LOADING STEADY POSITION DATA WITH SINGLE STAND

In [1]:

```python
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import os
#--------------------------------LOADING DATA----------------------------------------------
-----------
os.getcwd()
os.chdir('C:\\Users\\Serving Minds\\Desktop\\Exa-mobility')
df=pd.read_csv('steady position with single stand.csv')
df.head()
```

Out[1]:

	raw_ax	raw_ay	raw_az	cal_ax	cal_ay	cal_az	raw_gx	raw_gy	raw_gz	cal_gx	...	filtered_my	filtered_mz	time_sec
0	491.0	1047.0	16818.0	0.029968	0.063904	1.026489	181.0	348.0	57.0	0.011047	...	-0.324943	-0.930326	1
1	450.0	1000.0	16739.0	0.027466	0.061035	1.021667	177.0	341.0	73.0	0.010803	...	-0.342173	-0.925590	1
2	508.0	1022.0	16803.0	0.031006	0.062378	1.025574	179.0	346.0	56.0	0.010925	...	-0.358125	-0.921371	2
3	466.0	1013.0	16760.0	0.028442	0.061829	1.022949	170.0	350.0	47.0	0.010376	...	-0.348576	-0.923586	2
4	456.0	969.0	16747.0	0.027832	0.059143	1.022156	189.0	355.0	48.0	0.011536	...	-0.298063	-0.938176	2

5 rows × 35 columns

In [3]:

```python
df.dtypes
```

Out[3]:

```
raw_ax        float64
 raw_ay        float64
 raw_az        float64
 cal_ax        float64
 cal_ay        float64
 cal_az        float64
 raw_gx        float64
 raw_gy        float64
 raw_gz        float64
 cal_gx        float64
 cal_gy        float64
 cal_gz        float64
 raw_mx        float64
 raw_my        float64
 raw_mz        float64
 cal_mx        float64
 cal_my        float64
 cal_mz        float64
filtered_ax    float64
filtered_ay    float64
filtered_az    float64
filtered_gx    float64
filtered_gy    float64
filtered_gz    float64
filtered_mx    float64
filtered_my    float64
filtered_mz    float64
time_sec        int64
 yaw           float64
 pitch         float64
 roll          float64
```

```
 linearAccX     float64
linearAccY     float64
linearAccZ     float64
timed          float64
dtype: object
```

```
ax=df.iloc[:,-17]
t=df.iloc[:,-8]
ay=df.iloc[:,-16]
az=df.iloc[:,-15]
```

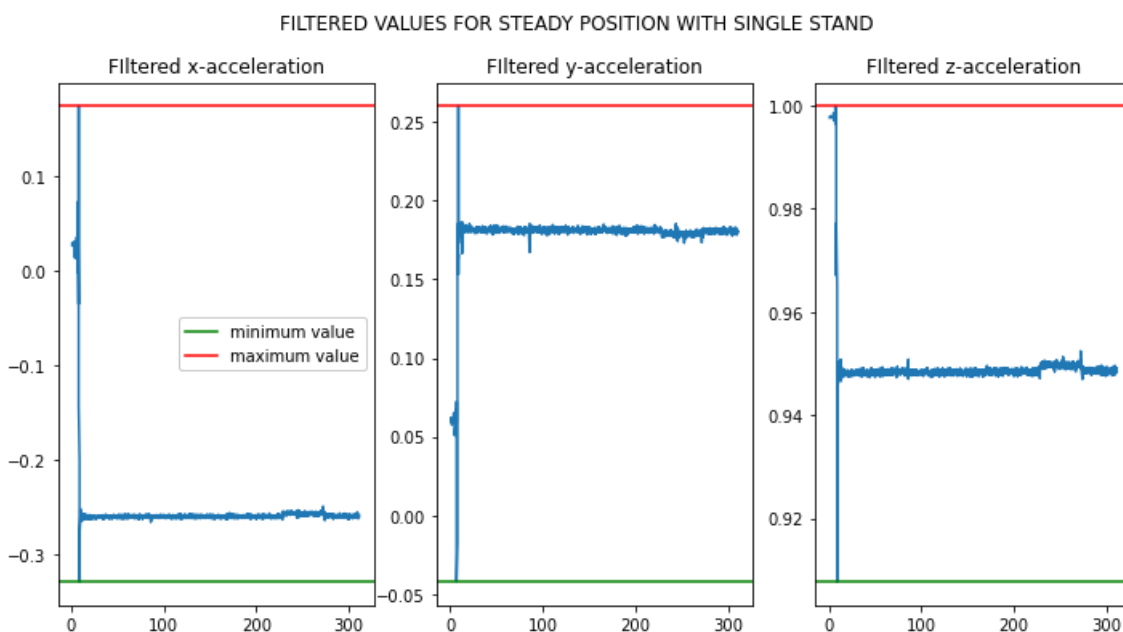# FILTERED ACCELERATION VALUES FOR STEADY POSITION WITH SINGLE STAND

```
plt.figure(figsize = (12,6))
plt.subplot(131)
plt.suptitle('FILTERED VALUES FOR STEADY POSITION WITH SINGLE STAND')
plt.plot(t,ax)
plt.axhline(y=np.min(ax),label='minimum value',color="green")
plt.axhline(y=np.max(ax),label='maximum value',color="red")
plt.title('FIltered x-acceleration')
plt.xlabel("Time(in seconds)")
plt.legend(framealpha=1, frameon=True)
plt.subplot(132)
plt.plot(t,ay)
plt.axhline(y=np.min(ay),label='minimum value',color="green")
plt.axhline(y=np.max(ay),label='maximum value',color="red")
plt.title('FIltered y-acceleration')
plt.xlabel("Time(in seconds)")

plt.subplot(133)
plt.plot(t,az)
plt.axhline(y=np.min(az),label='minimum value',color="green")
plt.axhline(y=np.max(az),label='maximum value',color="red")
plt.title('FIltered z-acceleration')
plt.xlabel("Time(in seconds)")
```

```
Text(0.5, 1.0, 'FIltered z-acceleration')
```


