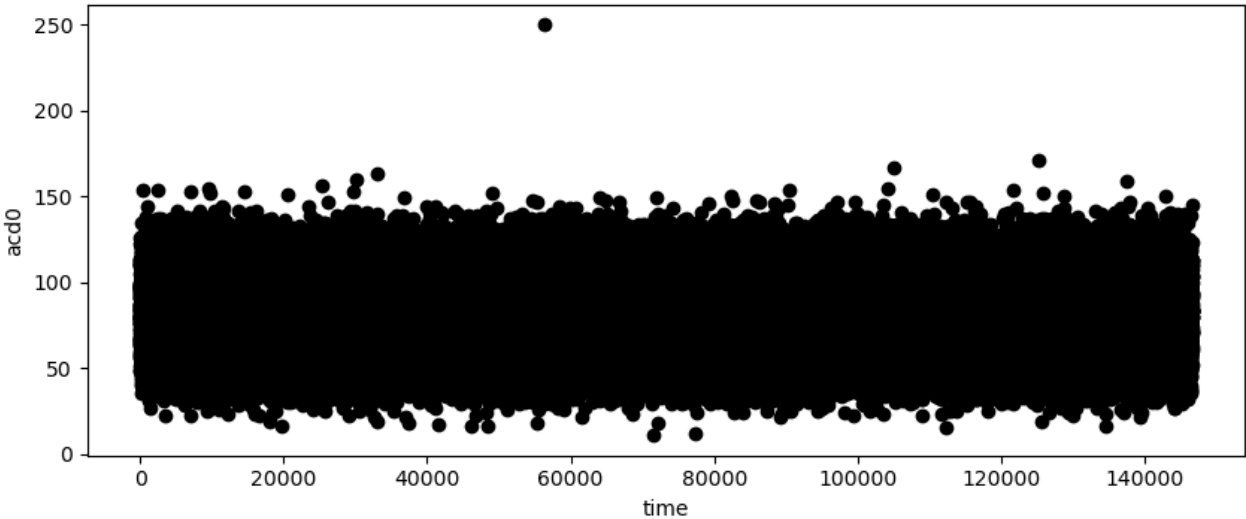
146520

moduleID : 2, stripID : 250, axisID : 0



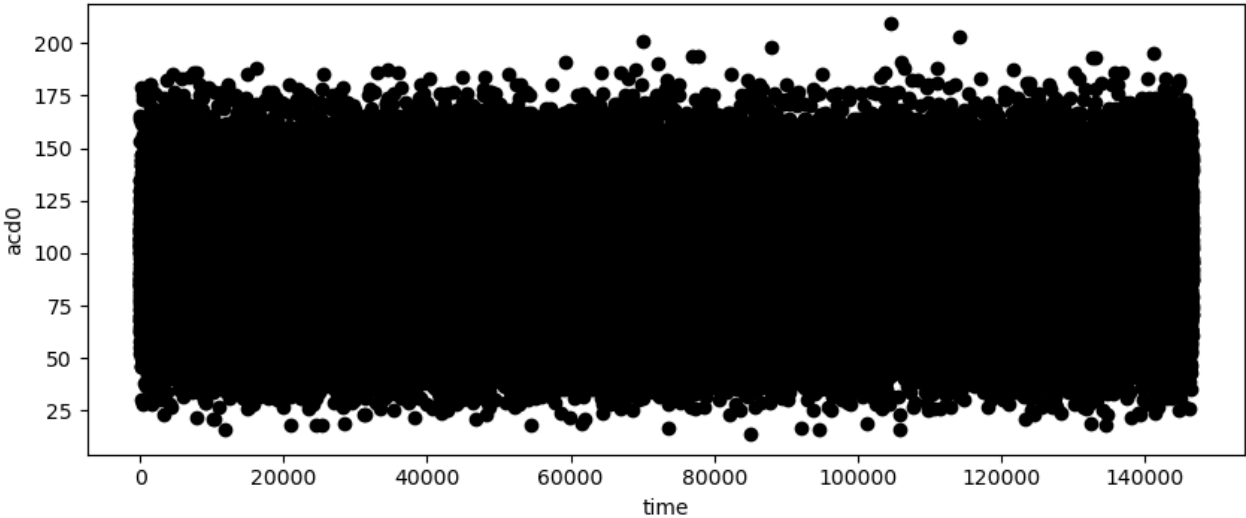
146520

moduleID : 2, stripID : 251, axisID : 0



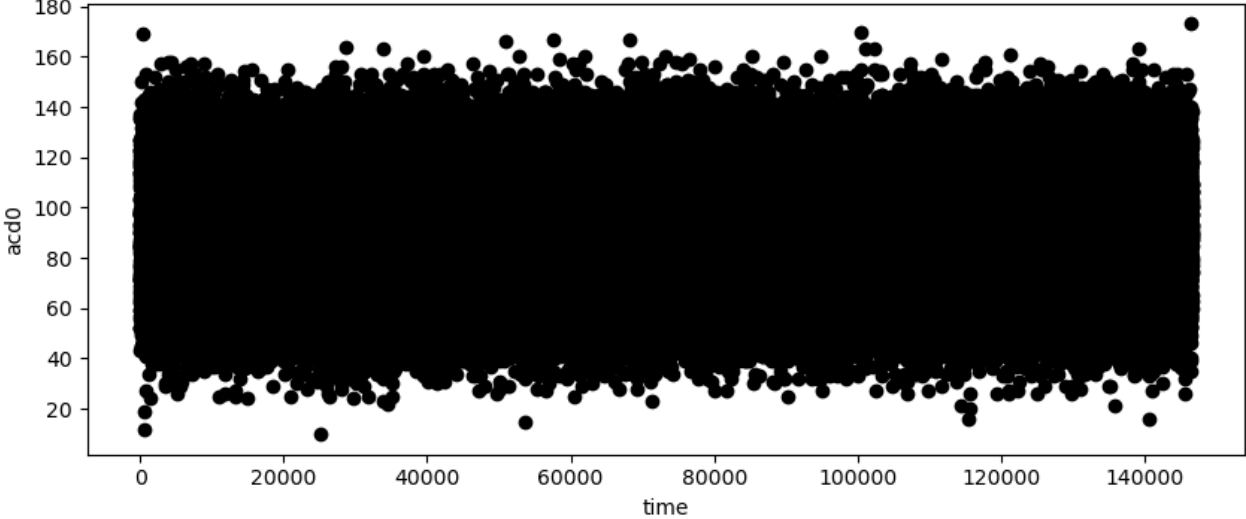
146520

moduleID : 2, stripID : 252, axisID : 0



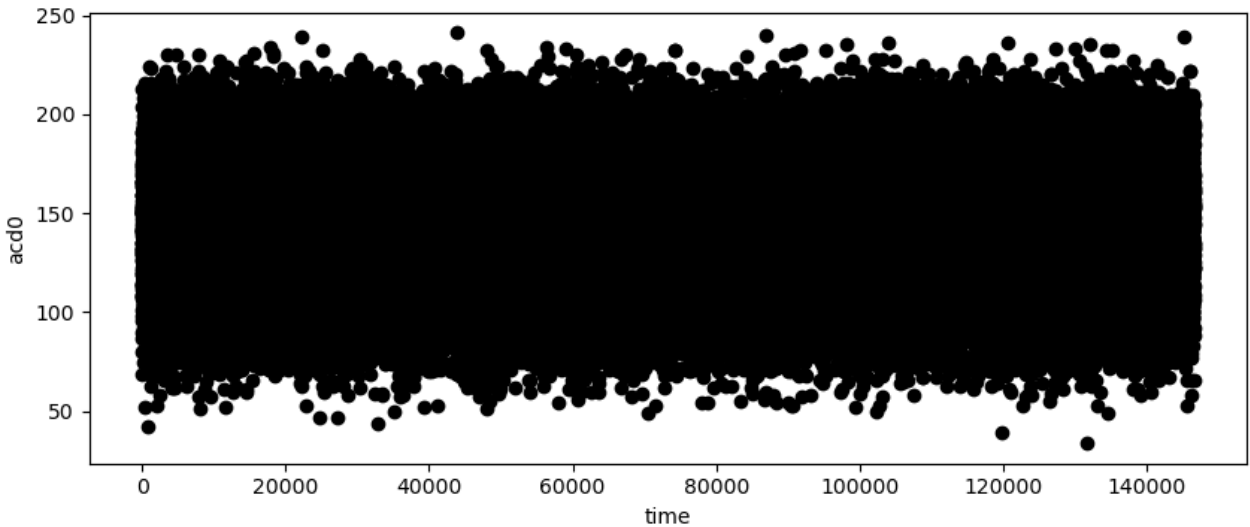
146520

moduleID : 2, stripID : 254, axisID : 0



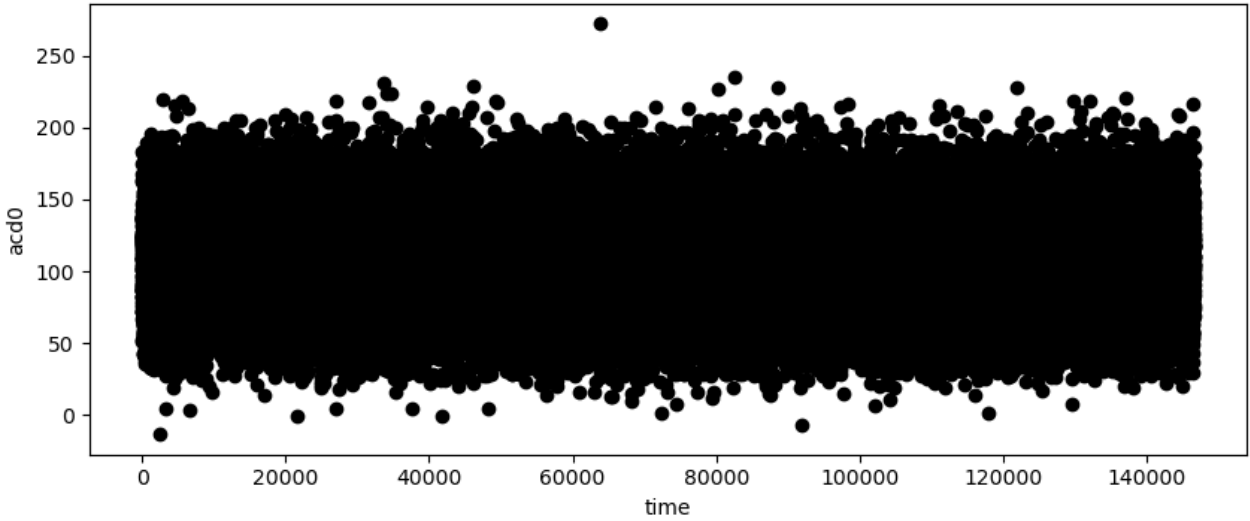
146520

moduleID : 2, stripID : 254, axisID : 1



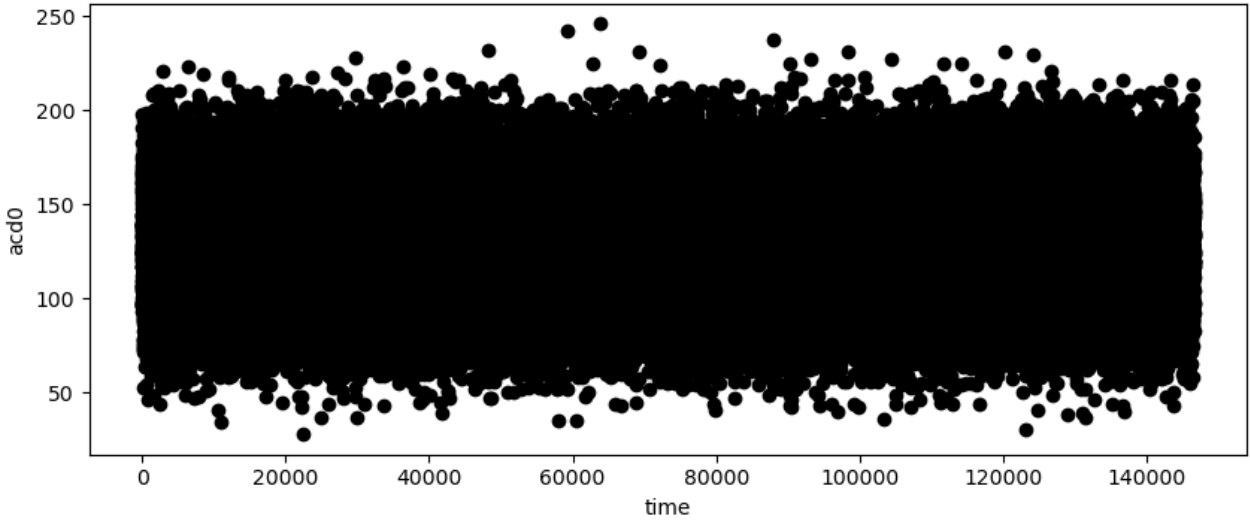
146520

moduleID : 3, stripID : 248, axisID : 1



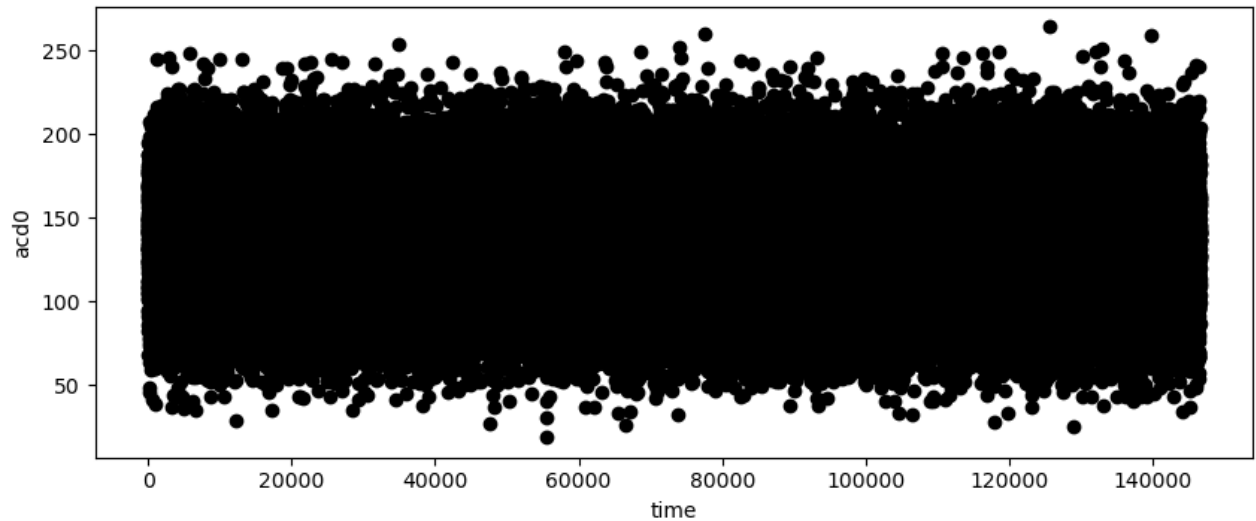
146520

moduleID : 3, stripID : 250, axisID : 1



