In [1]:

```
# Delay and sum beamforming using python

import numpy as np
import matplotlib.pyplot as plt
from scipy.signal import hilbert, chirp
import time
f = open("RF_DATA.txt", "r")
data = f.read().split()
```

In [2]:

```
z=[]
for x in data:
    z.append(x.split(",")[-1])
data1=np.array(z)
np.shape(data1)
```

Out[2]:

```
(771200,)
```

In [3]:

```
shape=(6025,128)
RF_input1 =data1.reshape(shape)
np.shape(RF_input1)
```

Out[3]:

```
(6025, 128)
```

In [4]:

```
start_time = time.time()

theta_d                  = 0
N_elements               = 128
pitch                    = 0.30480E-3
c                        = 1540
fs                       = 80E6
lambda_fs                = c/fs
```

In [ ]:

```

```

In [5]:

```
x_axis = []
z_axis = []
for x in np.arange(-19.5E-3, 19.5E-3,  1.5240E-04):
     x_axis.append(x)
for z in np.arange(0e-3, 39.4e-3, 9.625e-06*16):
     z_axis.append(z)

a = (len(z_axis),len(x_axis))
a
```

Out[5]:

```
(256, 256)
```

In [6]:

```
Beamformed_DATA = np.zeros(a)
print(Beamformed_DATA)
```

```
[[0. 0. 0. ... 0. 0. 0.]
 [0. 0. 0. ... 0. 0. 0.]
 [0. 0. 0. ... 0. 0. 0.]
 ...
 [0. 0. 0. ... 0. 0. 0.]
 [0. 0. 0. ... 0. 0. 0.]
 [0. 0. 0. ... 0. 0. 0.]]
```

In [7]:

```
X, Z = np.meshgrid(x_axis, z_axis)

d1=Z
for i in range(128):
        RF_address =  (np.around(np.divide(d1+((Z**2+(X-(i-N_elements/2)*pitc
        RF_input = RF_input1[:,i]
        Beamformed_DATA=  Beamformed_DATA + RF_input[RF_address].astype(np.ir

BF_DATA_MID = 20*np.log10(abs(hilbert(Beamformed_DATA)/np.max(Beamformed_DATA
print(Beamformed_DATA)
stop_time = time.time()
hw_exec_time = stop_time-start_time
print('Executiont time of Ultrasound Beamforming',  hw_exec_time)
plt.imshow(BF_DATA_MID, cmap = 'gray')
plt.colorbar()
plt.show()
```

```
[[ 1123.    69. -2214. ... -2619. -1975.  3186.]
 [-5424.  6932. -5364. ...  1698.  3746. -3852.]
 [ 2451.  -268.  2596. ...  1716. -4110.  2375.]
 ...
 [  -15.   423.   187. ...  -221.   269.   267.]
 [   34.  -289.   558. ...   137.  -288.    35.]
 [ -278.  -483.  -425. ...  -749.  -702.  -692.]]
Executiont time of Ultrasound Beamforming 45.76479625701904
```