FILTERED VALUES FOR STEADY POSITION WITH SINGLE STAND

RAW-PITCH-ROLL FOR STEADY POSITION WITH SINGLE STAND

In [22]:

```python
roll=df.iloc[:,-5]
pitch=df.iloc[:,-6]
yaw=df.iloc[:,-7]
```

In [26]:

```python
plt.figure(figsize = (12,6))
plt.subplot(131)
plt.suptitle('ROLL-PITCH-YAW VALUES FOR STEADY POSITION WITH SINGLE STAND')
plt.plot(t,roll)
plt.axhline(y=np.min(roll),label='minimum_value',color="green")
plt.axhline(y=np.max(roll),label='maximum value',color="red")
plt.xlabel("Time(in seconds)")
plt.legend(framealpha=1, frameon=True)
plt.title('Roll values')
plt.subplot(132)
plt.plot(t,pitch)
plt.axhline(y=np.min(pitch),label='minimum_value',color="green")
plt.axhline(y=np.max(pitch),label='maximum value',color="red")
plt.xlabel("Time(in seconds)")
plt.title('Pitch values')
plt.subplot(133)
plt.plot(t,yaw)
plt.axhline(y=np.min(yaw),label='minimum_value',color="green")
plt.axhline(y=np.max(yaw),label='maximum value',color="red")
plt.xlabel("Time(in seconds)")
plt.title('Yaw values')
```

Out[26]:

```
Text(0.5, 1.0, 'Yaw values')
```


Loading Steady State data with double stand

In [8]:

```python
df1=pd.read_csv('steady position with double stand.csv')
df1.head()
```

`Out[8]:`

	raw_ax	raw_ay	raw_az	cal_ax	cal_ay	cal_az	raw_gx	raw_gy	raw_gz	cal_gx	...	filtered_my	filtered_mz	time_sec
0	491.0	1047.0	16818.0	0.029968	0.063904	1.026489	181.0	348.0	57.0	0.011047	...	-0.324943	-0.930326	1
1	450.0	1000.0	16739.0	0.027466	0.061035	1.021667	177.0	341.0	73.0	0.010803	...	-0.342173	-0.925590	1
2	508.0	1022.0	16803.0	0.031006	0.062378	1.025574	179.0	346.0	56.0	0.010925	...	-0.358125	-0.921371	2
3	466.0	1013.0	16760.0	0.028442	0.061829	1.022949	170.0	350.0	47.0	0.010376	...	-0.348576	-0.923586	2
4	456.0	969.0	16747.0	0.027832	0.059143	1.022156	189.0	355.0	48.0	0.011536	...	-0.298063	-0.938176	2

5 rows × 35 columns

`In [29]:`

```
df1.dtypes
```

`Out[29]:`

```
raw_ax         float64
 raw_ay        float64
 raw_az        float64
 cal_ax        float64
 cal_ay        float64
 cal_az        float64
 raw_gx        float64
 raw_gy        float64
 raw_gz        float64
 cal_gx        float64
 cal_gy        float64
 cal_gz        float64
 raw_mx        float64
 raw_my        float64
 raw_mz        float64
 cal_mx        float64
 cal_my        float64
 cal_mz        float64
filtered_ax    float64
filtered_ay    float64
filtered_az    float64
filtered_gx    float64
filtered_gy    float64
filtered_gz    float64
filtered_mx    float64
filtered_my    float64
filtered_mz    float64
time_sec         int64
 yaw           float64
 pitch         float64
 roll          float64
 linearAccX    float64
linearAccY     float64
linearAccZ     float64
timed          float64
dtype: object
```

`In [10]:`

```
ax1=df1.iloc[:,-17]
t=df1.iloc[:,-8]
ay1=df1.iloc[:,-16]
az1=df1.iloc[:,-15]
```

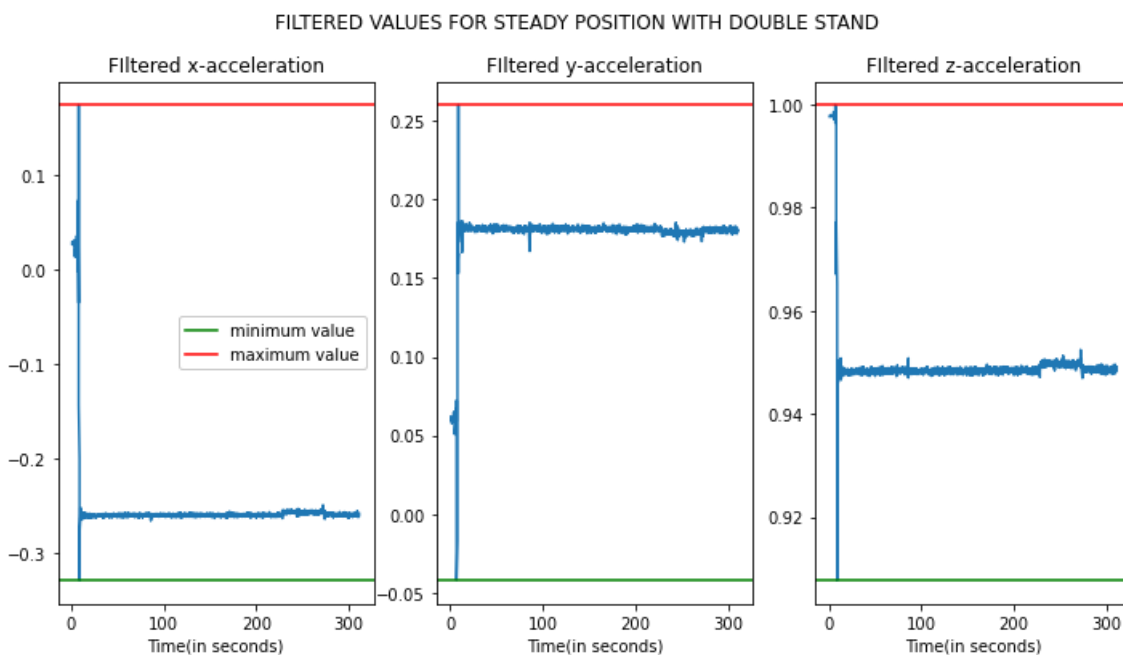# FILTERED ACCELERATION VALUES FOR DOUBLE STAND

```
plt.figure(figsize = (12,6))
plt.subplot(131)
plt.suptitle('FILTERED VALUES FOR STEADY POSITION WITH DOUBLE STAND')
plt.plot(t,ax1)
plt.axhline(y=np.min(ax1),label='minimum value',color="green")
plt.axhline(y=np.max(ax1),label='maximum value',color="red")
plt.title('FIltered x-acceleration')
plt.xlabel("Time(in seconds)")
plt.legend(framealpha=1, frameon=True)
plt.subplot(132)
plt.plot(t,ay1)
plt.axhline(y=np.min(ay1),label='minimum value',color="green")
plt.axhline(y=np.max(ay1),label='maximum value',color="red")
plt.title('FIltered y-acceleration')
plt.xlabel("Time(in seconds)")

plt.subplot(133)
plt.plot(t,az1)
plt.axhline(y=np.min(az1),label='minimum value',color="green")
plt.axhline(y=np.max(az1),label='maximum value',color="red")
plt.title('FIltered z-acceleration')
plt.xlabel("Time(in seconds)")
```

```
Text(0.5, 0, 'Time(in seconds)')
```


