In [2]:
```
import numpy as np
import matplotlib.pyplot as plt
from scipy.signal import hilbert, chirp
import time
```

In [3]:
```
import scipy.io
mat = scipy.io.loadmat(r'C:\Users\Block-03-EE\Desktop\Matlab\frame1.mat')
```

In [4]:
```
mat.keys()
RF_input1 = mat['FRAME1']
```

In [5]:
```
type(mat['FRAME1'])
```

Out[5]:
```
numpy.ndarray
```

In [6]:
```
print(np.shape(mat['FRAME1']))
```

```
(6025, 128)
```

In [7]:
```
start_time = time.time()

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

In [8]:
```
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[8]:
```
(256, 256)
```

In [9]:
```
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.]]
```

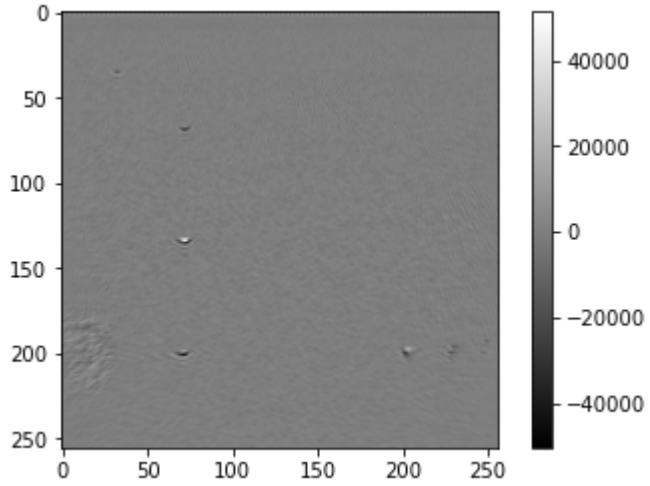
In [10]:
```
X, Z = np.meshgrid(x_axis, z_axis)
np.shape(Z)
```

Out[10]:
```
(256, 256)
```

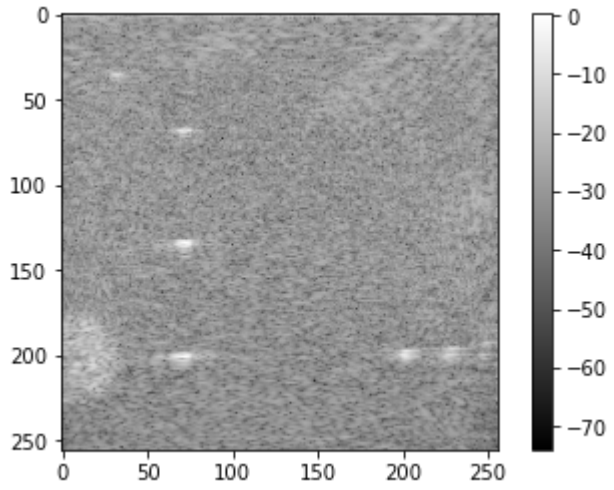
In [11]:
```
X, Z = np.meshgrid(x_axis, z_axis)

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.in

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)
```

```
[[ 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 1.3999638557434082
```

In [12]:
```
plt.imshow(Beamformed_DATA, cmap = 'gray')
plt.colorbar()
plt.show()
```



In [13]:
```
#this is after applying hilbert transform
plt.imshow(BF_DATA_MID, cmap = 'gray')
plt.colorbar()
plt.show()
```



In [ ]:
```

```