```
%reading the audio file
[a fs]=audioread("C:\Users\pooja\Desktop\Cryptography\sig100.wav")
```

```
a = 650000×2
   -0.0283   -0.0127
   -0.0283   -0.0127
   -0.0283   -0.0127
   -0.0283   -0.0127
   -0.0283   -0.0127
   -0.0283   -0.0127
   -0.0283   -0.0127
   -0.0283   -0.0127
   -0.0234   -0.0156
   -0.0264   -0.0156
      :
      :
 fs = 360
```

```
%extracting the first 10 seconds of the audio file
a_cut = a((fs * (10- 1)) + 1 : fs * ( 20- 1), :)
```
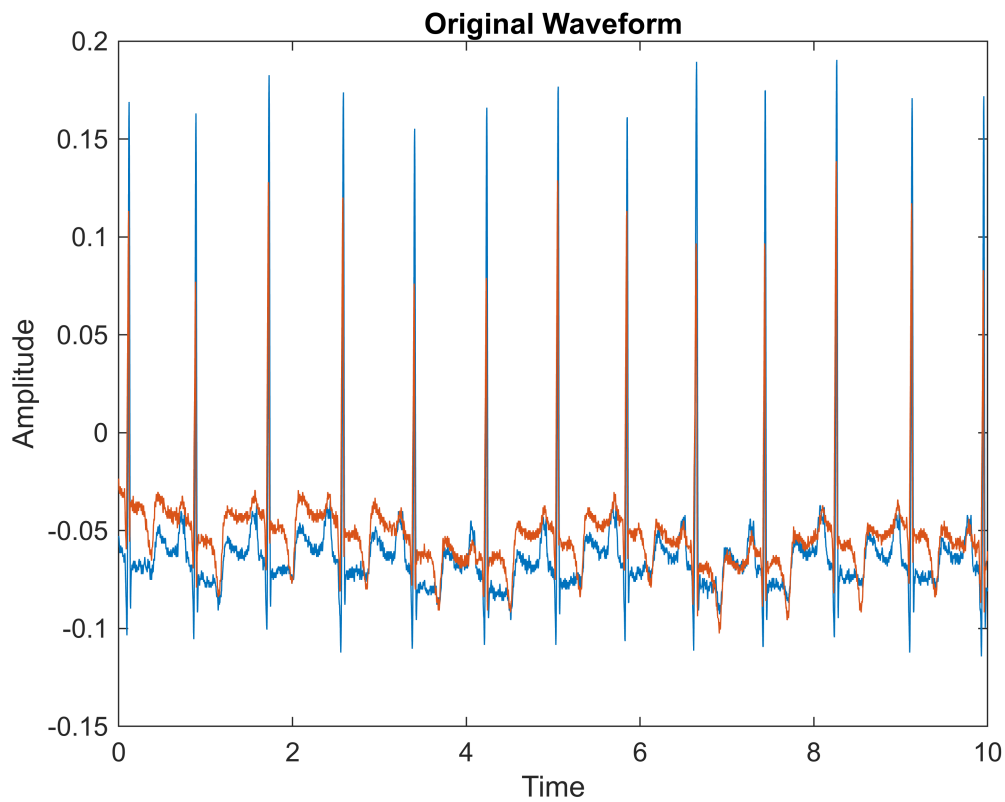
```
a_cut = 3600×2
   -0.0527   -0.0234
   -0.0537   -0.0293
   -0.0557   -0.0293
   -0.0586   -0.0303
   -0.0586   -0.0312
   -0.0615   -0.0283
   -0.0596   -0.0273
   -0.0586   -0.0283
   -0.0576   -0.0283
   -0.0586   -0.0312
      :
      :
```

```
%plotting the original waveform\

t_og=(0:length(a_cut)-1)/fs
```

```
t_og = 1×3600
        0    0.0028    0.0056    0.0083    0.0111    0.0139    0.0167    0.0194 ···
```

```
plot(t_og,a_cut)
title("Original Waveform")
xlabel("Time")
ylabel("Amplitude")
```