FILTERED VALUES FOR STEADY POSITION WITH DOUBLE STAND

RAW-PITCH-ROLL VALUES FOR DOUBLE STAND

```
roll1=df1.iloc[:,-5]
pitch1=df1.iloc[:,-6]
yaw1=df1.iloc[:,-7]
```

```
plt.figure(figsize = (12,6))
plt.subplot(131)
plt.suptitle('ROLL-PITCH-YAW VALUES FOR STEADY POSITION WITH DOUBLE STAND')
plt.plot(t,roll1)
plt.axhline(y=np.min(roll1),label='minimum_value',color="green")
plt.axhline(y=np.max(roll1),label='maximum value',color="red")
plt.xlabel("TIme(in seconds)")
plt.legend(framealpha=1, frameon=True)
```

```
plt.legend(framealpha=1, frameon=True)
plt.title('Roll values')
plt.subplot(132)
plt.plot(t,pitch1)
plt.axhline(y=np.min(pitch1),label='minimum_value',color="green")
plt.axhline(y=np.max(pitch1),label='maximum value',color="red")
plt.xlabel("Time(in seconds)")
plt.title('Pitch values')
plt.subplot(133)
plt.plot(t,yaw1)
plt.axhline(y=np.min(yaw1),label='minimum_value',color="green")
plt.axhline(y=np.max(yaw1),label='maximum value',color="red")
plt.xlabel("Time(in seconds)")
plt.title('Yaw values')
```

Out[76]:

```
Text(0.5, 1.0, 'Yaw values')
```


ROLL-PITCH-YAW VALUES FOR STEADY POSITION WITH DOUBLE STAND

Loading fast tilt movement data

In [12]:

```
df2=pd.read_csv('fast tilt.csv')
df2.head()
```

Out[12]:

	raw_ax	raw_ay	raw_az	cal_ax	cal_ay	cal_az	raw_gx	raw_gy	raw_gz	cal_gx	...	filtered_my	filtered_mz	time_sec
0	498.0	440.0	16865.0	0.030396	0.026855	1.029358	172.0	314.0	45.0	0.010498	...	-0.319055	-0.935341	1
1	517.0	447.0	16730.0	0.031555	0.027283	1.021118	182.0	344.0	49.0	0.011108	...	-0.360338	-0.916462	1
2	521.0	456.0	16785.0	0.031799	0.027832	1.024475	190.0	338.0	62.0	0.011597	...	-0.345148	-0.925143	2
3	520.0	463.0	16815.0	0.031738	0.028259	1.026306	184.0	366.0	57.0	0.011230	...	-0.315051	-0.934555	2
4	488.0	462.0	16737.0	0.029785	0.028198	1.021545	159.0	307.0	54.0	0.009705	...	-0.331199	-0.925835	2

5 rows × 35 columns

FILTERED ACCELERATION VALUES FOR FAST TILT

```
ax2=df2.iloc[:,-17]
t=df2.iloc[:,-8]
ay2=df2.iloc[:,-16]
az2=df2.iloc[:,-15]
```
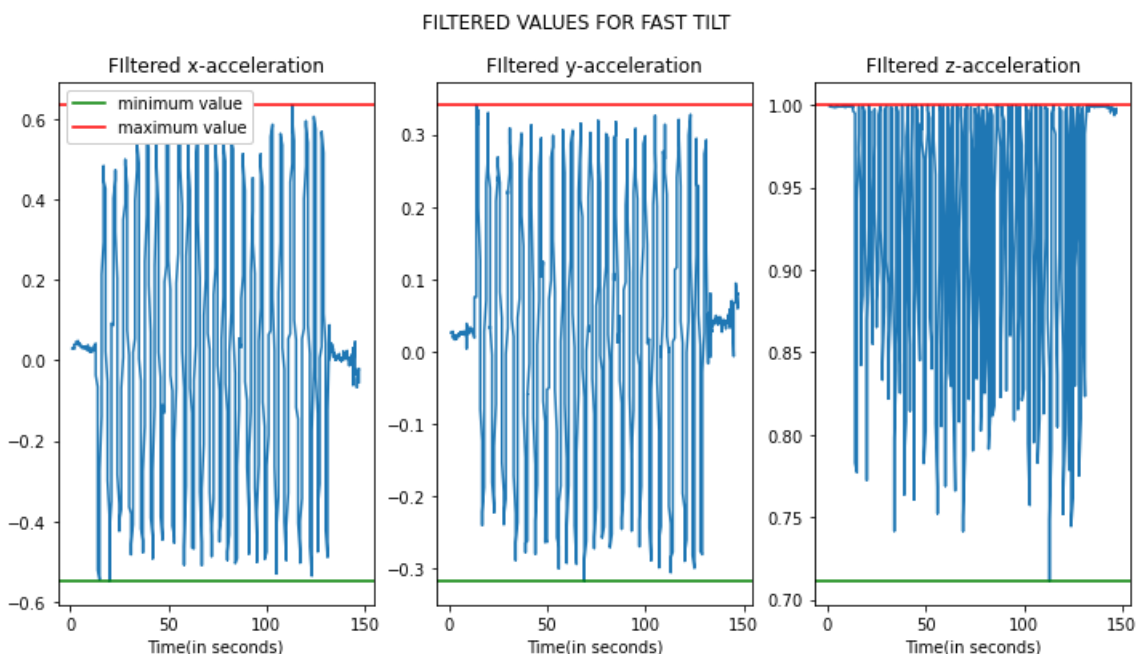
```
plt.figure(figsize = (12,6))
plt.subplot(131)
plt.suptitle('FILTERED VALUES FOR FAST TILT')
plt.plot(t,ax2)
plt.axhline(y=np.min(ax2),label='minimum value',color="green")
plt.axhline(y=np.max(ax2),label='maximum value',color="red")
plt.title('FIltered x-acceleration')
plt.xlabel("Time(in seconds)")
plt.legend(framealpha=1, frameon=True)
plt.subplot(132)
plt.plot(t,ay2)
plt.axhline(y=np.min(ay2),label='minimum value',color="green")
plt.axhline(y=np.max(ay2),label='maximum value',color="red")
plt.title('FIltered y-acceleration')
plt.xlabel("Time(in seconds)")

plt.subplot(133)
plt.plot(t,az2)
plt.axhline(y=np.min(az2),label='minimum value',color="green")
plt.axhline(y=np.max(az2),label='maximum value',color="red")
plt.title('FIltered z-acceleration')
plt.xlabel("Time(in seconds)")
```

```
Text(0.5, 0, 'Time(in seconds)')
```