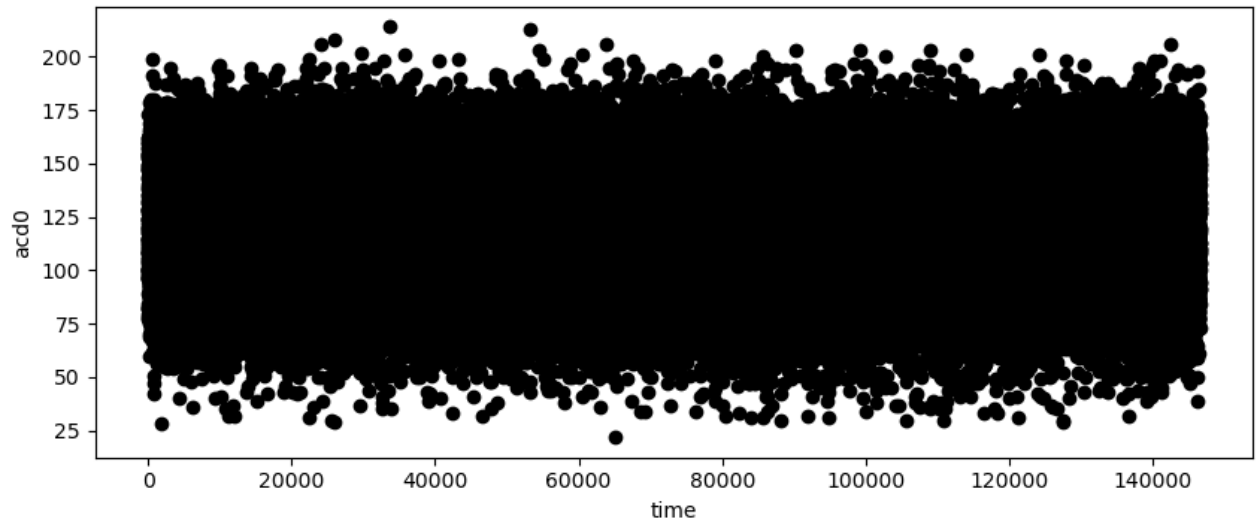
146520

moduleID : 3, stripID : 252, axisID : 1



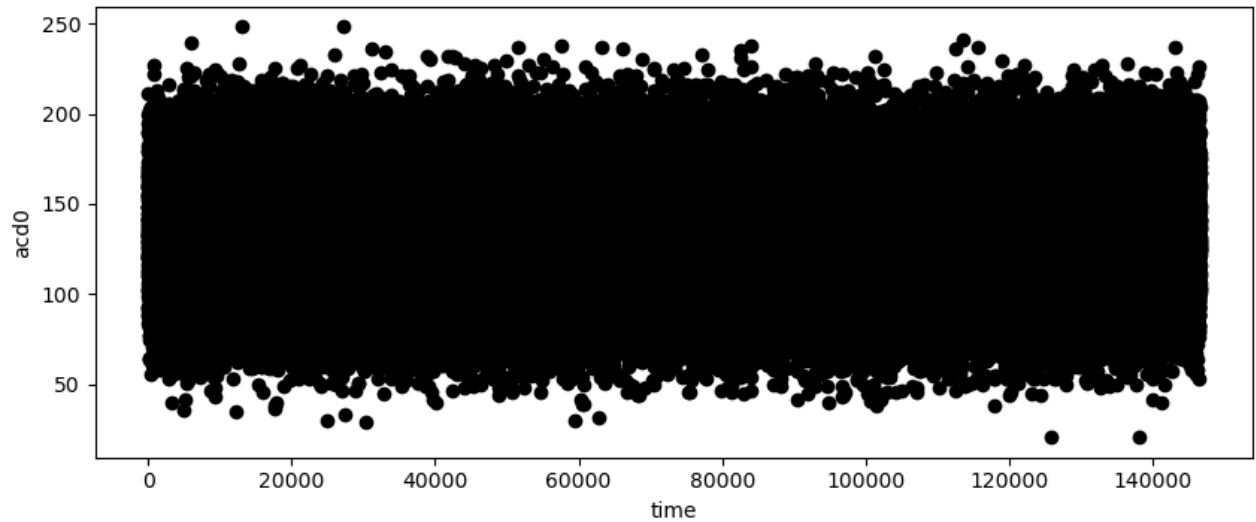
146520

moduleID : 3, stripID : 254, axisID : 0



146520

moduleID : 3, stripID : 254, axisID : 1



Using ADWIN method to Detect Change

```
In [43]: import time
import adwin2
```

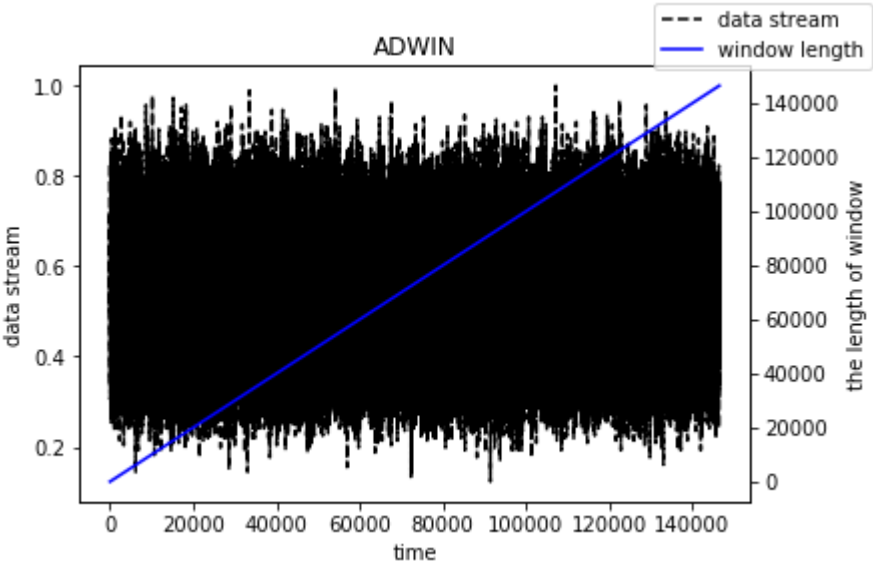
```
In [44]: for i in range(len(moduleID)):
    for j in range(200, 300):
        for k in range(len(axisID)):

            index = 'moduleID : ' + str(moduleID[i])\
```

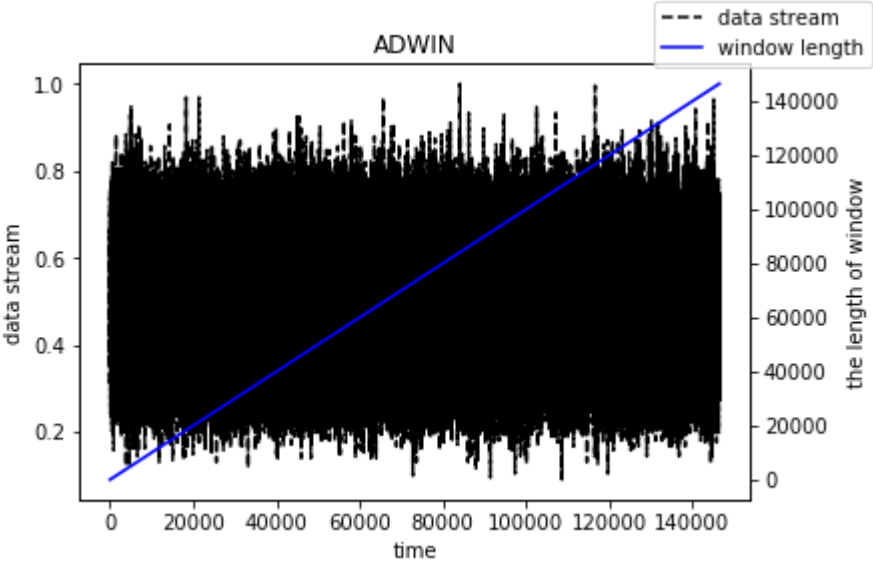
```
+' stripID : ' + str(stripID[j])\
+ ' axisID : ' + str(axisID[k])