Original Waveform

```
     0.2 ┤
          │
    0.15 ┤  │    │    │         │                   │    │
          │  │    │    │    │   │    │    │         │    │         │
     0.1 ┤  │    │    │    │   │    │    │    │     │    │    │    │
          │  │    │    │    │   │    │    │    │     │    │    │    │
    0.05 ┤  │    │    │    │   │    │    │    │     │    │    │    │
          │  │    │    │    │   │    │    │    │     │    │    │    │
       0 ┤  │    │    │    │   │    │    │    │     │    │    │    │
          │
   -0.05 ┤
          │
    -0.1 ┤
          │
   -0.15 ┤
          └──────┬──────┬──────┬──────┬──────┬──────
          0      2      4      6      8     10
                        Time
```

Amplitude (y-axis label)

```
%changing the stereo wav file into a mono stream
a_cut_mono=reshape(a_cut,[],1)
```

```
a_cut_mono = 7200×1
   -0.0527
   -0.0537
   -0.0557
   -0.0586
   -0.0586
   -0.0615
   -0.0596
   -0.0586
   -0.0576
   -0.0586
      ⋮
```

```
%padding zeros to make a square matrix

sq_wave = [a_cut_mono,zeros(7200,7199)]
```

```
sq_wave = 7200×7200
   -0.0527        0        0        0        0        0        0        0 ⋯
   -0.0537        0        0        0        0        0        0        0
   -0.0557        0        0        0        0        0        0        0
   -0.0586        0        0        0        0        0        0        0
```

```
    -0.0586         0         0         0         0         0         0         0
    -0.0615         0         0         0         0         0         0         0
    -0.0596         0         0         0         0         0         0         0
    -0.0586         0         0         0         0         0         0         0
    -0.0576         0         0         0         0         0         0         0
    -0.0586         0         0         0         0         0         0         0
       :
       :
```

```
%generating a random key
key=rand(size(sq_wave))
```

```
key = 7200×7200
    0.0845    0.1199    0.8140    0.3196    0.4824    0.7107    0.2987    0.4227 ···
    0.8110    0.7258    0.0520    0.3673    0.2312    0.0890    0.9526    0.6931
    0.0530    0.7180    0.7528    0.2874    0.8442    0.9179    0.1569    0.6176
    0.6924    0.8738    0.1327    0.1314    0.4626    0.2223    0.1002    0.7889
    0.8188    0.6060    0.7274    0.2010    0.2525    0.9540    0.6166    0.4534
    0.7461    0.3291    0.8545    0.7353    0.4158    0.7500    0.5356    0.5333
    0.1133    0.0050    0.1082    0.4178    0.5545    0.4069    0.2900    0.1366
    0.4565    0.0345    0.1696    0.3338    0.5975    0.9531    0.2813    0.6416
    0.7007    0.6017    0.1694    0.8645    0.8583    0.3083    0.7372    0.0296
    0.4026    0.5243    0.9234    0.8256    0.6298    0.9708    0.0169    0.5592
       :
       :
```

```
%encryption
enc=sq_wave*key
```

```
enc = 7200×7200
   -0.0045   -0.0063   -0.0429   -0.0169   -0.0254   -0.0375   -0.0158   -0.0223 ···
   -0.0045   -0.0064   -0.0437   -0.0172   -0.0259   -0.0382   -0.0160   -0.0227
   -0.0047   -0.0067   -0.0453   -0.0178   -0.0269   -0.0396   -0.0166   -0.0235