RAW-PITCH-YAW VALUES FOR FAST TILT

```
roll2=df.iloc[:,-5]
pitch2=df.iloc[:,-6]
yaw2=df.iloc[:,-7]
t=df.iloc[:,-8]
```

```python
plt.figure(figsize = (12,6))
plt.subplot(131)
plt.suptitle('ROLL-PITCH-YAW VALUES FOR FAST TILT')
plt.plot(t,roll2)
plt.axhline(y=np.min(roll2),label='minimum_value',color="green")
plt.axhline(y=np.max(roll2),label='maximum value',color="red")
plt.xlabel("Time(in seconds)")
plt.legend(framealpha=1, frameon=True)
plt.title('Roll values')
plt.subplot(132)
plt.plot(t,pitch2)
plt.axhline(y=np.min(pitch2),label='minimum_value',color="green")
plt.axhline(y=np.max(pitch2),label='maximum value',color="red")
plt.xlabel("Time(in seconds)")
plt.title('Pitch values')
plt.subplot(133)
plt.plot(t,yaw2)
plt.axhline(y=np.min(yaw2),label='minimum_value',color="green")
plt.axhline(y=np.max(yaw2),label='maximum value',color="red")
plt.xlabel("Time(in seconds)")
plt.title('Yaw values')
```

Out[45]:

```
Text(0.5, 1.0, 'Yaw values')
```
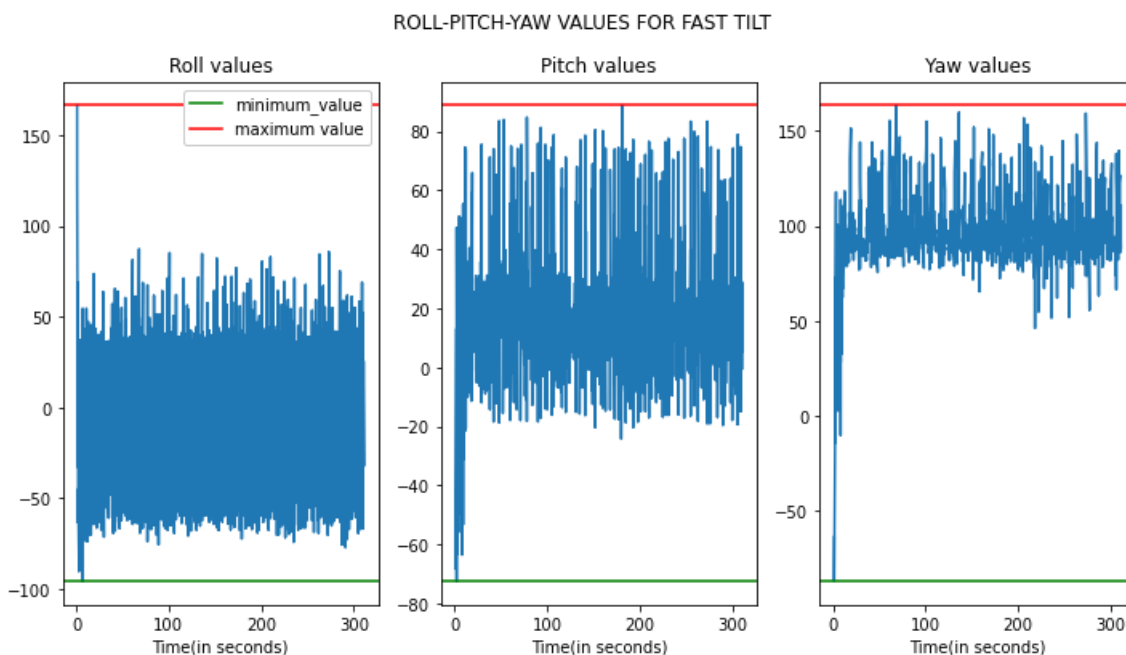

Loading data with slow tilt

In [15]:

```python
df3=pd.read_csv('slow tilt.csv')
df3.head()
```

Out[15]:

	raw_ax	raw_ay	raw_az	cal_ax	cal_ay	cal_az	raw_gx	raw_gy	raw_gz	cal_gx	...	filtered_my	filtered_mz	time_sec
0	-4363.0	3050.0	16079.0	-0.266296	0.186157	0.981384	186.0	352.0	58.0	0.011353	...	-0.312382	-0.934466	1
1	-4414.0	3036.0	16062.0	-0.269409	0.185303	0.980347	171.0	347.0	55.0	0.010437	...	-0.375776	-0.920389	1
2	-4383.0	3070.0	16086.0	-0.267517	0.187378	0.981812	162.0	332.0	69.0	0.009888	...	-0.325195	-0.941223	2

	raw_ax	raw_ay	raw_az	cal_ax	cal_ay	cal_az	raw_gx	raw_gy	raw_gz	cal_gx	:::	filtered_my	filtered_mz	time_sec	
3	-4446.0	3051.0	16112.0	-0.271362	0.186218	0.983398	178.0	347.0	52.0	0.010864	...	-0.363846	-0.927366	2	1
4	-4411.0	3053.0	16018.0	-0.269226	0.186340	0.977661	176.0	361.0	60.0	0.010742	...	-0.395893	-0.910471	2	1