stream = adcs0[index]
stream = np.array(stream)
if len(stream) == 146520:
    print(index)
    stream = np.array(stream)
    stream = stream/np.abs(stream).max()
    threshold = 2.0
    delta = 0.001
    changvalue = 2000
    start = time.time()
    var = 'q2'
    %matplotlib inline
    start = time.time()
    fig = adwin2.adwin2_1d(stream, var, delta, threshold, changvalue, min_t
    end = time.time()
    print('time: ', end - start)
```

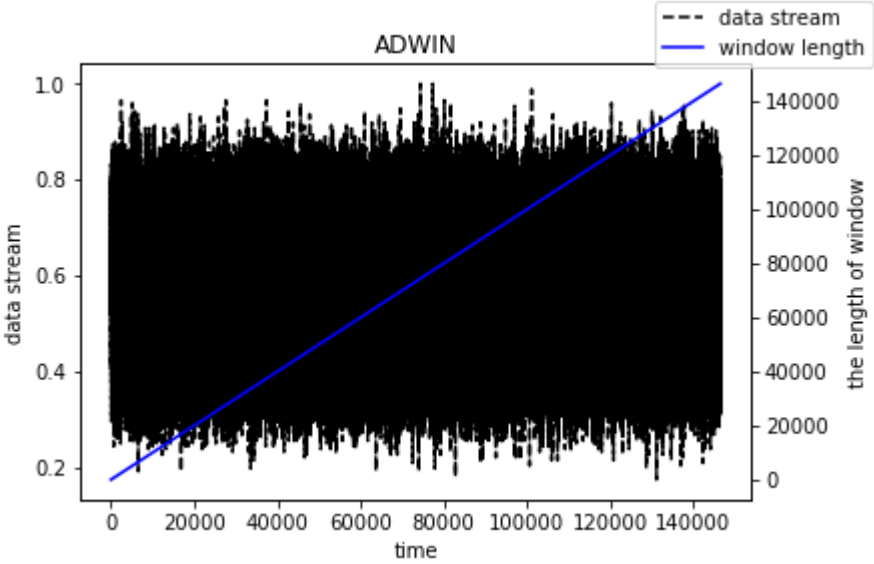
moduleID : 1 stripID : 250 axisID : 0



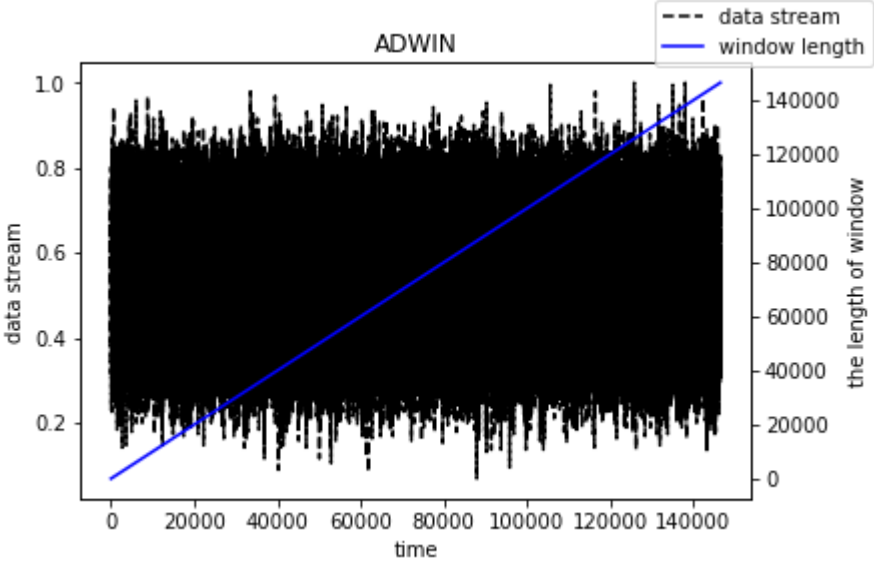
time: 40.78110694885254
moduleID : 1 stripID : 252 axisID : 0