   -0.0050   -0.0070   -0.0477   -0.0187   -0.0283   -0.0416   -0.0175   -0.0248
   -0.0050   -0.0070   -0.0477   -0.0187   -0.0283   -0.0416   -0.0175   -0.0248
   -0.0052   -0.0074   -0.0501   -0.0197   -0.0297   -0.0437   -0.0184   -0.0260
   -0.0050   -0.0071   -0.0485   -0.0190   -0.0287   -0.0423   -0.0178   -0.0252
   -0.0050   -0.0070   -0.0477   -0.0187   -0.0283   -0.0416   -0.0175   -0.0248
   -0.0049   -0.0069   -0.0469   -0.0184   -0.0278   -0.0410   -0.0172   -0.0244
   -0.0050   -0.0070   -0.0477   -0.0187   -0.0283   -0.0416   -0.0175   -0.0248
       :
       :
```

```
enc_col=enc(:,1)
```

```
enc_col = 7200×1
   -0.0045
   -0.0045
   -0.0047
   -0.0050
   -0.0050
   -0.0052
   -0.0050
   -0.0050
   -0.0049
   -0.0050
      :
      :
```

```
enc_col=abs(enc_col)
```

```
enc_col = 7200×1
    0.0045
    0.0045
    0.0047
    0.0050
    0.0050
    0.0052
    0.0050
    0.0050
    0.0049
    0.0050
      :
      :
```

```
a_row=enc_col'
```

```
a_row = 1×7200
    0.0045    0.0045    0.0047    0.0050    0.0050    0.0052    0.0050    0.0050 ···
```

```
%reshaping and converting the matrix into a png image
a_square=reshape(a_row,[100,72])
```

```
a_square = 100×72
    0.0045    0.0061    0.0052    0.0059    0.0064    0.0051    0.0054    0.0059 ···
    0.0045    0.0060    0.0053    0.0057    0.0066    0.0054    0.0054    0.0059
    0.0047    0.0059    0.0051    0.0057    0.0066    0.0054    0.0054    0.0057
    0.0050    0.0057    0.0051    0.0058    0.0067    0.0054    0.0055    0.0058
    0.0050    0.0057    0.0050    0.0060    0.0069    0.0051    0.0058    0.0057
    0.0052    0.0057    0.0051    0.0063    0.0069    0.0050    0.0056    0.0059
    0.0050    0.0056    0.0051    0.0067    0.0071    0.0050    0.0057    0.0061
    0.0050    0.0055    0.0053    0.0070    0.0071    0.0053    0.0059    0.0060
    0.0049    0.0054    0.0054    0.0073    0.0070    0.0054    0.0064    0.0059
    0.0050    0.0055    0.0051    0.0078    0.0069    0.0054    0.0070    0.0059
      :
      :
```

```
imwrite(a_square,'C:\Users\pooja\Desktop\Cryptography\hillcipher_wave_png.png')

%reading the png image and converting the pixel values to doubles
a_png=imread('C:\Users\pooja\Desktop\Cryptography\hillcipher_wave_png.png')
```

```
a_png = 100×72 uint8 matrix
   1   2   1   1   2   1   1   2   1   1   2   1   1   2   1   2   2   1   2   2 ···
   1   2   1   1   2   1   1   1   1   1   2   1   1   2   1   2   2   1   1   2
   1   1   1   1   2   1   1   1   1   1   1   1   1   2   1   2   2   1   2   2
   1   1   1   1   2   1   1   1   1   1   1   1   2   2   1   2   2   1   2   2
   1   1   1   2   2   1   1   1   1   1   2   1   2   2   1   2   2   1   2   2
   1   1   1   2   2   1   1   1   1   1   2   1   2   2   1   2   2   1   2   2
   1   1   1   2   2   1   1   2   1   1   2   1   1   2   1   2   2   1   2   2
   1   1   1   2   2   1   1   2   1   1   2   1   1   2   1   2   2   1   2   2
   1   1   1   2   2   1   2   1   1   1   2   1   1   2   1   2   2   2   2   2
   1   1   1   2   2   1   2   2   1   1   2   1   2   2   1   2   2   2   2   2
      :
      :
```

```
a_png_double=im2double(a_png)
```

```
a_png_double = 100×72
```