5 rows × 35 columns

In [16]:

```python
ax3=df3.iloc[:,-17]
t=df3.iloc[:,-8]
ay3=df3.iloc[:,-16]
az3=df3.iloc[:,-15]
```
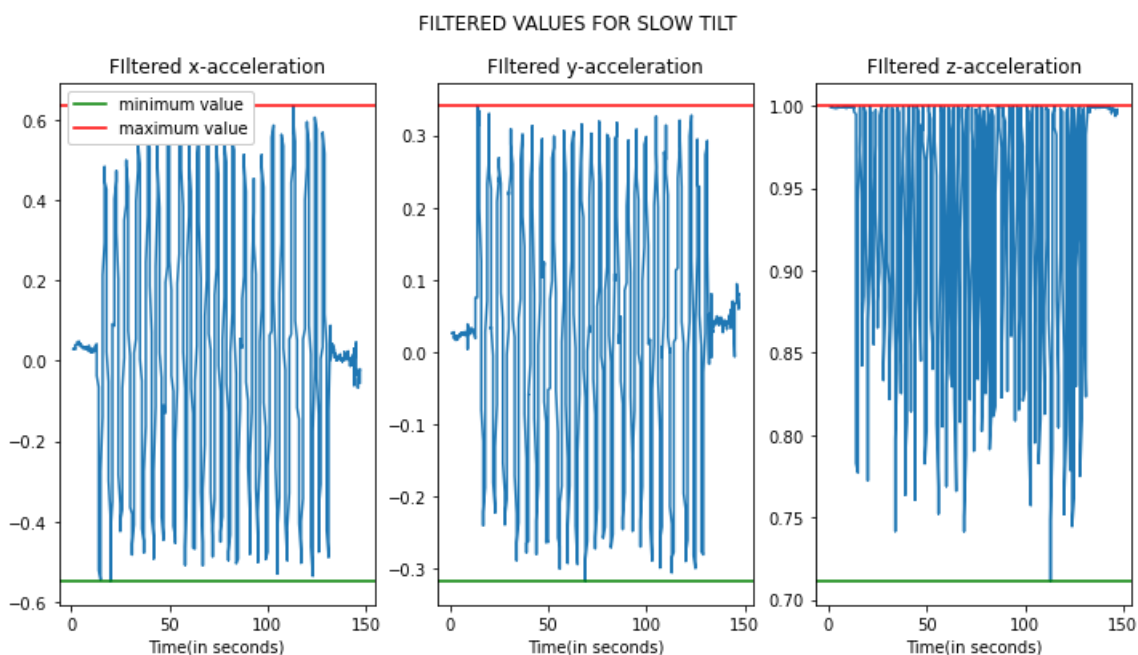
In [70]:

```python
plt.figure(figsize = (12,6))
plt.subplot(131)
plt.suptitle('FILTERED VALUES FOR SLOW TILT')
plt.plot(t,ax3)
plt.axhline(y=np.min(ax3),label='minimum value',color="green")
plt.axhline(y=np.max(ax3),label='maximum value',color="red")
plt.title('FIltered x-acceleration')
plt.xlabel("Time(in seconds)")
plt.legend(framealpha=1, frameon=True)
plt.subplot(132)
plt.plot(t,ay3)
plt.axhline(y=np.min(ay3),label='minimum value',color="green")
plt.axhline(y=np.max(ay3),label='maximum value',color="red")
plt.title('FIltered y-acceleration')
plt.xlabel("Time(in seconds)")

plt.subplot(133)
plt.plot(t,az3)
plt.axhline(y=np.min(az3),label='minimum value',color="green")
plt.axhline(y=np.max(az3),label='maximum value',color="red")
plt.title('FIltered z-acceleration')
plt.xlabel("Time(in seconds)")
```

Out[70]:

```
Text(0.5, 0, 'Time(in seconds)')
```


In [71]:

```python
roll3=df.iloc[:,-5]
pitch3=df.iloc[:,-6]
```

```
yaw3=df.iloc[:,-7]
t=df.iloc[:,-8]
```

RAW-PITCH-YAW VALUES FOR SLOW TILT

In [72]:

```python
plt.figure(figsize = (12,6))
plt.subplot(131)
plt.suptitle('ROLL-PITCH-YAW VALUES FOR FAST TILT')
plt.plot(t,roll3)
plt.axhline(y=np.min(roll3),label='minimum_value',color="green")
plt.axhline(y=np.max(roll3),label='maximum value',color="red")
plt.xlabel("Time(in seconds)")
plt.legend(framealpha=1, frameon=True)
plt.title('Roll values')
plt.subplot(132)
plt.plot(t,pitch3)
plt.axhline(y=np.min(pitch3),label='minimum_value',color="green")
plt.axhline(y=np.max(pitch3),label='maximum value',color="red")
plt.xlabel("Time(in seconds)")
plt.title('Pitch values')
plt.subplot(133)
plt.plot(t,yaw3)
plt.axhline(y=np.min(yaw3),label='minimum_value',color="green")
plt.axhline(y=np.max(yaw3),label='maximum value',color="red")
plt.xlabel("Time(in seconds)")
plt.title('Yaw values')
```

Out[72]:

```
Text(0.5, 1.0, 'Yaw values')
```


ROLL-PITCH-YAW VALUES FOR FAST TILT
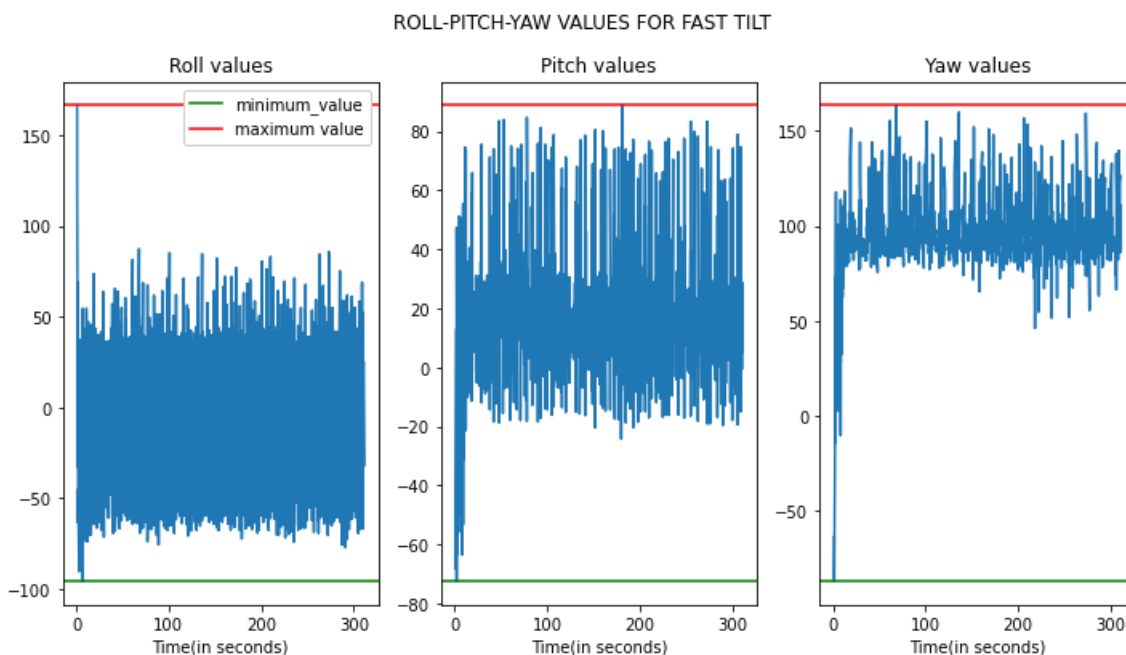
Loading data with bounce movement