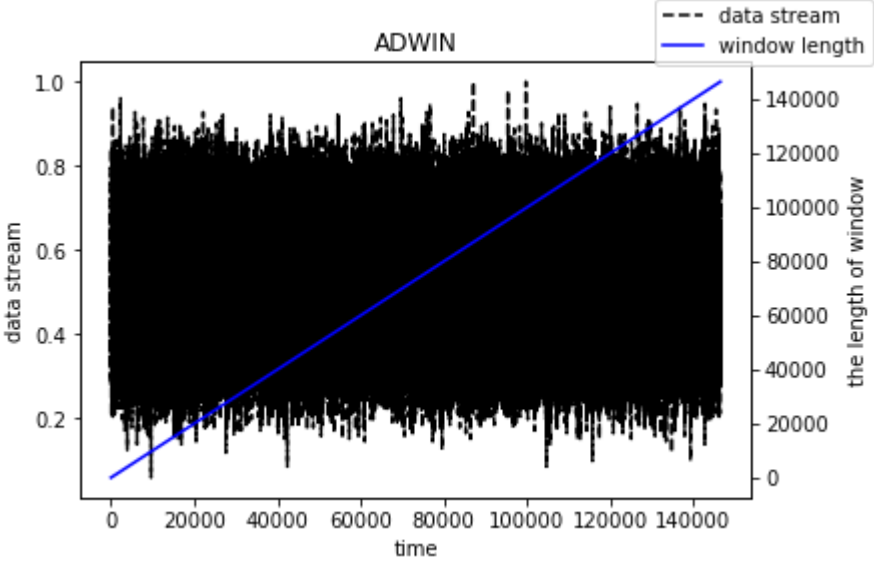
time: 43.97102332115173
moduleID : 1 stripID : 254 axisID : 0



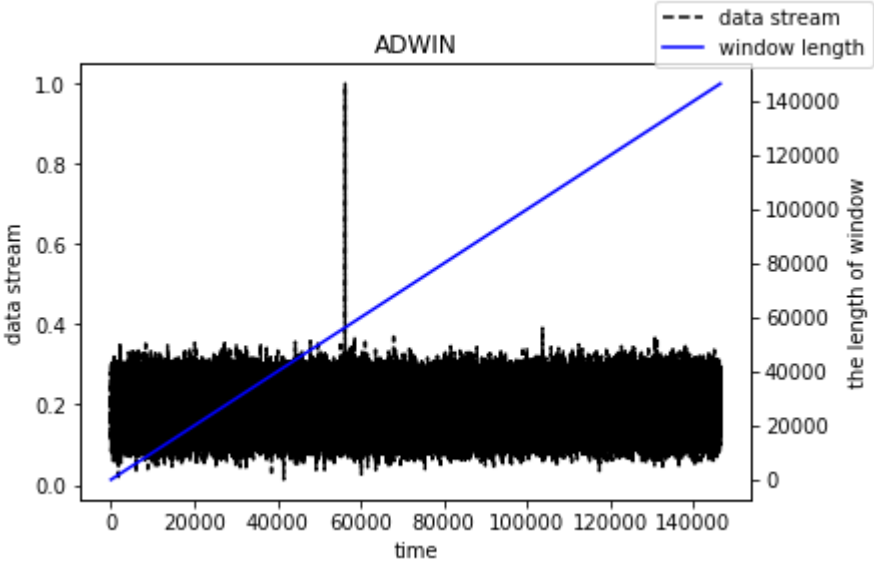
time: 81.04446911811829
moduleID : 1 stripID : 260 axisID : 1



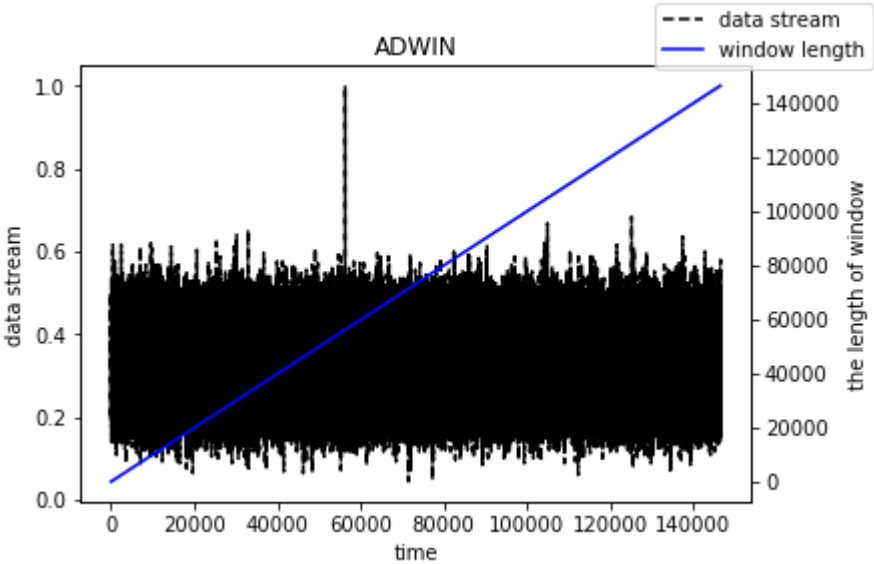
time: 42.438992977142334
moduleID : 2 stripID : 242 axisID : 0



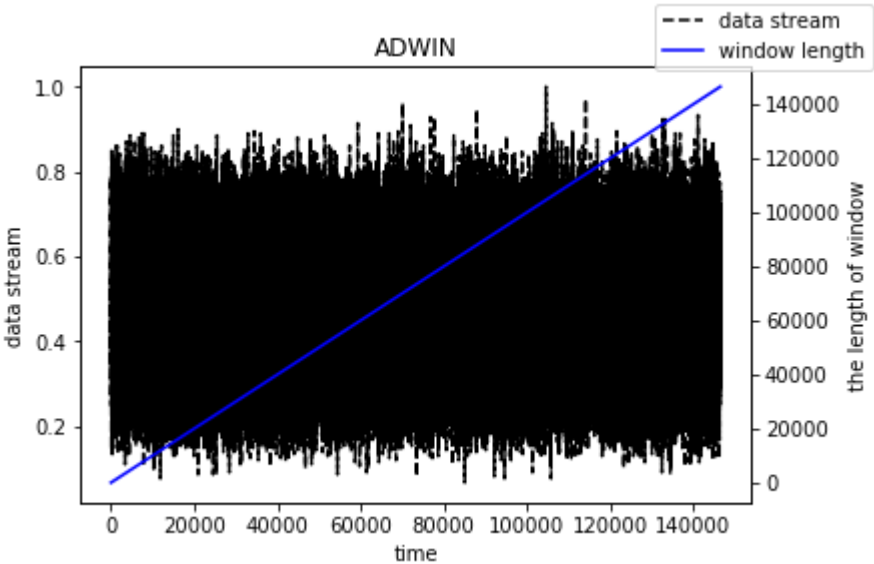
time: 44.146432399749756
moduleID : 2 stripID : 250 axisID : 0



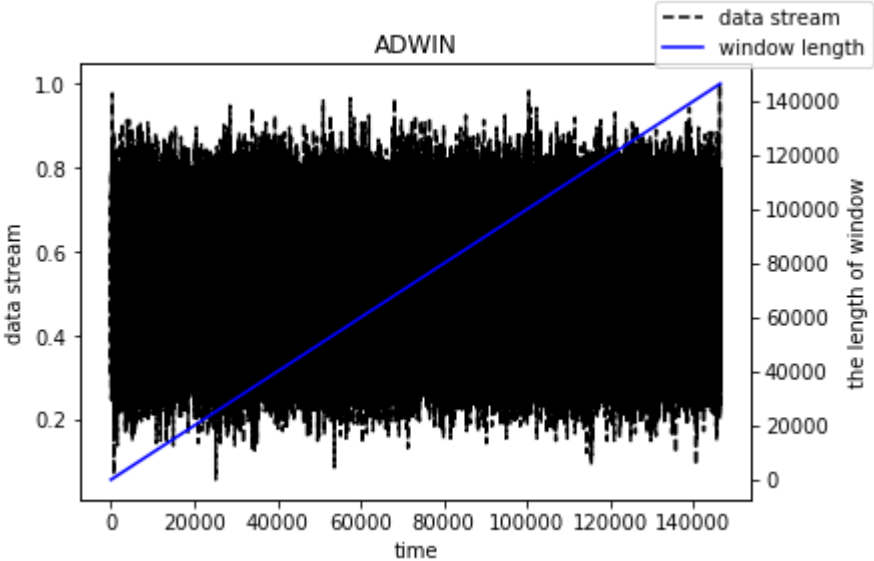
time: 40.92474889755249
moduleID : 2 stripID : 251 axisID : 0