4

```
0.0039    0.0078    0.0039    0.0039    0.0078    0.0039    0.0039    0.0078 ···
0.0039    0.0078    0.0039    0.0039    0.0078    0.0039    0.0039    0.0039
0.0039    0.0039    0.0039    0.0039    0.0078    0.0039    0.0039    0.0039
0.0039    0.0039    0.0039    0.0039    0.0078    0.0039    0.0039    0.0039
0.0039    0.0039    0.0039    0.0078    0.0078    0.0039    0.0039    0.0039
0.0039    0.0039    0.0039    0.0078    0.0078    0.0039    0.0039    0.0039
0.0039    0.0039    0.0039    0.0078    0.0078    0.0039    0.0039    0.0078
0.0039    0.0039    0.0039    0.0078    0.0078    0.0039    0.0039    0.0078
0.0039    0.0039    0.0039    0.0078    0.0078    0.0039    0.0078    0.0039
0.0039    0.0039    0.0039    0.0078    0.0078    0.0039    0.0078    0.0078
   :
   :
```

```
%decrypting the matrix
dec_png=enc*inv(key)
```

```
dec_png = 7200×7200
-0.0527    0.0000   -0.0000    0.0000    0.0000   -0.0000    0.0000   -0.0000 ···
-0.0537    0.0000   -0.0000    0.0000    0.0000   -0.0000    0.0000   -0.0000
-0.0557    0.0000   -0.0000    0.0000    0.0000   -0.0000    0.0000   -0.0000
-0.0586    0.0000   -0.0000    0.0000    0.0000   -0.0000    0.0000   -0.0000
-0.0586    0.0000   -0.0000    0.0000    0.0000   -0.0000    0.0000   -0.0000