In [18]:

```python
df5=pd.read_csv('movement with bump.csv')
df5.head()
```

Out[18]:

| raw_ax | raw_ay | raw_az | cal_ax | cal_ay | cal_az | raw_gx | raw_gy | raw_gz | cal_gx | ... | filtered_my | filtered_mz | time_sec |

	raw_ax	raw_ay	raw_az	cal_ax	cal_ay	cal_az	raw_gx	raw_gy	raw_gz	cal_gx	...	filtered_my	filtered_mz	time_sec	
0	288.0	693.0	16758.0	0.017578	0.042297	1.022827	205.0	383.0	42.0	0.012512	...	-0.356393	-0.920520	1	6
1	196.0	698.0	16792.0	0.011963	0.042603	1.024902	248.0	470.0	49.0	0.015137	...	-0.362713	-0.918442	1	9
2	167.0	756.0	16750.0	0.010193	0.046143	1.022339	260.0	513.0	45.0	0.015869	...	-0.357030	-0.922165	2	
3	91.0	750.0	16825.0	0.005554	0.045776	1.026917	279.0	528.0	49.0	0.017029	...	-0.366692	-0.915061	2	1
4	1.0	830.0	16851.0	0.000061	0.050659	1.028503	257.0	469.0	52.0	0.015686	...	-0.300256	-0.935473	2	1

5 rows × 35 columns

In [19]:

```python
ax4=df5.iloc[:,-17]
t=df5.iloc[:,-8]
ay4=df5.iloc[:,-16]
az4=df5.iloc[:,-15]
```
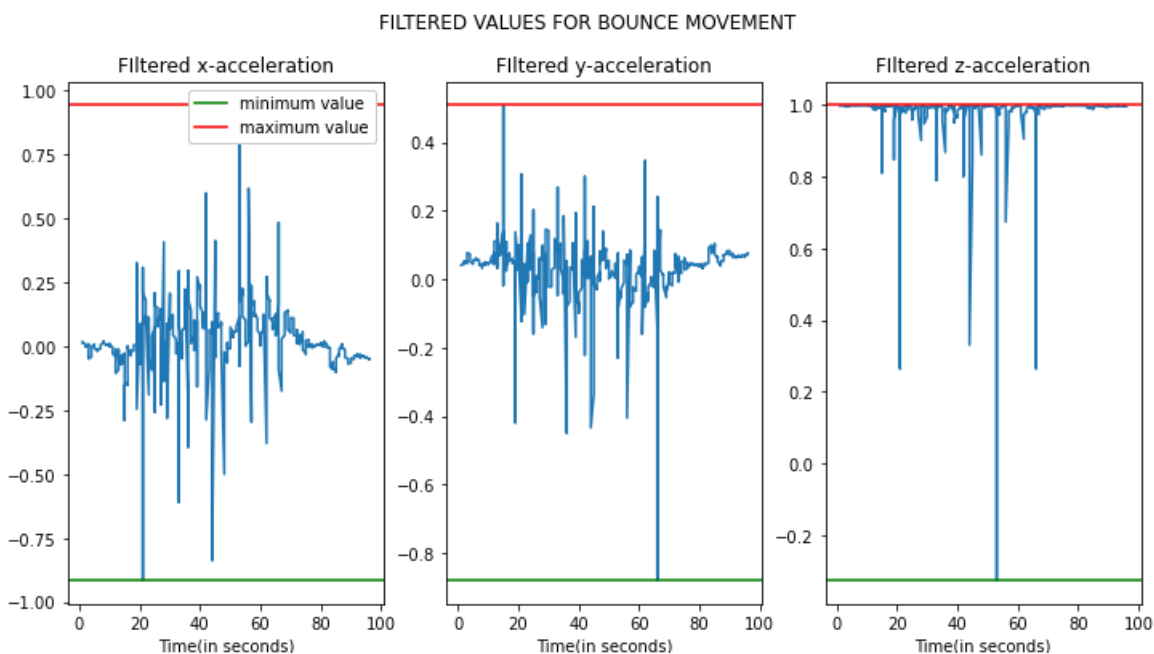
In [53]:

```python
plt.figure(figsize = (12,6))
plt.subplot(131)
plt.suptitle('FILTERED VALUES FOR BOUNCE MOVEMENT')
plt.plot(t,ax4)
plt.axhline(y=np.min(ax4),label='minimum value',color="green")
plt.axhline(y=np.max(ax4),label='maximum value',color="red")
plt.title('FIltered x-acceleration')
plt.xlabel("Time(in seconds)")
plt.legend(framealpha=1, frameon=True)
plt.subplot(132)
plt.plot(t,ay4)
plt.axhline(y=np.min(ay4),label='minimum value',color="green")
plt.axhline(y=np.max(ay4),label='maximum value',color="red")
plt.title('FIltered y-acceleration')
plt.xlabel("Time(in seconds)")

plt.subplot(133)
plt.plot(t,az4)
plt.axhline(y=np.min(az4),label='minimum value',color="green")
plt.axhline(y=np.max(az4),label='maximum value',color="red")
plt.title('FIltered z-acceleration')
plt.xlabel("Time(in seconds)")
```

Out[53]:

Text(0.5, 0, 'Time(in seconds)')

# PITCH-ROLL-YAW MOVEMENT FOR BOUNCE MOVEMENT

In [54]:

```
roll4=df5.iloc[:,-5]
pitch4=df5.iloc[:,-6]
yaw4=df5.iloc[:,-7]
t=df5.iloc[:,-8]
```