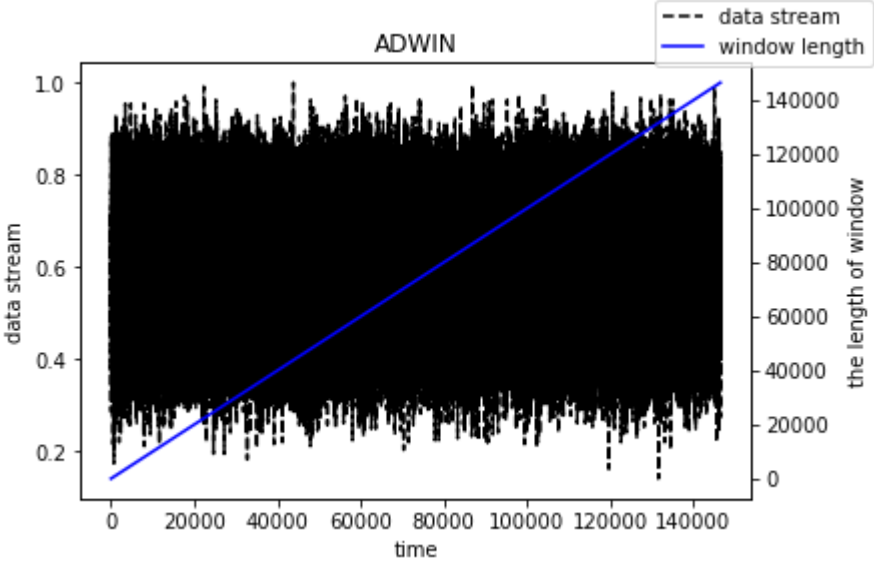
time: 44.09520673751831
moduleID : 2 stripID : 252 axisID : 0



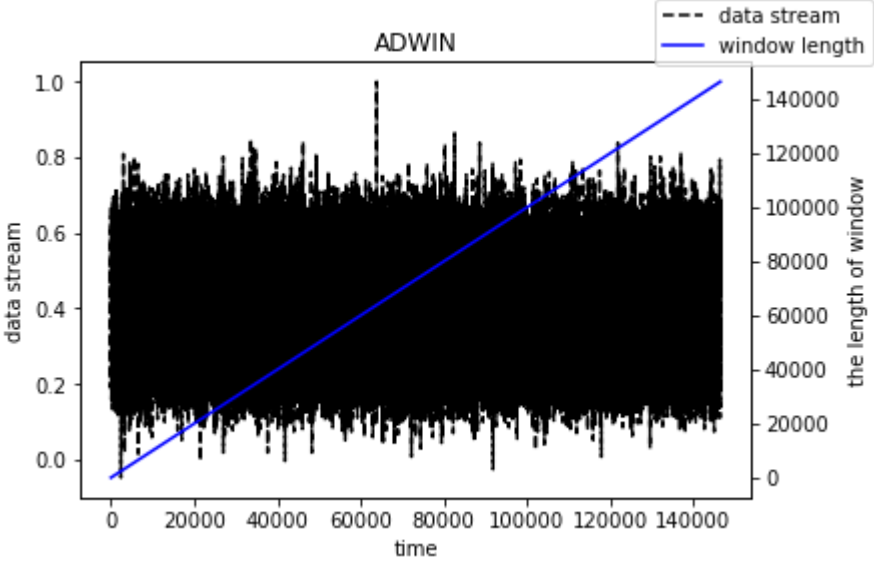
time: 44.28263545036316
moduleID : 2 stripID : 254 axisID : 0



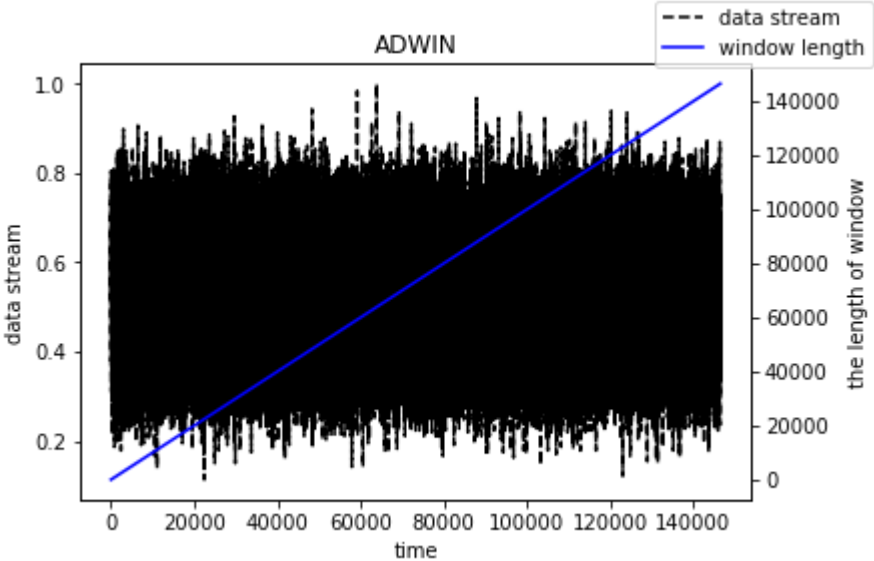
time: 73.80850505828857
moduleID : 2 stripID : 254 axisID : 1



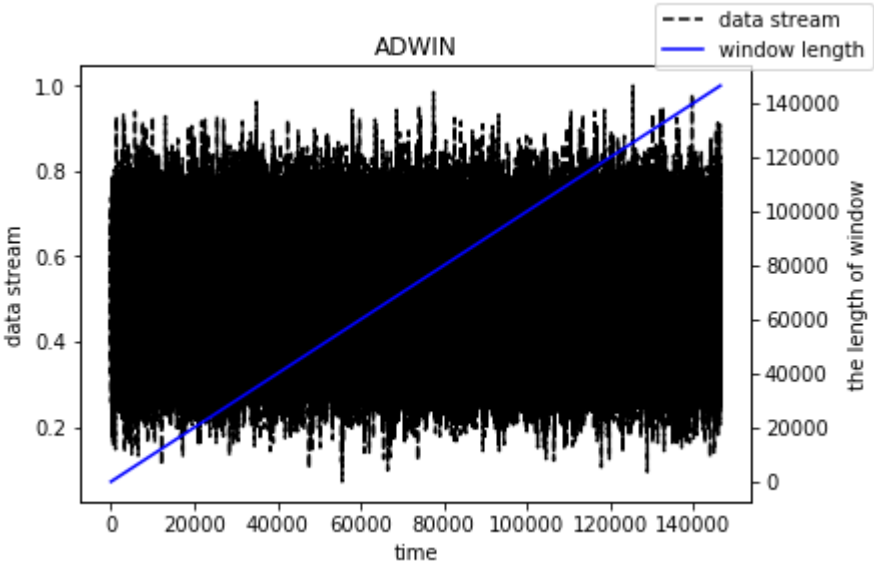
time: 43.022321939468384
moduleID : 3 stripID : 248 axisID : 1



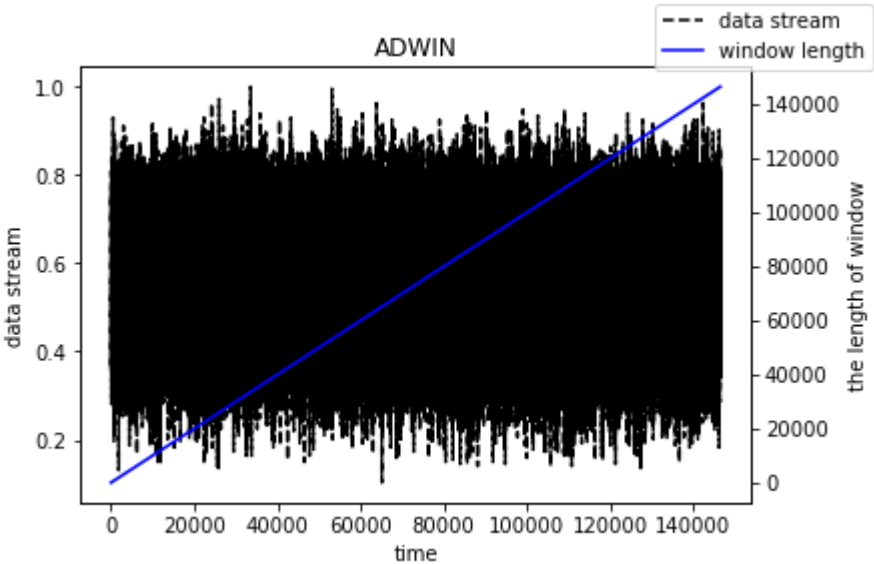
time: 43.59136509895325
moduleID : 3 stripID : 250 axisID : 1