-0.0615    0.0000   -0.0000    0.0000    0.0000   -0.0000    0.0000   -0.0000
-0.0596    0.0000   -0.0000    0.0000    0.0000   -0.0000    0.0000   -0.0000
-0.0586    0.0000   -0.0000    0.0000    0.0000   -0.0000    0.0000   -0.0000
-0.0576    0.0000   -0.0000    0.0000    0.0000   -0.0000    0.0000   -0.0000
-0.0586    0.0000   -0.0000    0.0000    0.0000   -0.0000    0.0000   -0.0000
   :
   :
```

```
dec=dec(:,1)
```

```
dec = 7200×1
-0.0527
-0.0537
-0.0557
-0.0586
-0.0586
-0.0615
-0.0596
-0.0586
-0.0576
-0.0586
   :
   :
```

```
%reshaping the matrix into the original 2 channel waveform
orig=reshape(dec,[],2);


%plotting the original, encrypted and decrypted waveforms
%original 2 channel waveform

t_og=(0:length(a_cut)-1)/fs
```
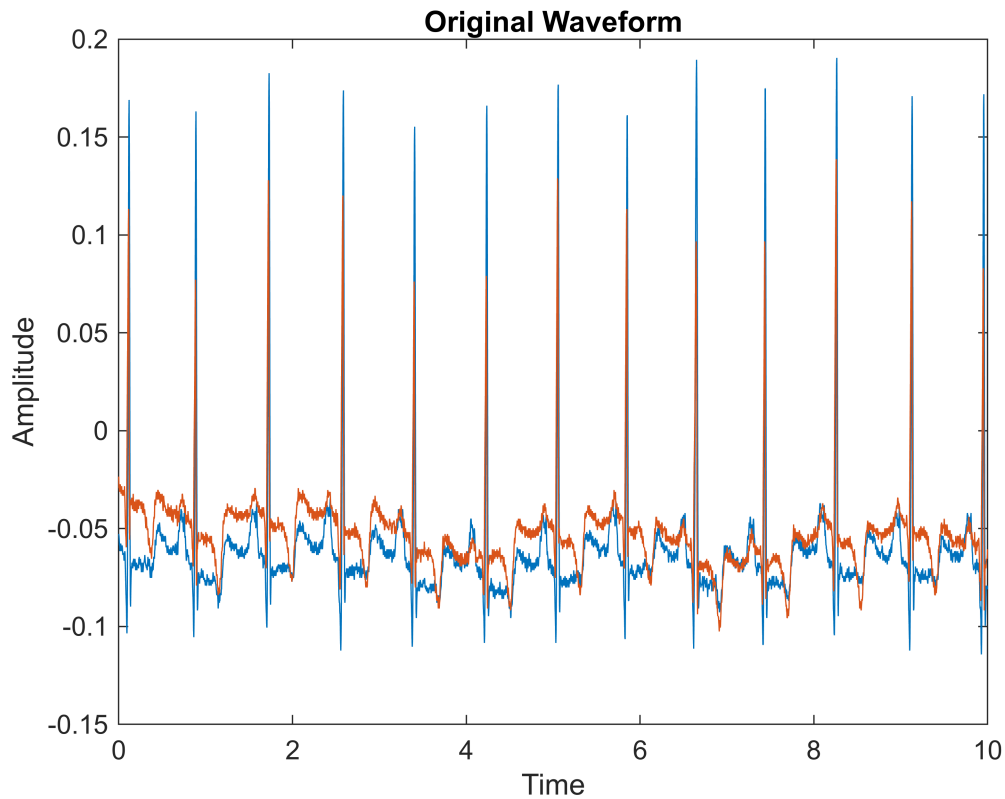
```
t_og = 1×3600
     0    0.0028    0.0056    0.0083    0.0111    0.0139    0.0167    0.0194 ···
```

```
plot(t_og,a_cut)
xlabel("Time")
ylabel("Amplitude")
title("Original Waveform")
```



```
%encrypted waveform (Hill Cipher)
t_enc=(0:length(enc_col)-1)/fs
```
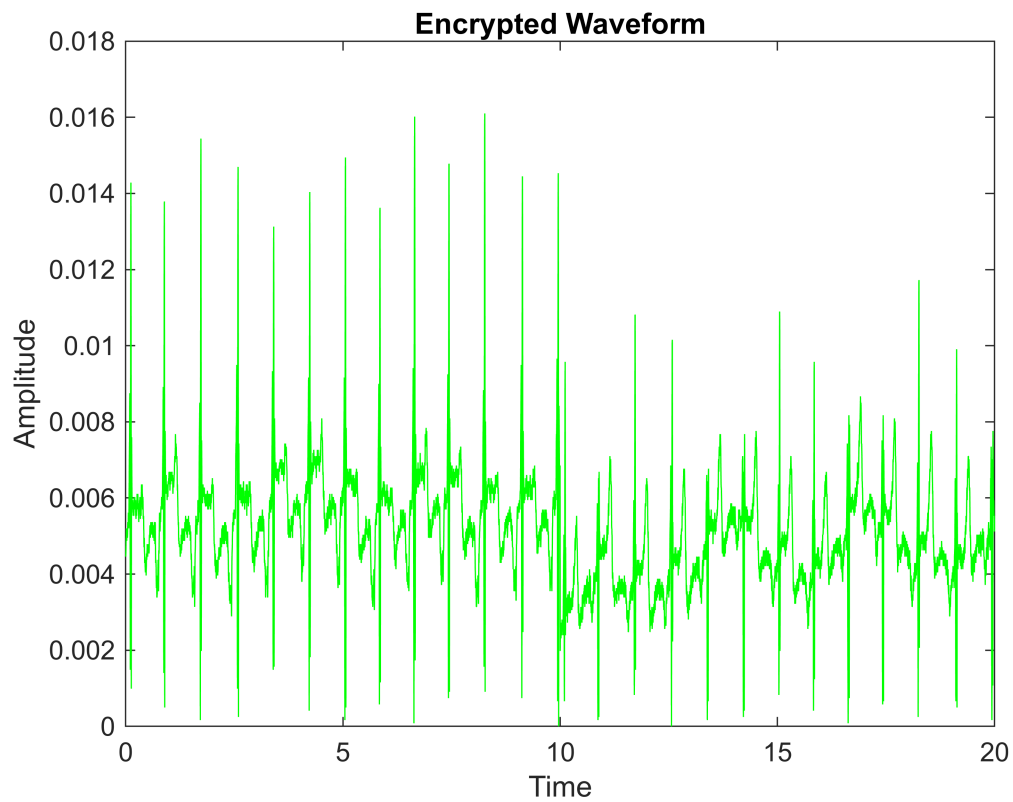
t_enc = 1×7200
        0   0.0028   0.0056   0.0083   0.0111   0.0139   0.0167   0.0194 · · ·

```
plot(t_enc,enc_col,'g')
xlabel("Time")
ylabel("Amplitude")
title("Encrypted Waveform")
```