In [55]:

```python
plt.figure(figsize = (12,6))
plt.subplot(131)
plt.suptitle('ROLL-PITCH-YAW VALUES FOR BOUNCE MOVEMENT')
plt.plot(t,roll4)
plt.axhline(y=np.min(roll4),label='minimum_value',color="green")
plt.axhline(y=np.max(roll4),label='maximum value',color="red")
plt.xlabel("Time(in seconds)")
plt.legend(framealpha=1, frameon=True)
plt.title('Roll values')
plt.subplot(132)
plt.plot(t,pitch4)
plt.axhline(y=np.min(pitch4),label='minimum_value',color="green")
plt.axhline(y=np.max(pitch4),label='maximum value',color="red")
plt.xlabel("Time(in seconds)")
plt.title('Pitch values')
plt.subplot(133)
plt.plot(t,yaw4)
plt.axhline(y=np.min(yaw4),label='minimum_value',color="green")
plt.axhline(y=np.max(yaw4),label='maximum value',color="red")
plt.xlabel("Time(in seconds)")
plt.title('Yaw values')
```

Out[55]:

```
Text(0.5, 1.0, 'Yaw values')
```


ROLL-PITCH-YAW VALUES FOR BOUNCE MOVEMENT
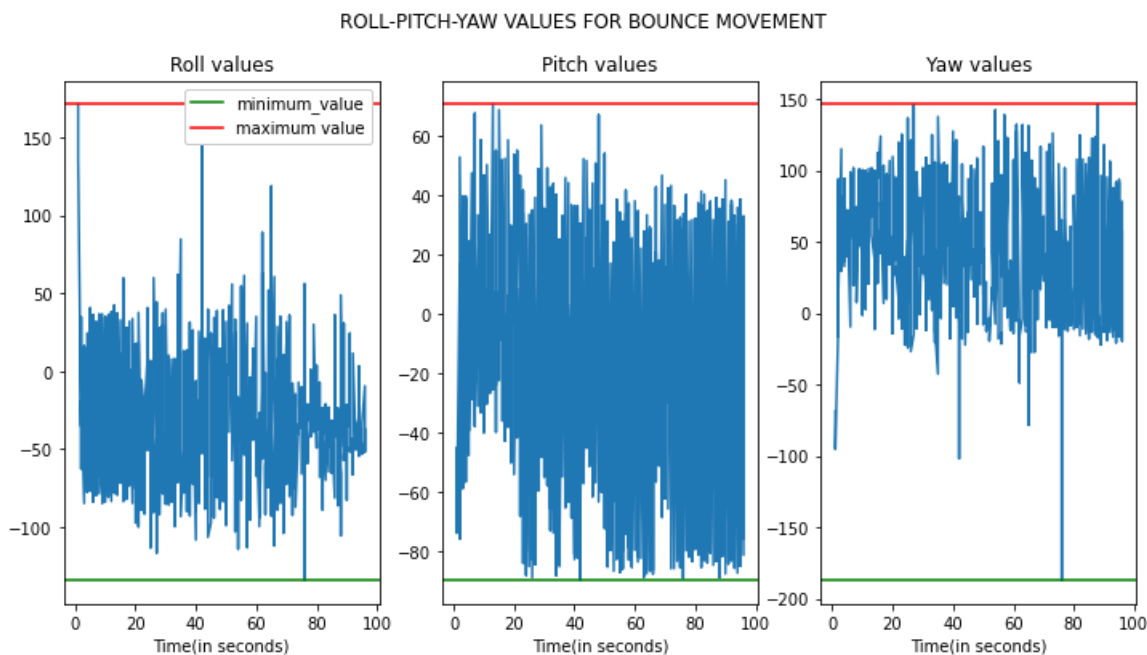
Final summary table for thresholds

1)Single stand

```
data={'parameters':
['Fil_acc_x','Fil_acc_y','Fil_acc_z','Fil_gy_x','Fil_gy_y','Fil_gy_z','Fil_mg_x','Fil_mg_y','Fil_mg
_z','Pitch','Roll','Yaw'],
    'Min_value':[np.min(ax),np.min(ay),np.min(az),np.min(df.iloc[-14]),np.min(df.iloc[-13]),np.min
(df.iloc[-12]),np.min(df.iloc[-11]),np.min(df.iloc[-10]),np.min(df.iloc[-9]),np.min(df.iloc[-5]),np
.min(df.iloc[-6]),np.min(df.iloc[-7])],
    'Max_value':[np.max(ax),np.max(ay),np.max(az),np.max(df.iloc[-14]),np.max(df.iloc[-13]),np.max
(df.iloc[-12]),np.max(df.iloc[-11]),np.max(df.iloc[-10]),np.max(df.iloc[-9]),np.max(df.iloc[-5]),np
.max(df.iloc[-6]),np.max(df.iloc[-7])]}
my_data=pd.DataFrame(data,columns=['parameters','Min_value','Max_value'])
print(my_data)
```

```
    parameters    Min_value      Max_value
0   Fil_acc_x    -0.329236       0.174783
1   Fil_acc_y    -0.041991       0.260015
2   Fil_acc_z     0.907742       0.999851
3    Fil_gy_x -4379.000000   16122.000000
4    Fil_gy_y -4374.000000   16058.000000
5    Fil_gy_z -4408.000000   16040.000000
6    Fil_mg_x -4415.000000   16040.000000
7    Fil_mg_y -4411.000000   16012.000000
8    Fil_mg_z -4349.000000   16131.000000
9       Pitch -4386.000000   16026.000000
10       Roll -4390.000000   16079.000000
11        Yaw -4441.000000   16032.000000
```

2)DOUBLE STAND

```
data1={'parameters':
['Fil_acc_x','Fil_acc_y','Fil_acc_z','Fil_gy_x','Fil_gy_y','Fil_gy_z','Fil_mg_x','Fil_mg_y','Fil_mg
_z','Pitch','Roll','Yaw'],
    'Min_value':[np.min(ax1),np.min(ay1),np.min(az1),np.min(df1.iloc[-14]),np.min(df1.iloc[-13]),n
p.min(df1.iloc[-12]),np.min(df1.iloc[-11]),np.min(df1.iloc[-10]),np.min(df1.iloc[-9]),np.min(df1.il
oc[-5]),np.min(df1.iloc[-6]),np.min(df1.iloc[-7])],
    'Max_value':[np.max(ax1),np.max(ay1),np.max(az1),np.max(df1.iloc[-14]),np.max(df1.iloc[-13]),n
p.max(df1.iloc[-12]),np.max(df1.iloc[-11]),np.max(df1.iloc[-10]),np.max(df1.iloc[-9]),np.max(df1.il
oc[-5]),np.max(df1.iloc[-6]),np.max(df1.iloc[-7])]}
my_data1=pd.DataFrame(data1,columns=['parameters','Min_value','Max_value'])
print(my_data1)
```

```
    parameters    Min_value      Max_value
0   Fil_acc_x    -0.329236       0.174783
1   Fil_acc_y    -0.041991       0.260015
2   Fil_acc_z     0.907742       0.999851
3    Fil_gy_x -4379.000000   16122.000000
4    Fil_gy_y -4374.000000   16058.000000
5    Fil_gy_z -4408.000000   16040.000000
6    Fil_mg_x -4415.000000   16040.000000
7    Fil_mg_y -4411.000000   16012.000000
8    Fil_mg_z -4349.000000   16131.000000
9       Pitch -4386.000000   16026.000000
10       Roll -4390.000000   16079.000000
11        Yaw -4441.000000   16032.000000
```