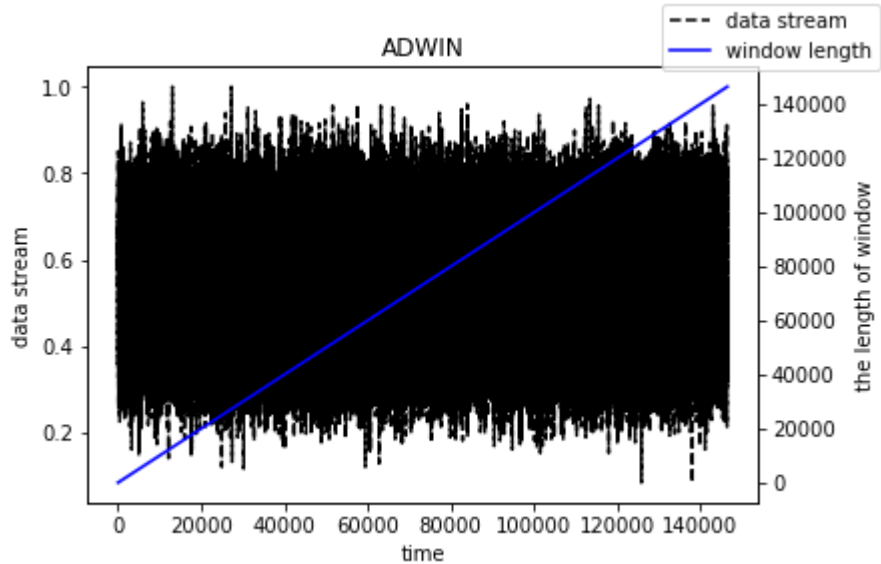
time: 42.28103756904602
moduleID : 3 stripID : 252 axisID : 1



time: 44.326844453811646
moduleID : 3 stripID : 254 axisID : 0



time: 44.73107624053955
moduleID : 3 stripID : 254 axisID : 1



time: 72.27458047866821

Using Multiscale method to detect change

```
In [69]: import Multiscale1Modify
import imp
imp.reload(Multiscale1Modify)

Out[69]: <module 'Multiscale1Modify' from '/home/rfang002/Ronglong/INDRA_ASTR/Multiscale1Modify.py'>

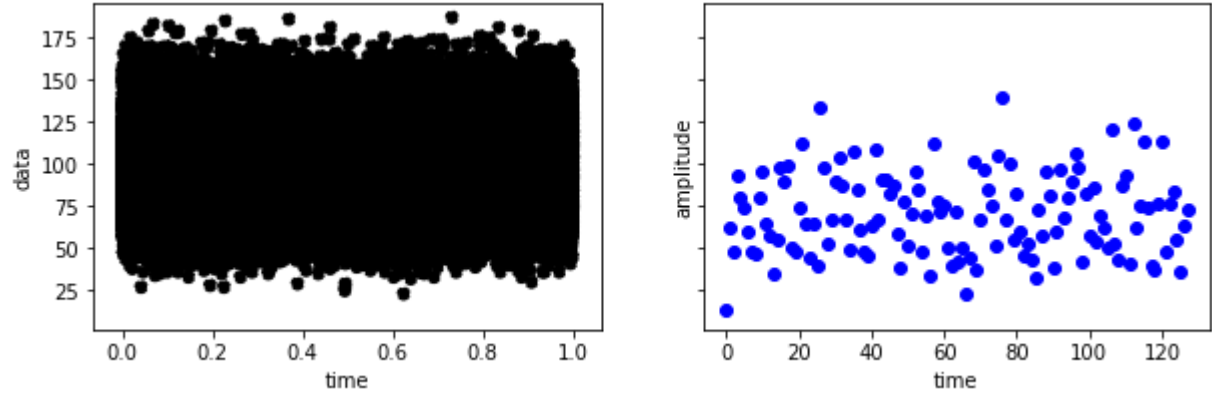
In [70]: for i in range(len(moduleID)):
    for j in range(200, 300):
        for k in range(len(axisID)):

            index = 'moduleID : ' + str(moduleID[i])\
                    + ' stripID : ' + str(stripID[j])\
                    + ' axisID : ' + str(axisID[k])

            stream = adcs0[index]
            if len(stream) == 146520:
                print(index)
                stream = np.array(stream)
                N = 1
                k = 7
                I = 2000
                Ex = 10
                In = 8
                var = 'sudden'
                threshold = 2.5
                Data = []
                Index = []
                Data.append(stream)
                Index.append(np.arange(0, len(stream), 1))
                %matplotlib inline
                start = time.time()
                changeIndex = Multiscale1Modify.mulDetect(N, k, I, Ex, Data, Index, thr
                end = time.time()
                print('time: ', end - start)
```

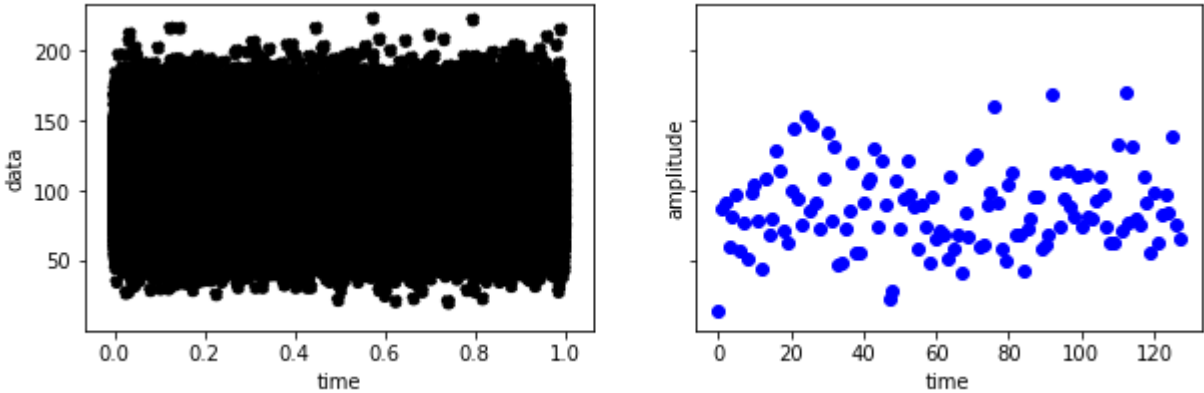
moduleID : 1 stripID : 250 axisID : 0

change detect level : 0



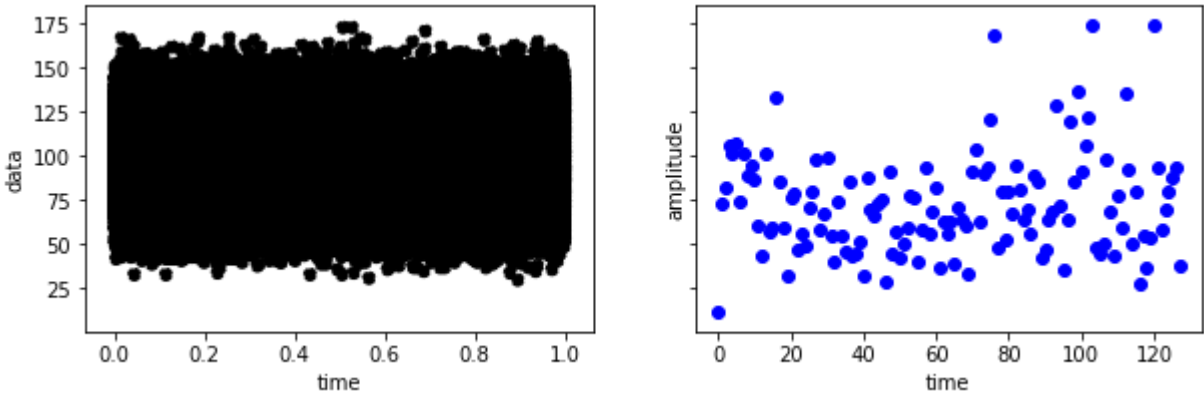
time: 8.222799301147461
moduleID : 1 stripID : 252 axisID : 0

change detect level : 0



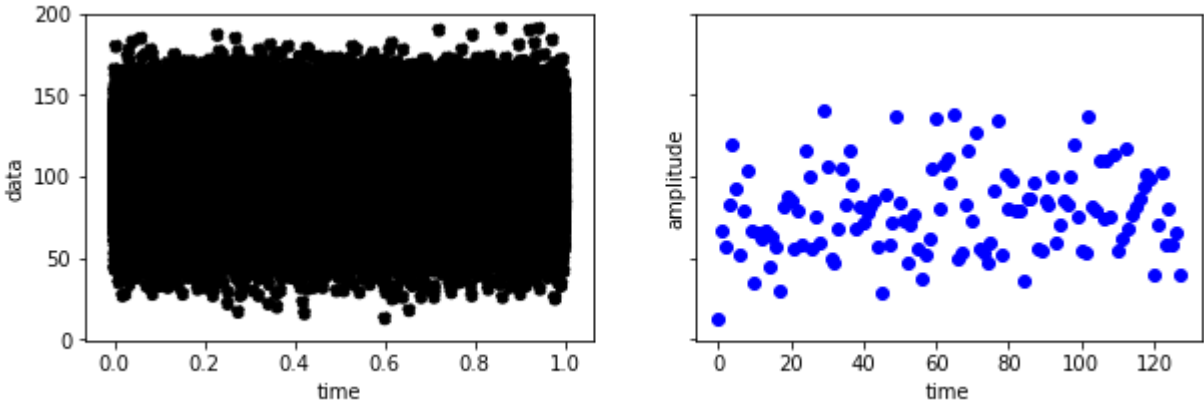
time: 7.961869478225708
moduleID : 1 stripID : 254 axisID : 0