Encrypted Waveform


```matlab
%Decrypted Waveform
t_dec=(0:length(orig)-1)/fs
```

t_dec = 1×3600

| 0 | 0.0028 | 0.0056 | 0.0083 | 0.0111 | 0.0139 | 0.0167 | 0.0194 ⋯ |

```matlab
plot(t_dec,orig)
xlabel("Time")
ylabel("Amplitude")
title("Decrypted Waveform")
```

Decrypted Waveform
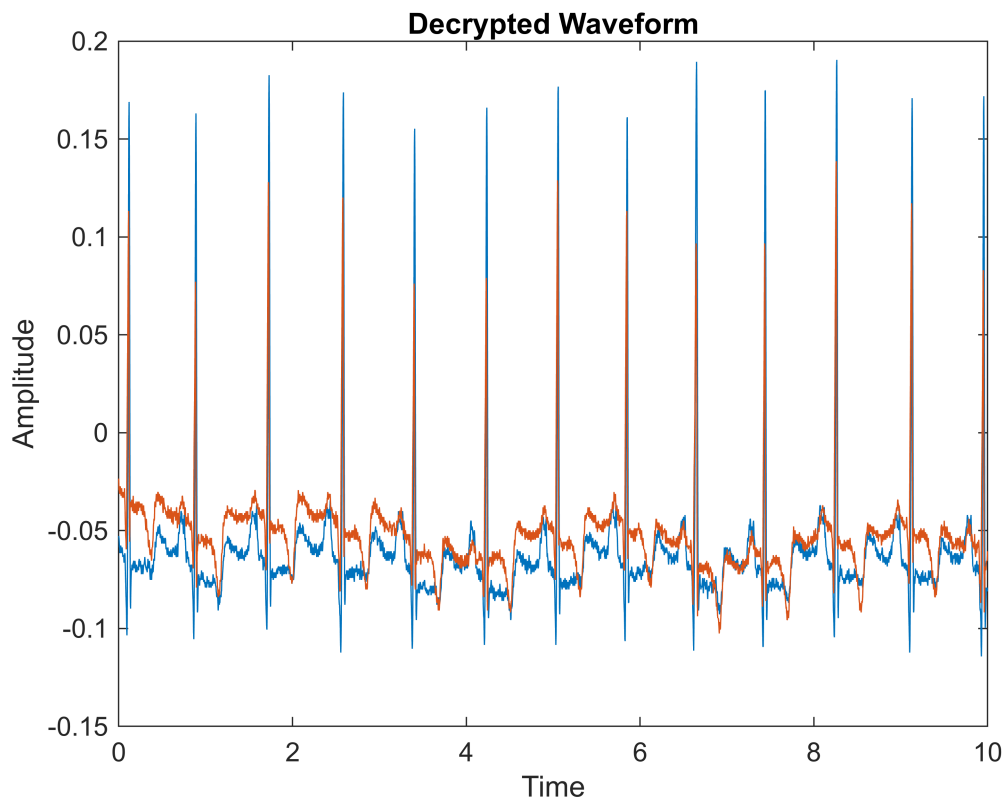

```
%Error Calculation
val1=abs(a_cut_mono)
```

```
val1 = 7200×1
    0.0527
    0.0537
    0.0557
    0.0586
    0.0586
    0.0615
    0.0596
    0.0586
    0.0576
    0.0586
      ⋮
      ⋮
```

```
val2=abs(dec)
```

```
val2 = 7200×1
    0.0527
    0.0537
    0.0557
    0.0586
    0.0586
    0.0615
    0.0596
    0.0586
    0.0576
    0.0586
```

$$\vdots$$

```
error=val1-val2
```

error = 7200×1

10^{-12} ×

    0.0424
    0.0433
    0.0448
    0.0472
    0.0472
    0.0495
    0.0479
    0.0472
    0.0462
    0.0472

$$\vdots$$