3)Fast tilt

```
data2={'parameters':
['Fil_acc_x','Fil_acc_y','Fil_acc_z','Fil_gy_x','Fil_gy_y','Fil_gy_z','Fil_mg_x','Fil_mg_y','Fil_mg
_z','Pitch','Roll','Yaw'],
    'Min_value':[np.min(ax2),np.min(ay2),np.min(az2),np.min(df2.iloc[-14]),np.min(df2.iloc[-13]),n
p.min(df2.iloc[-12]),np.min(df2.iloc[-11]),np.min(df2.iloc[-10]),np.min(df2.iloc[-9]),np.min(df2.il
oc[-5]),np.min(df2.iloc[-6]),np.min(df2.iloc[-7])],
    'Max_value':[np.max(ax2),np.max(ay2),np.max(az2),np.max(df2.iloc[-14]),np.max(df2.iloc[-13]),n
p.max(df2.iloc[-12]),np.max(df2.iloc[-11]),np.max(df2.iloc[-10]),np.max(df2.iloc[-9]),np.max(df2.il
```

```
oc[-5]),np.max(df2.iloc[-6]),np.max(df2.iloc[-7])]}
my_data2=pd.DataFrame(data2,columns=['parameters','Min_value','Max_value'])
print(my_data2)
```

```
    parameters    Min_value     Max_value
0    Fil_acc_x    -0.547649      0.633391
1    Fil_acc_y    -0.316619      0.340192
2    Fil_acc_z     0.711336      0.999829
3     Fil_gy_x  -580.000000  16733.000000
4     Fil_gy_y  -438.000000  16867.000000
5     Fil_gy_z  -500.000000  16829.000000
6     Fil_mg_x  -485.000000  16739.000000
7     Fil_mg_y  -388.000000  16822.000000
8     Fil_mg_z -1025.000000  16916.000000
9        Pitch  -785.000000  16961.000000
10        Roll  -815.000000  16764.000000
11         Yaw  -978.000000  16745.000000
```

4)Slow tilt

In [17]:

```
data3={'parameters':
['Fil_acc_x','Fil_acc_y','Fil_acc_z','Fil_gy_x','Fil_gy_y','Fil_gy_z','Fil_mg_x','Fil_mg_y','Fil_mg
_z','Pitch','Roll','Yaw'],
     'Min_value':[np.min(ax3),np.min(ay3),np.min(az3),np.min(df3.iloc[-14]),np.min(df3.iloc[-13]),n
p.min(df3.iloc[-12]),np.min(df3.iloc[-11]),np.min(df3.iloc[-10]),np.min(df3.iloc[-9]),np.min(df3.il
oc[-5]),np.min(df3.iloc[-6]),np.min(df3.iloc[-7])],
     'Max_value':[np.max(ax3),np.max(ay3),np.max(az3),np.max(df3.iloc[-14]),np.max(df3.iloc[-13]),n
p.max(df3.iloc[-12]),np.max(df3.iloc[-11]),np.max(df3.iloc[-10]),np.max(df3.iloc[-9]),np.max(df3.il
oc[-5]),np.max(df3.iloc[-6]),np.max(df3.iloc[-7])]}
my_data3=pd.DataFrame(data3,columns=['parameters','Min_value','Max_value'])
print(my_data3)
```

```
    parameters    Min_value     Max_value
0    Fil_acc_x    -0.588640      0.632457
1    Fil_acc_y    -0.312108      0.361075
2    Fil_acc_z     0.710562      0.999873
3     Fil_gy_x  -281.498047  16784.000000
4     Fil_gy_y  -286.714630  16748.000000
5     Fil_gy_z  -284.975769  16831.000000
6     Fil_mg_x  -278.020294  16825.000000
7     Fil_mg_y  -297.147858  16797.000000
8     Fil_mg_z  -286.714630  16805.000000
9        Pitch  -295.408966  16839.000000
10        Roll  -281.498047  16834.000000
11         Yaw  -288.453522  16803.000000
```

5)Bounce movement

In [21]:

```
data4={'parameters':
['Fil_acc_x','Fil_acc_y','Fil_acc_z','Fil_gy_x','Fil_gy_y','Fil_gy_z','Fil_mg_x','Fil_mg_y','Fil_mg
_z','Pitch','Roll','Yaw'],
     'Min_value':[np.min(ax4),np.min(ay4),np.min(az4),np.min(df5.iloc[-14]),np.min(df5.iloc[-13]),n
p.min(df5.iloc[-12]),np.min(df5.iloc[-11]),np.min(df5.iloc[-10]),np.min(df5.iloc[-9]),np.min(df5.il
oc[-5]),np.min(df5.iloc[-6]),np.min(df5.iloc[-7])],
     'Max_value':[np.max(ax4),np.max(ay4),np.max(az4),np.max(df5.iloc[-14]),np.max(df5.iloc[-13]),n
p.max(df5.iloc[-12]),np.max(df5.iloc[-11]),np.max(df5.iloc[-10]),np.max(df5.iloc[-9]),np.max(df5.il
oc[-5]),np.max(df5.iloc[-6]),np.max(df5.iloc[-7])]}
my_data4=pd.DataFrame(data4,columns=['parameters','Min_value','Max_value'])
print(my_data4)
```

```
    parameters    Min_value     Max_value
0    Fil_acc_x    -0.914135      0.942335
1    Fil_acc_y    -0.878238      0.508022
2    Fil_acc_z    -0.325987      0.999964
3     Fil_gy_x  -620.000000  16767.000000
```

```
4     Fil_gy_y  -620.000000   16796.000000
5     Fil_gy_z  -702.000000   16893.000000
6     Fil_mg_x  -669.000000   16770.000000
7     Fil_mg_y  -731.000000   16794.000000
8     Fil_mg_z  -686.000000   16805.000000
9        Pitch  -740.000000   16797.000000
10        Roll  -697.000000   16763.000000
11         Yaw  -757.000000   16775.000000
```