change detect level : 0



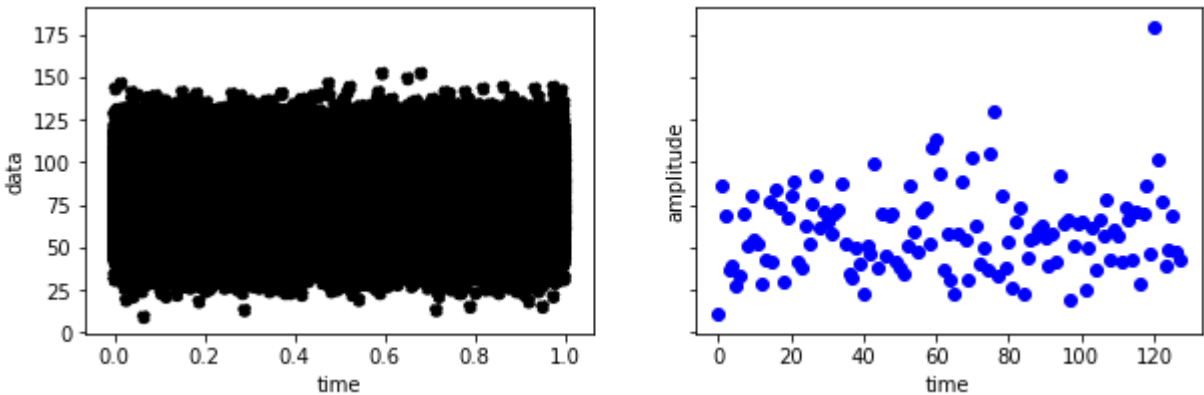
time: 7.81164288520813
moduleID : 1 stripID : 260 axisID : 1

change detect level : 0



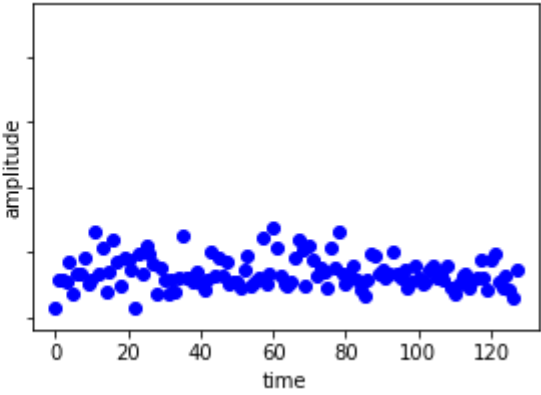
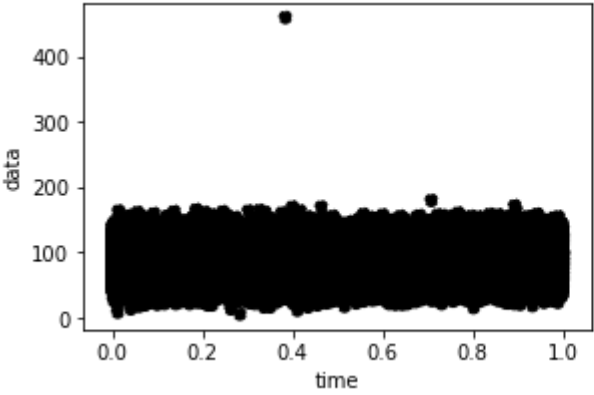
time: 8.196210861206055
moduleID : 2 stripID : 242 axisID : 0

change detect level : 0



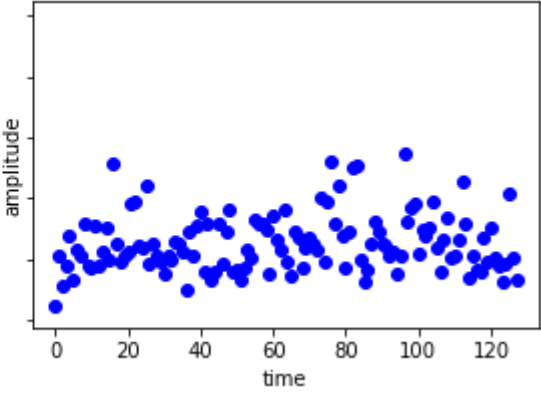
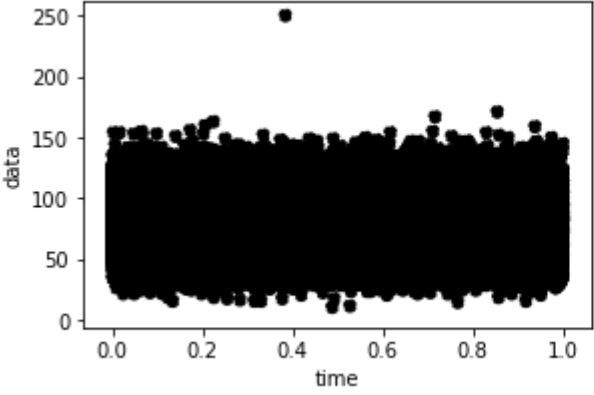
the change happens between : (137648, 138792)
time: 8.217814445495605
moduleID : 2 stripID : 250 axisID : 0

change detect level : 0



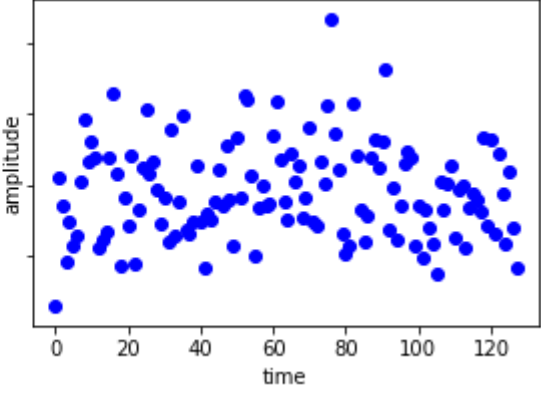
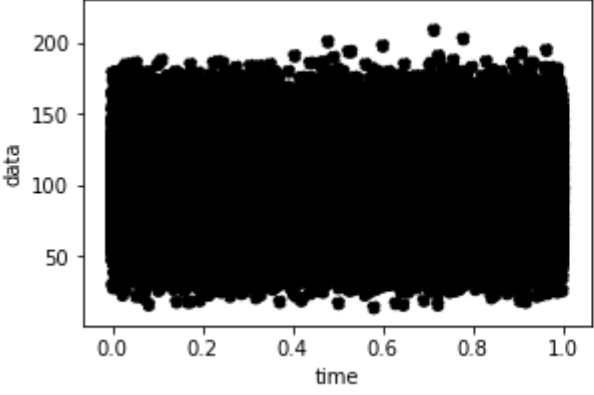
time: 8.136353015899658
moduleID : 2 stripID : 251 axisID : 0

change detect level : 0



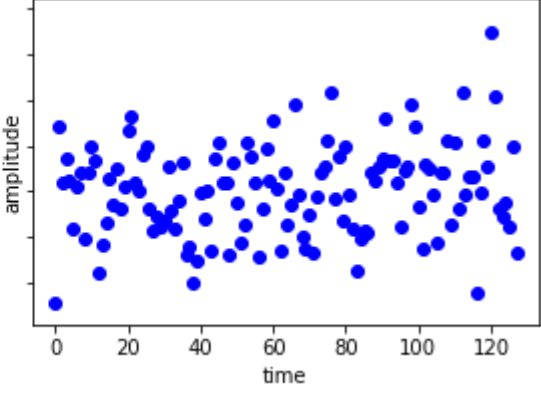
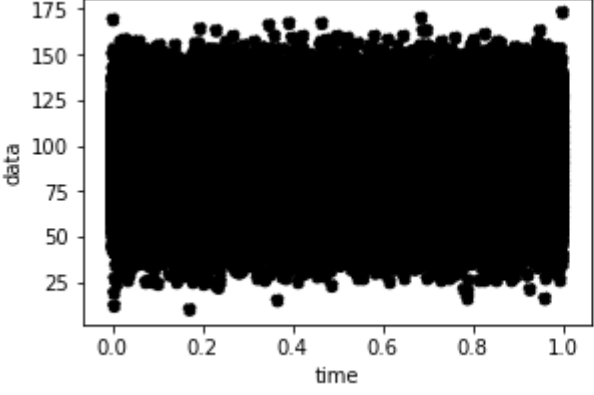
time: 46.35052990913391
moduleID : 2 stripID : 252 axisID : 0

change detect level : 0



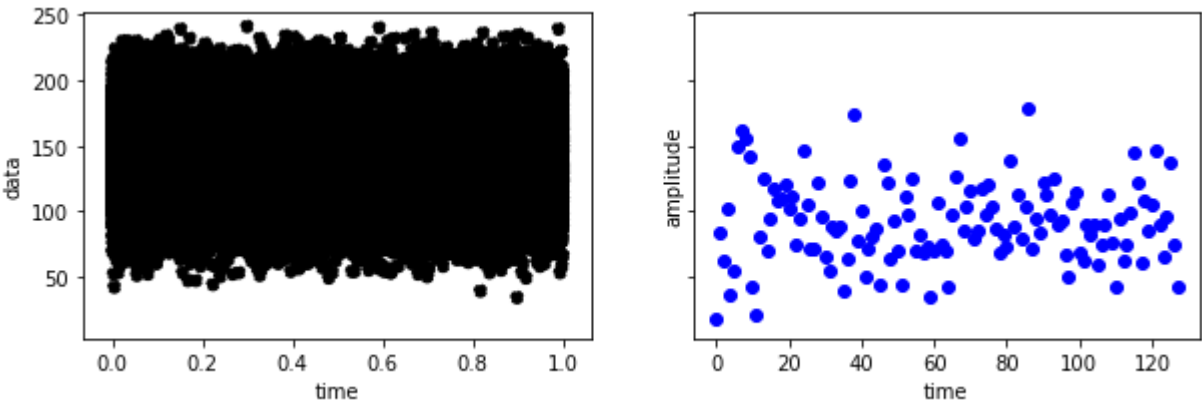
time: 7.9847092628479
moduleID : 2 stripID : 254 axisID : 0

change detect level : 0



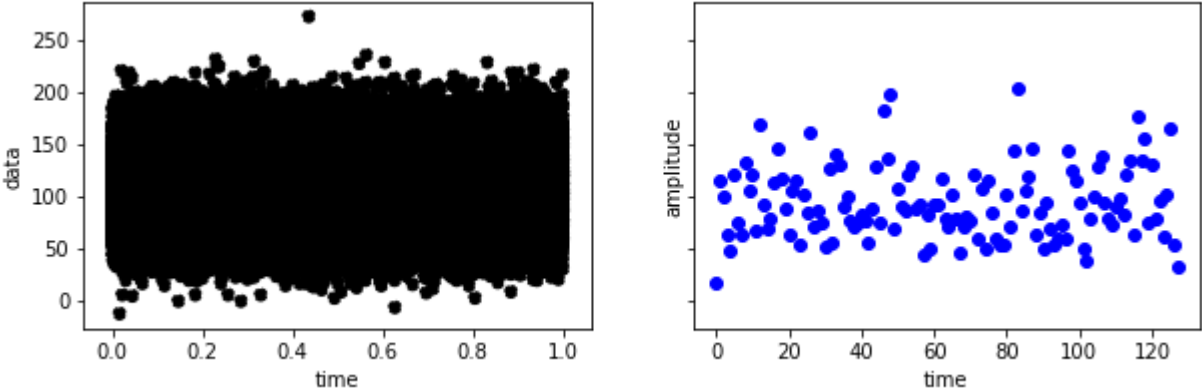
time: 7.862605094909668
moduleID : 2 stripID : 254 axisID : 1

change detect level : 0



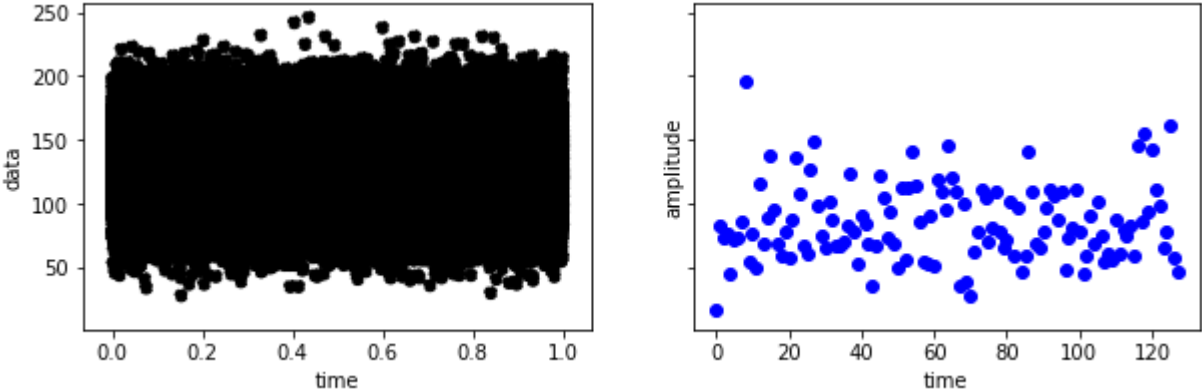
time: 7.879199743270874
moduleID : 3 stripID : 248 axisID : 1

change detect level : 0



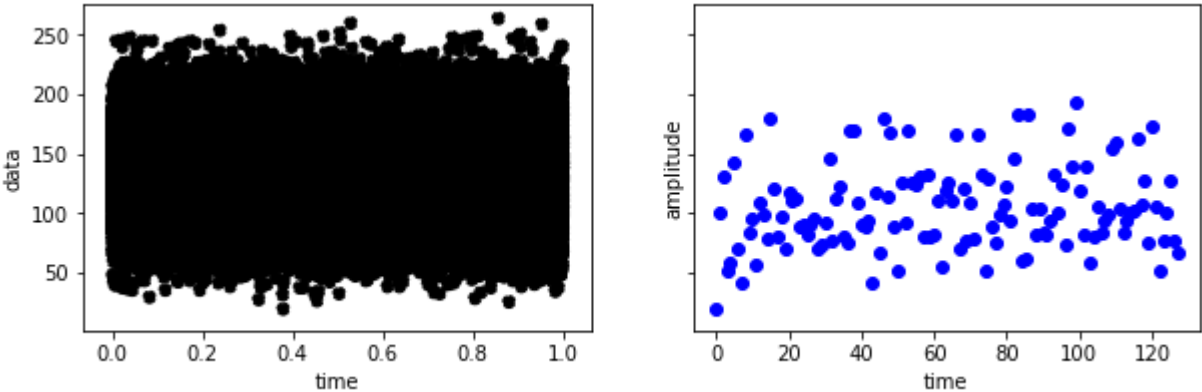
time: 8.085707664489746
moduleID : 3 stripID : 250 axisID : 1

change detect level : 0



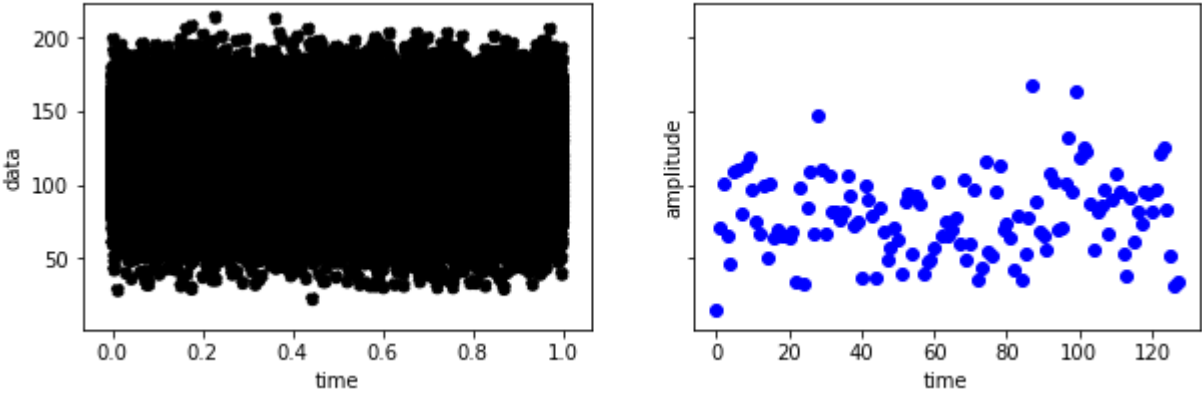
time: 8.058065176010132
moduleID : 3 stripID : 252 axisID : 1

change detect level : 0



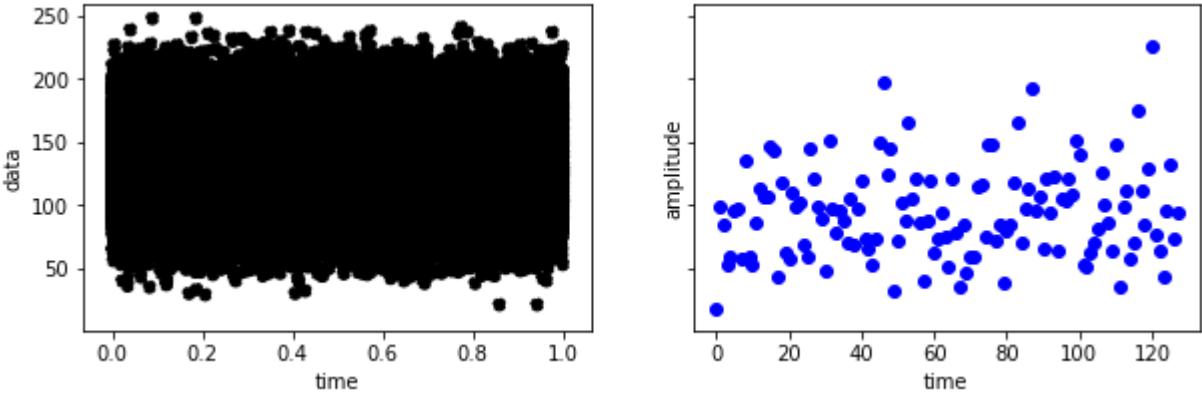
time: 38.48317241668701
moduleID : 3 stripID : 254 axisID : 0

change detect level : 0



time: 7.762851238250732
moduleID : 3 stripID : 254 axisID : 1

change detect level : 0



time: 7.76725172996521

In []: