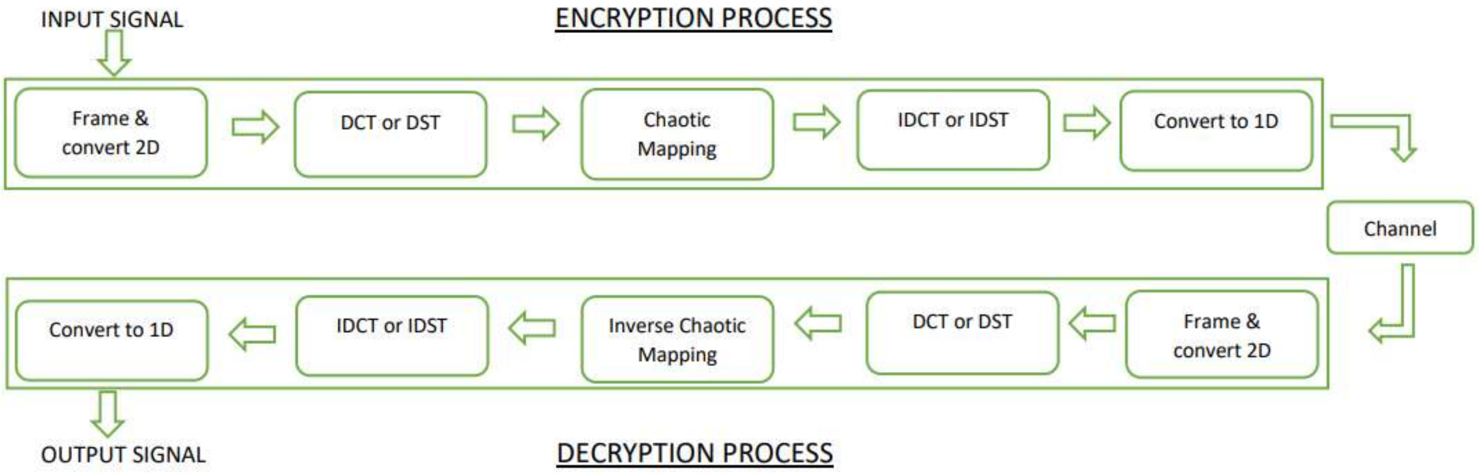
Speech Encryption and Decryption



References:

Speech Encryption Using Two Dimensional Chaotic Maps - D Alzharaa Mostafa *, Naglaa. F. Soliman *, Mohamoud Abdalluh* Fathi E. Abd El-samieD

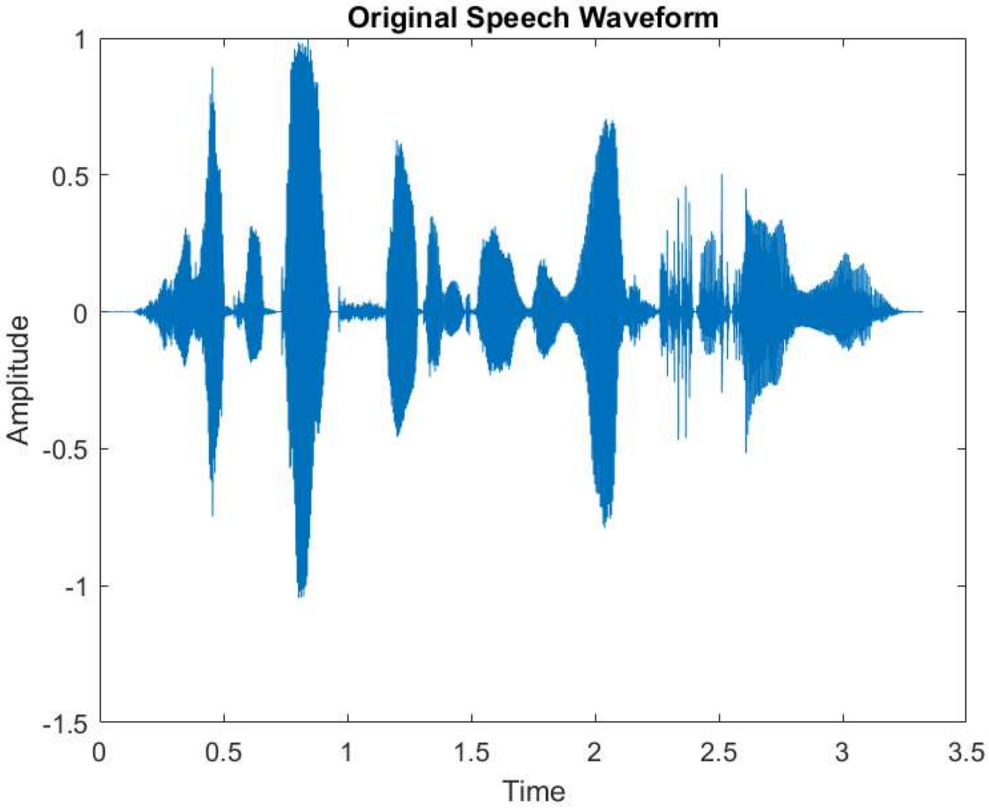
Code:

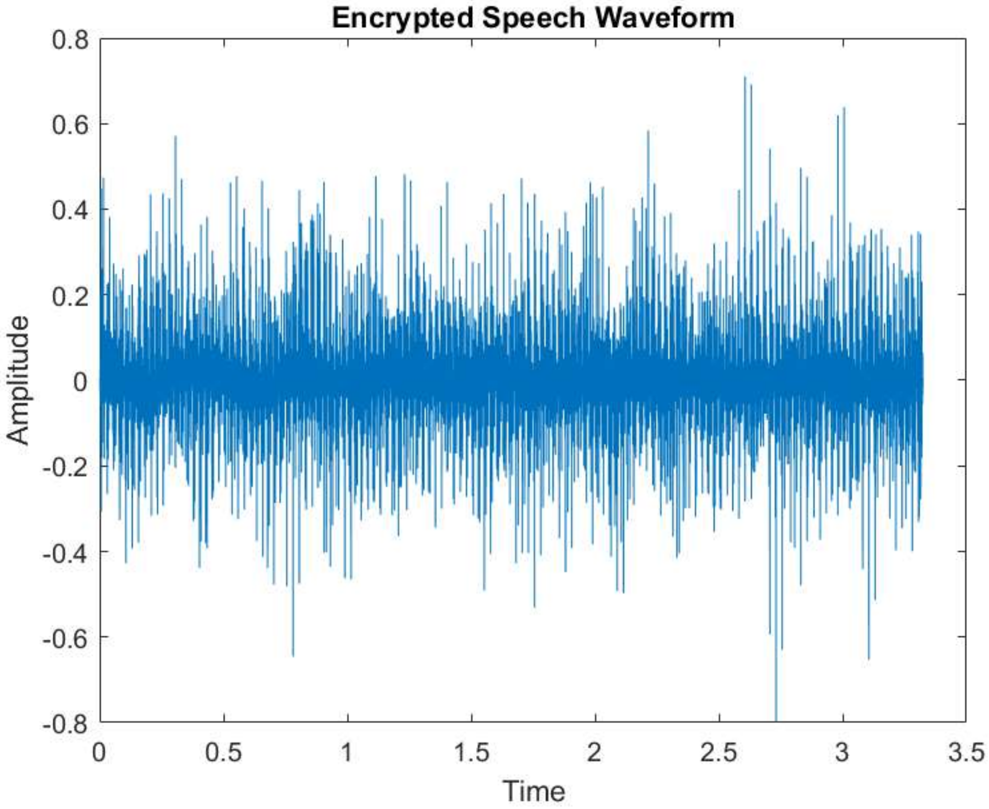
```
close all; clc; clear all;

files = dir(fullfile('C:\Users\Amrut Biju\Desktop\Study\6th Semester\SP\Project\Code\TIMIT\TRAIN\DR8\FCLT0\', '*.wav'));
L = length(files);
waves = {};
for i=1:L
    file=files(i).name;
    filepath = fullfile( 'C:\Users\Amrut Biju\Desktop\Study\6th Semester\SP\Project\Code\TIMIT\TRAIN\DR8\FCLT0\', file );
    waves{end+1} = filepath;
end
```

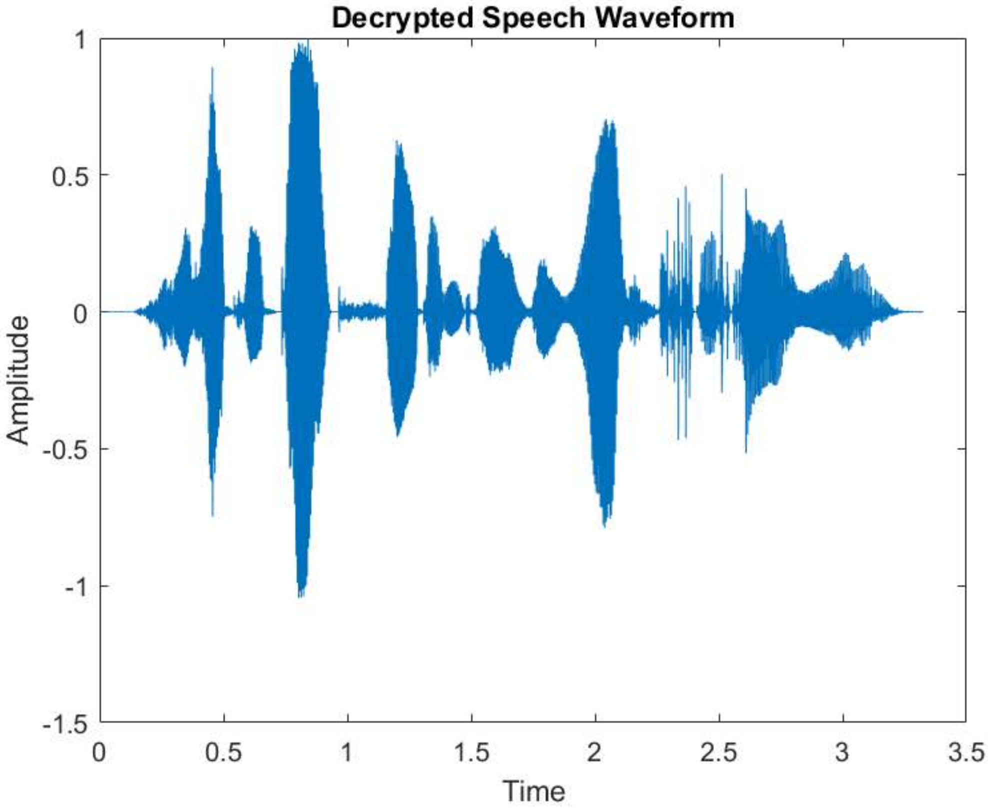
```
for i = 1:length(waves)
```

```
    [sample_sound,fs]=audioread(waves{i});
    fprintf('audio sample number : %d', i);
    sample_sound = sample_sound./max(sample_sound);

    frame_size = 0.025;
    frame_length = frame_size*fs;

    if mod(length(sample_sound), frame_length) ~= 0
        sample_sound = [sample_sound; (zeros(1, frame_length-mod(length(sample_sound), 200)))'];
    end

    figure
    plot((0:length(sample_sound)-1)/fs,sample_sound);
    xlabel("Time");
    ylabel("Amplitude");
    title('Original Speech Waveform');
    sound(sample_sound, fs);
    pause(5);

    [Encrypted_speech, Chaotic_map] = encryption(sample_sound, frame_length);

    figure
    plot((0:length(Encrypted_speech)-1)/fs,Encrypted_speech);
    xlabel("Time");
    ylabel("Amplitude");
    title('Encrypted Speech Waveform');
    sound(Encrypted_speech, fs);
    pause(5);

    [Decrypted_speech] = decryption(Encrypted_speech, Chaotic_map, frame_length);

    figure
    plot((0:length(Decrypted_speech)-1)/fs,Decrypted_speech);
    xlabel("Time");
    ylabel("Amplitude");
    title('Decrypted Speech Waveform');
    sound(Decrypted_speech, fs);
    pause(5);
end
```

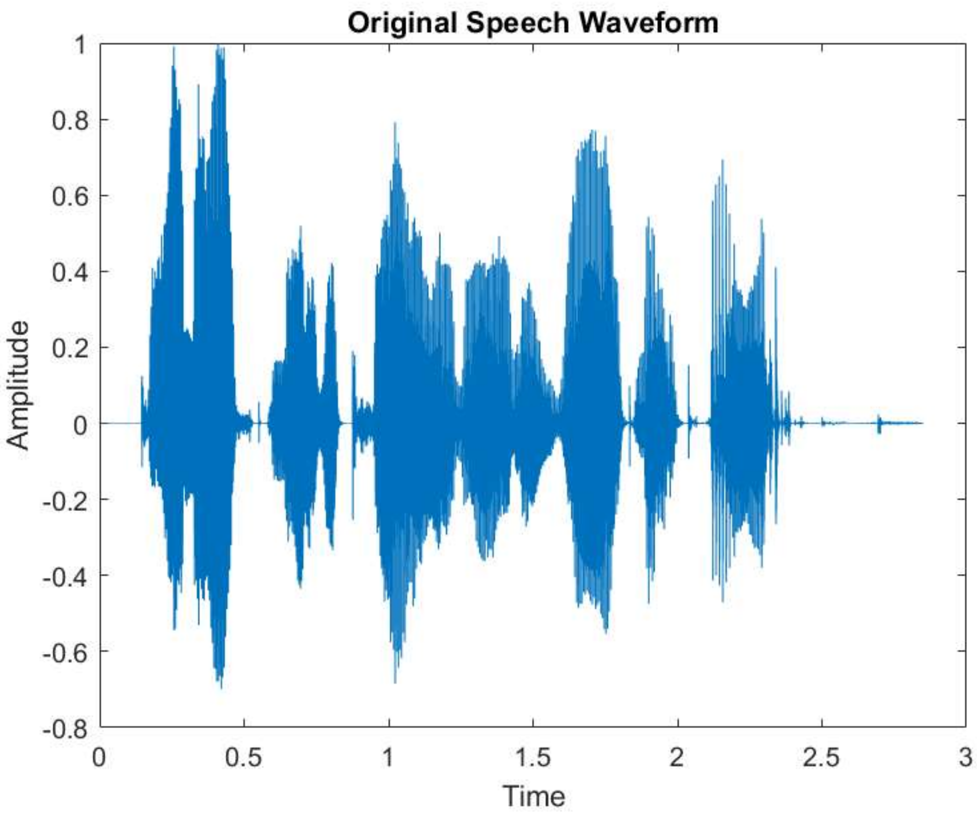
```
audio sample number : 1
```

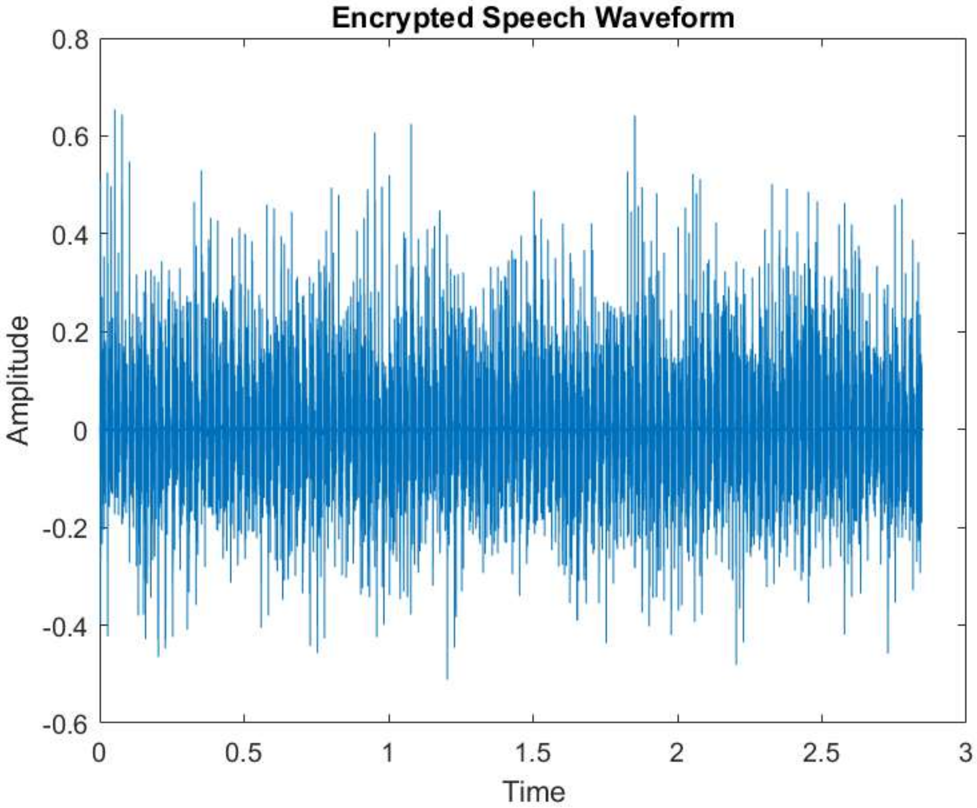

Original Speech Waveform
Amplitude
1
0.5
0
-0.5
-1
-1.5
Time
0
0.5
1
1.5
2
2.5
3
3.5

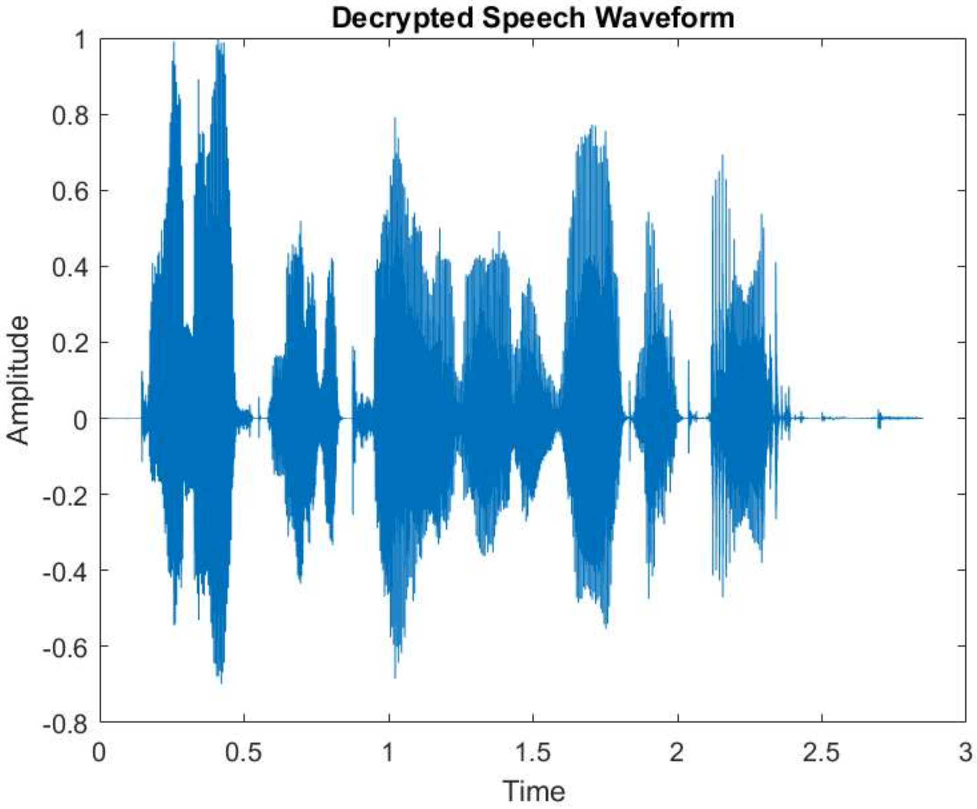

Encrypted Speech Waveform
Amplitude
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
0.5
1
1.5
2
2.5
3
3.5
Time



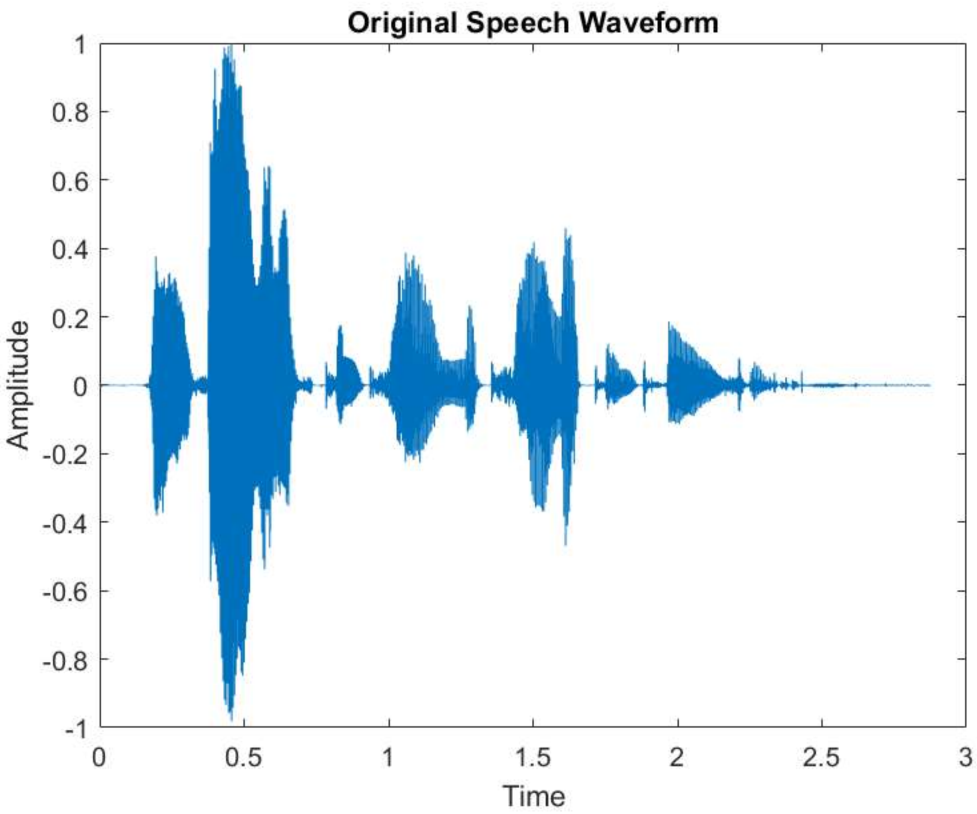
```
audio sample number : 2
```

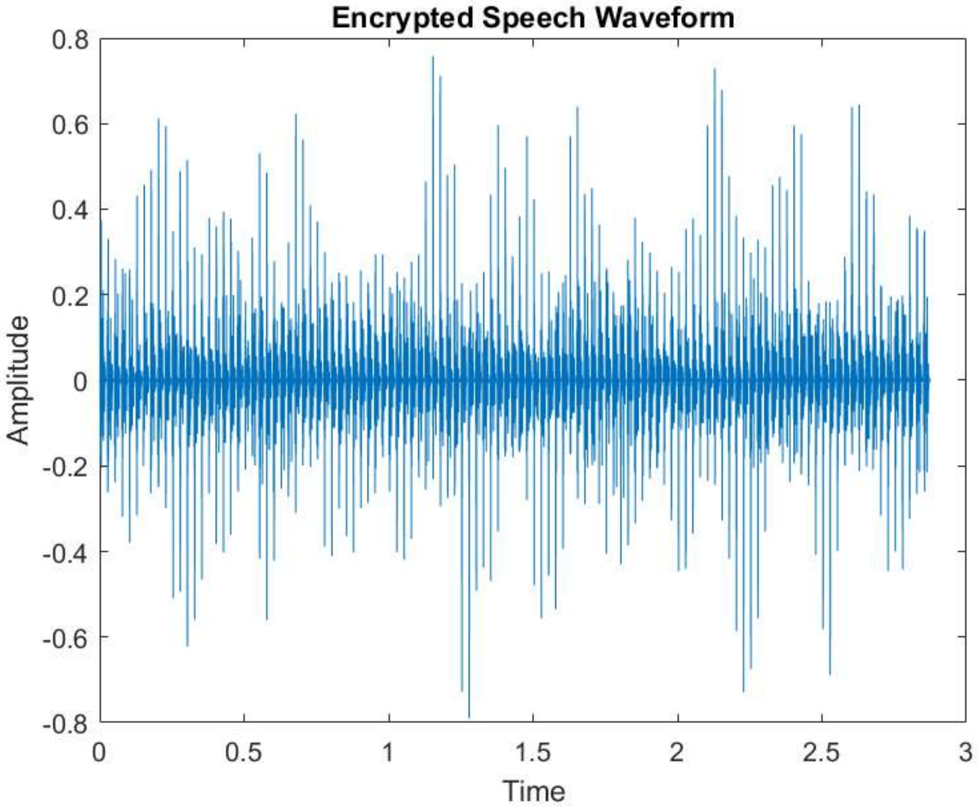

Original Speech Waveform
Amplitude
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
0.5
1
1.5
2
2.5
3
Time

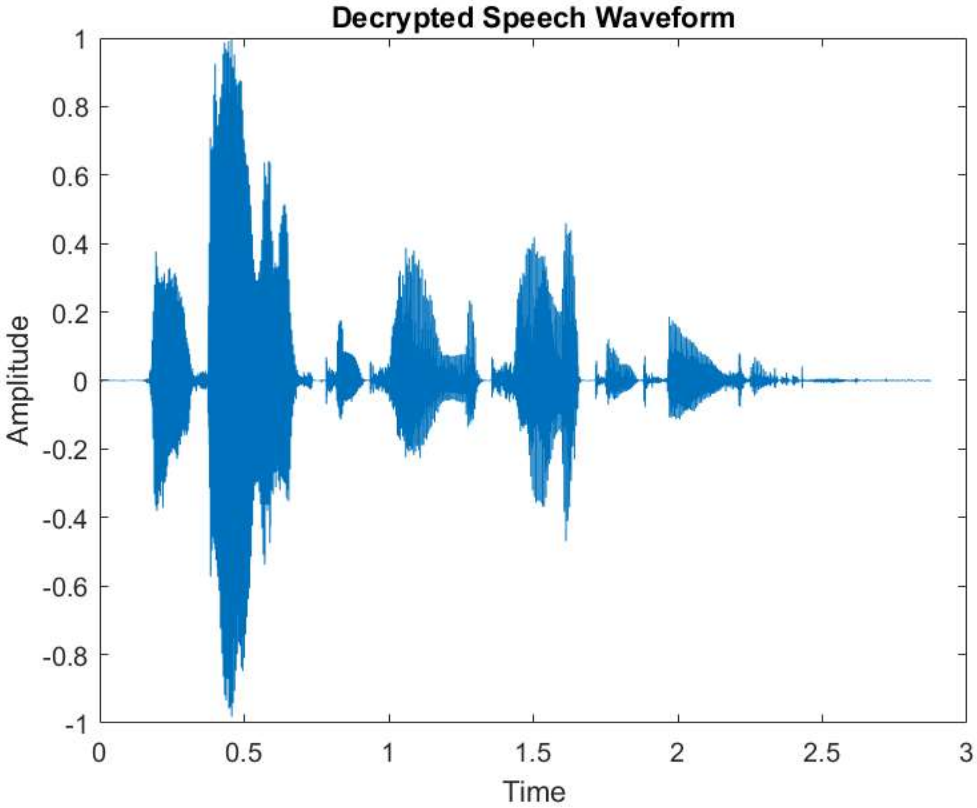

Encrypted Speech Waveform
Amplitude
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
0
0.5
1
1.5
2
2.5
3
Time



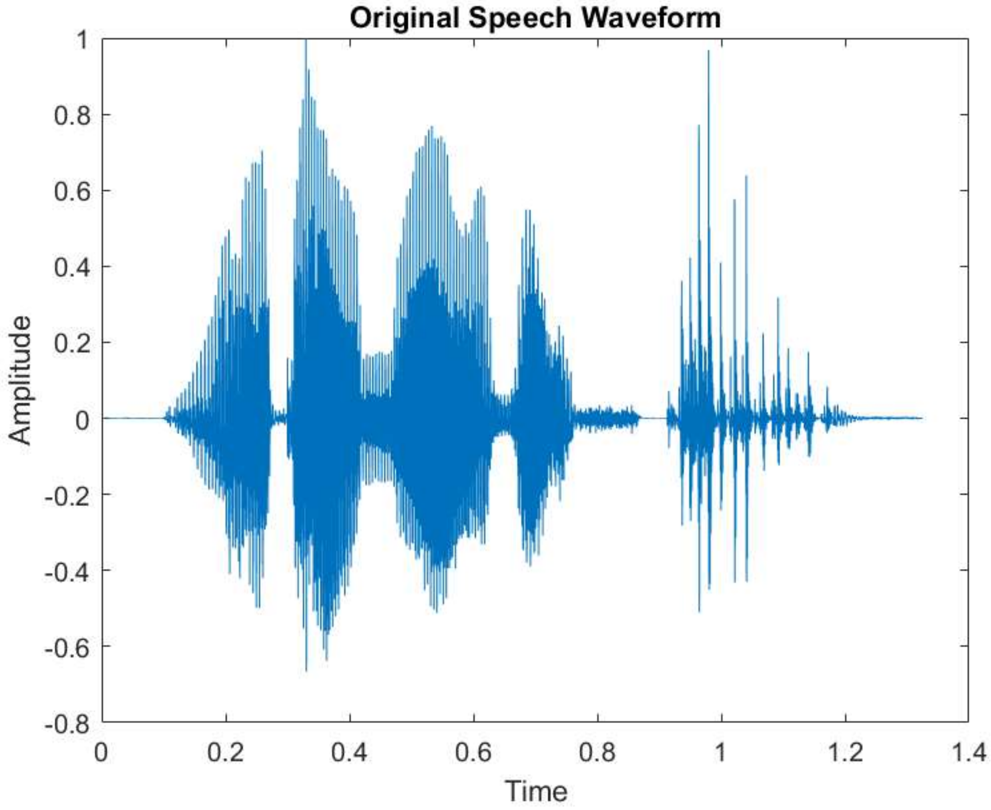
```
audio sample number : 3
```

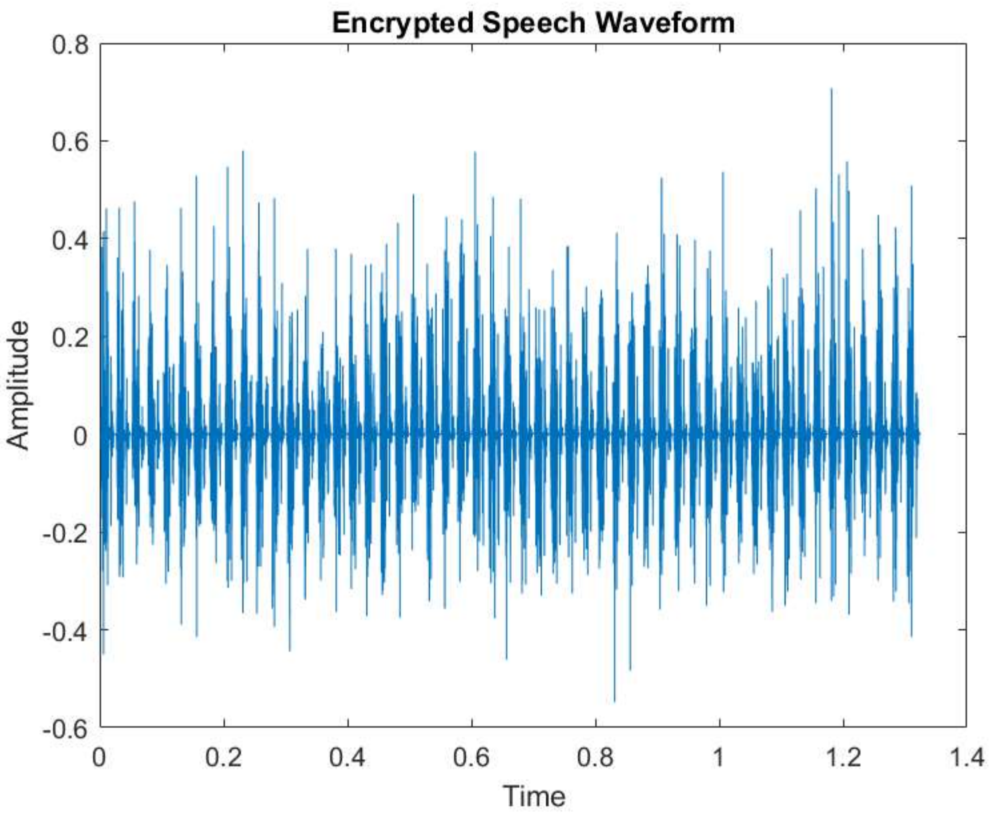

Original Speech Waveform
Amplitude
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
0.5
1
1.5
2
2.5
3
Time

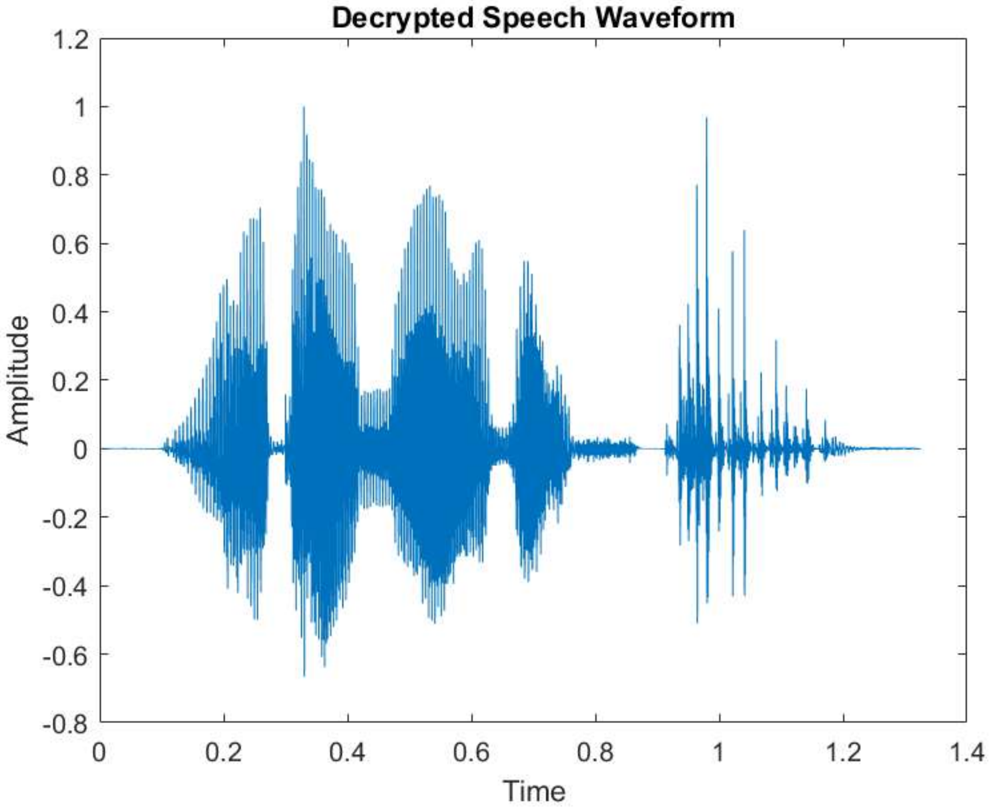

Encrypted Speech Waveform
Amplitude
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
0.5
1
1.5
2
2.5
3
Time



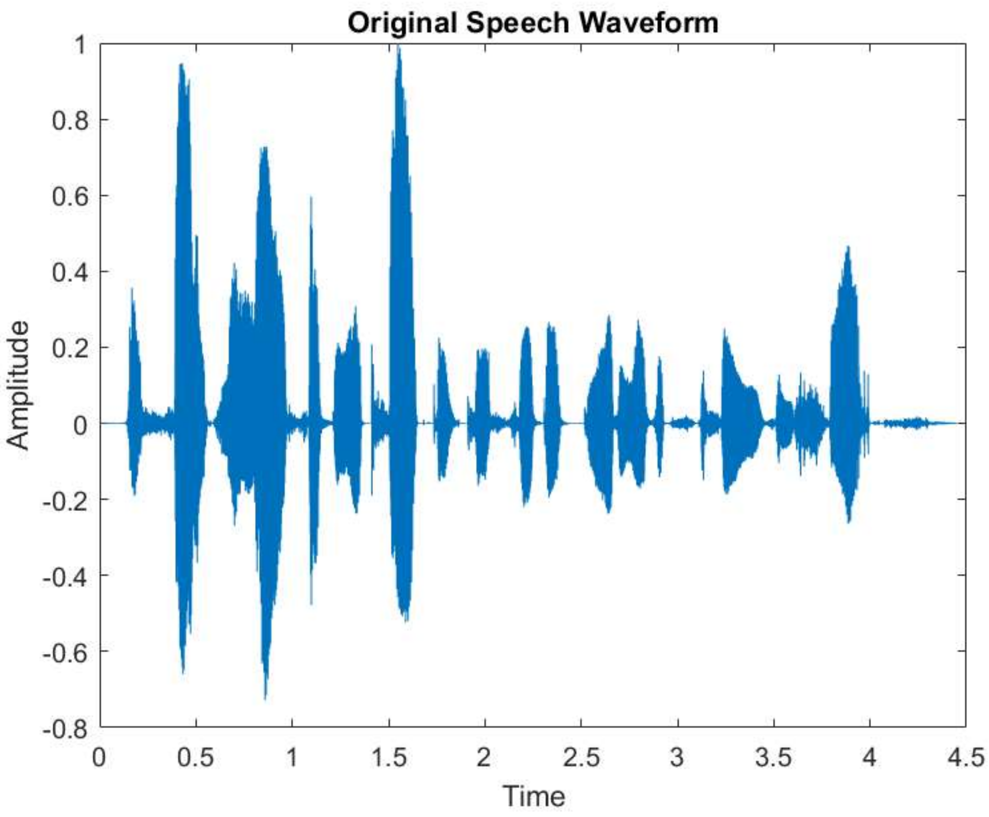
```
audio sample number : 4
```

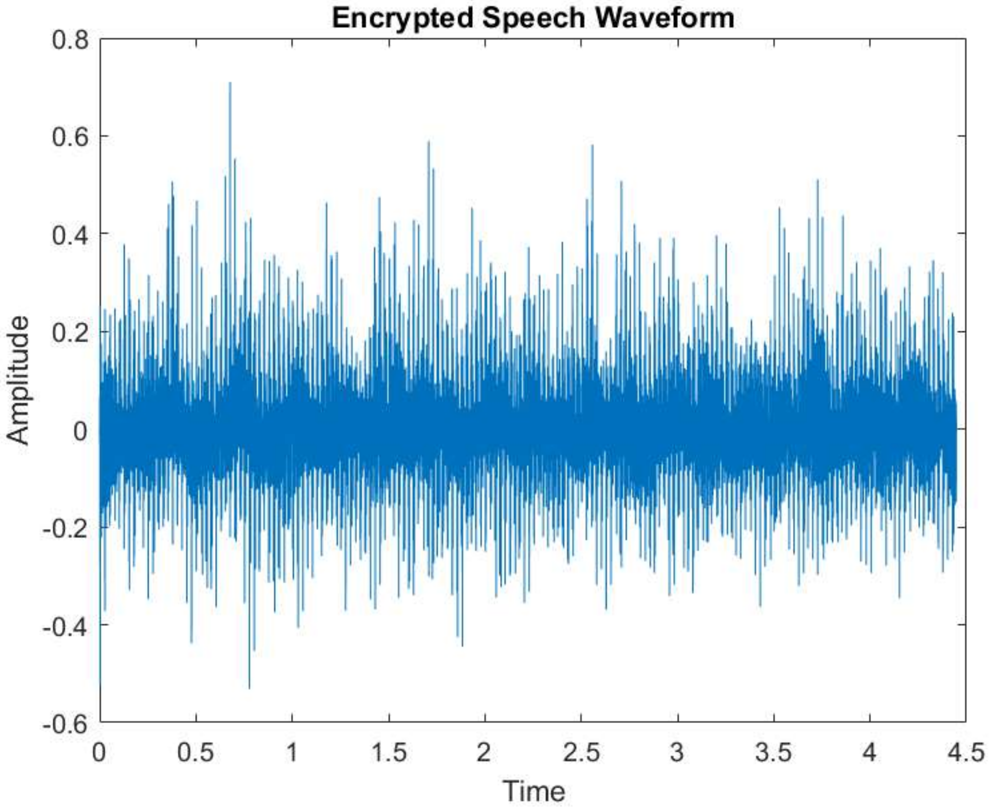

Original Speech Waveform
Amplitude
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
0.2
0.4
0.6
0.8
1
1.2
1.4
Time

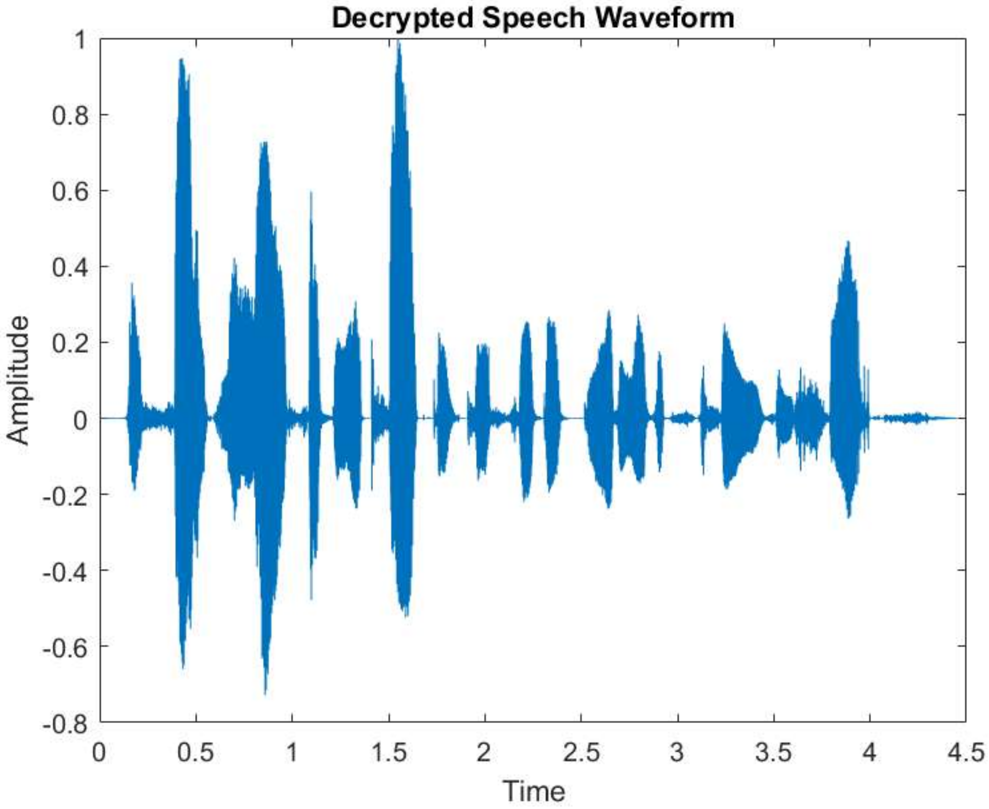

Encrypted Speech Waveform
Amplitude
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
Time
0
0.2
0.4
0.6
0.8
1
1.2
1.4



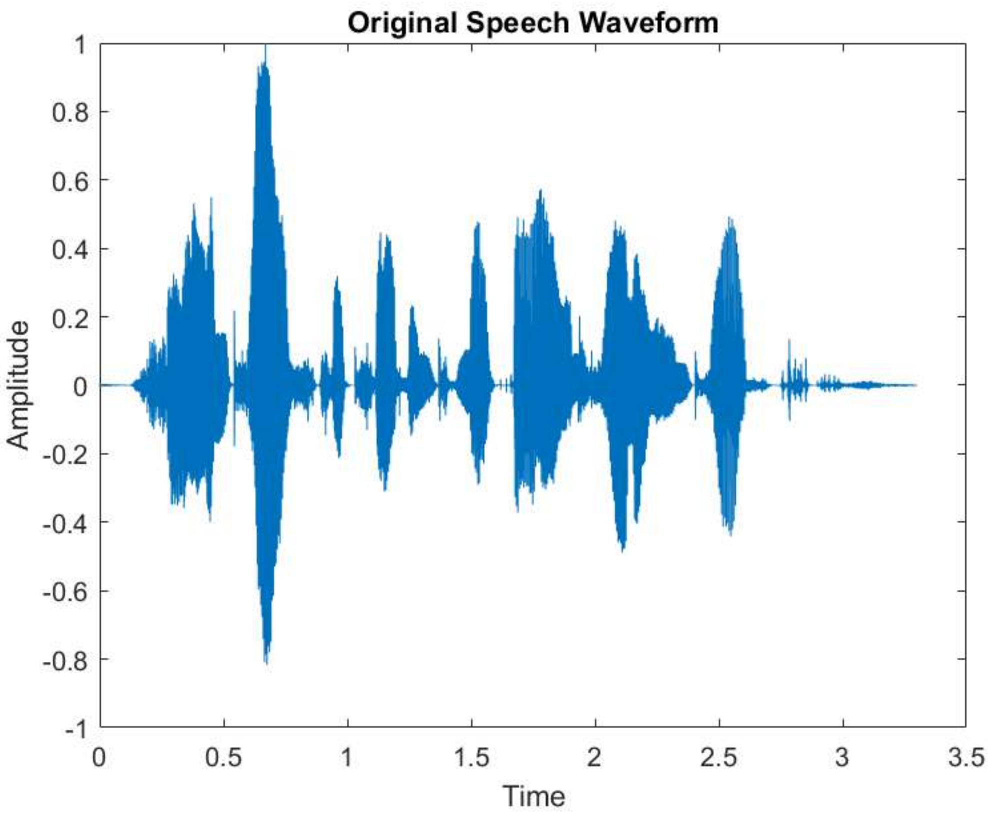
```
audio sample number : 5
```

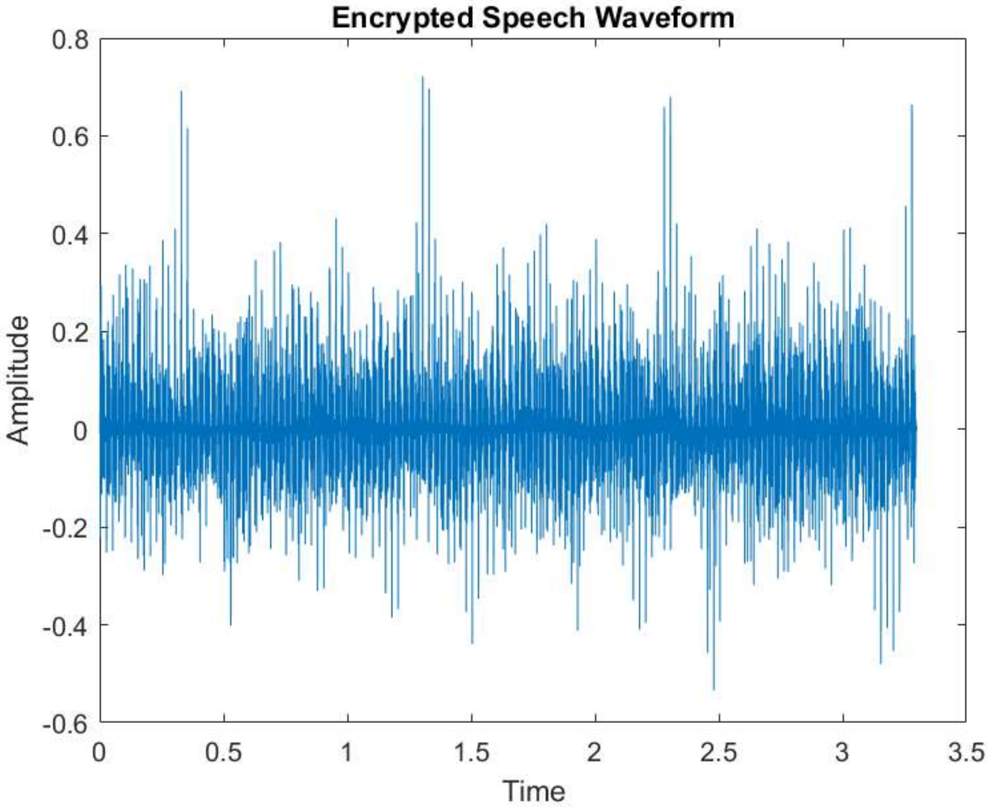

Original Speech Waveform
Amplitude
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
Time

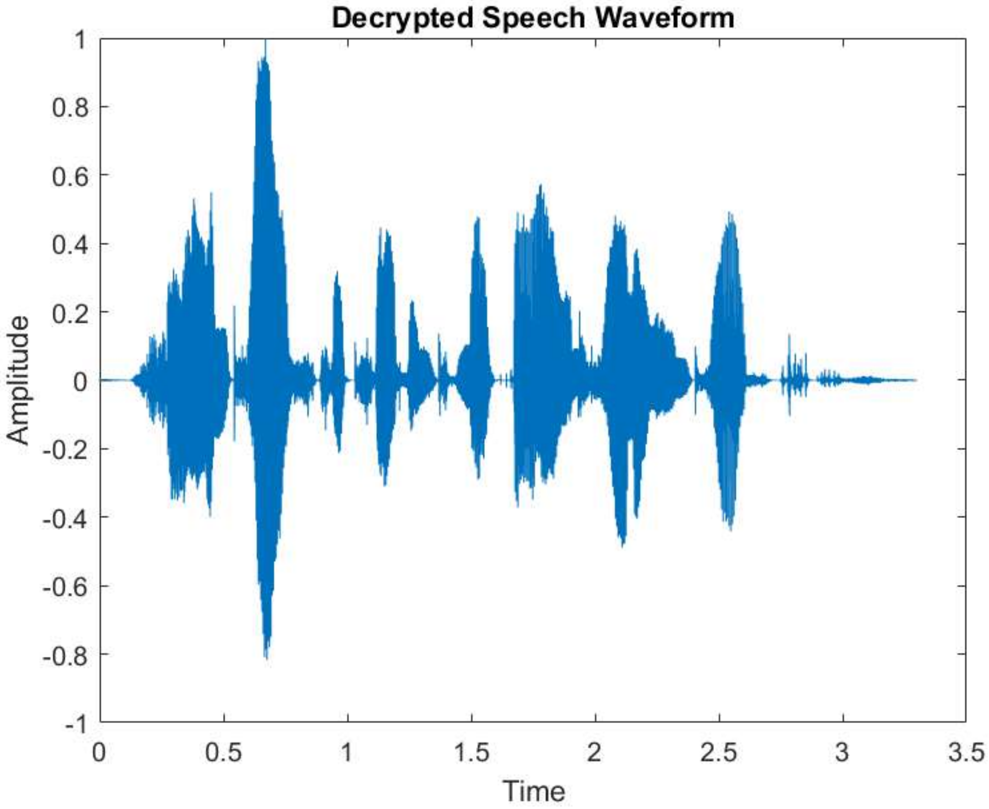

Encrypted Speech Waveform
Amplitude
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
Time



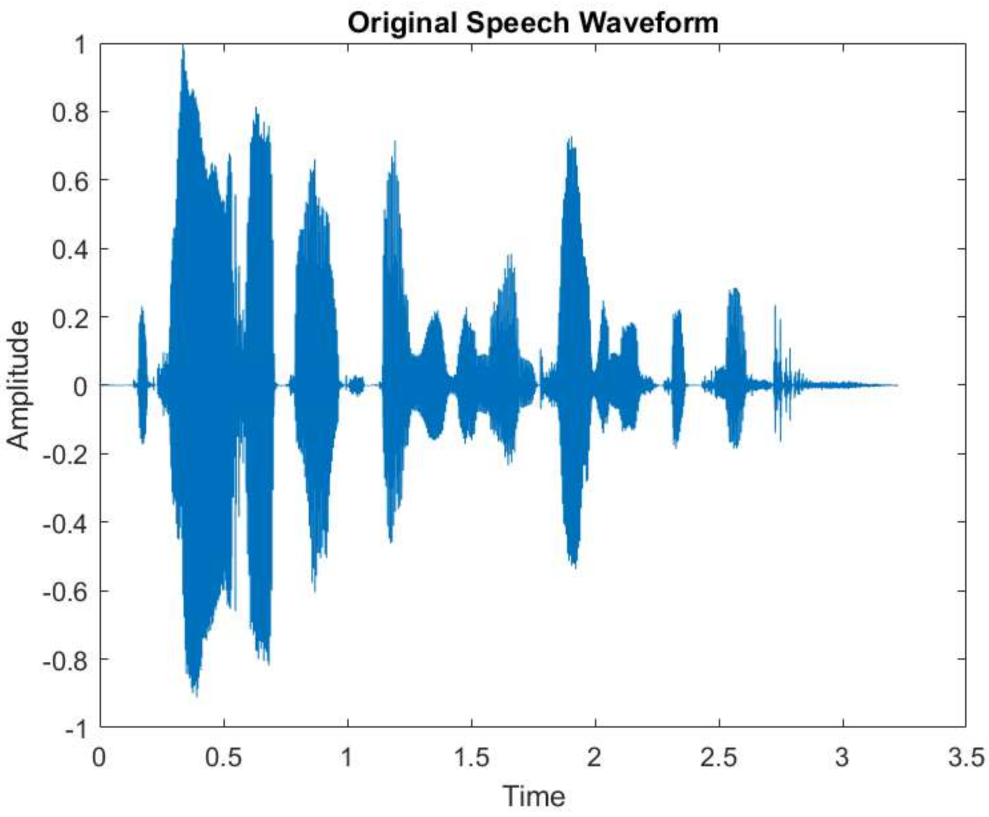
```
audio sample number : 6
```

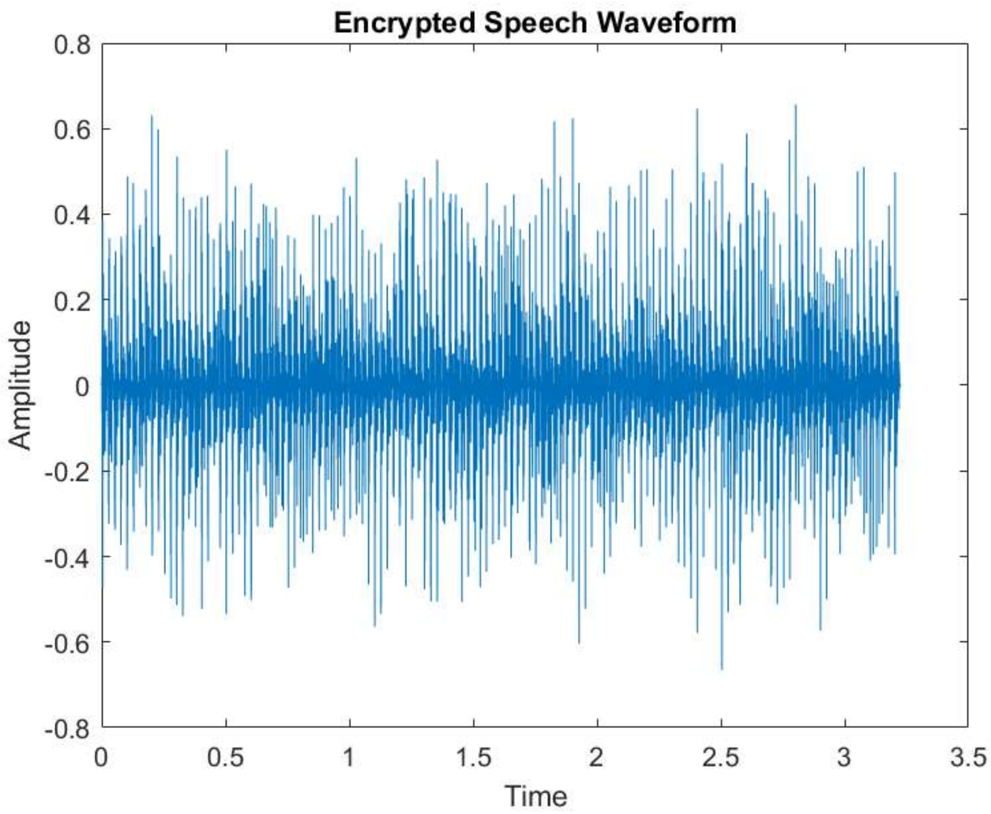

Original Speech Waveform
Amplitude
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
Time
0
0.5
1
1.5
2
2.5
3
3.5

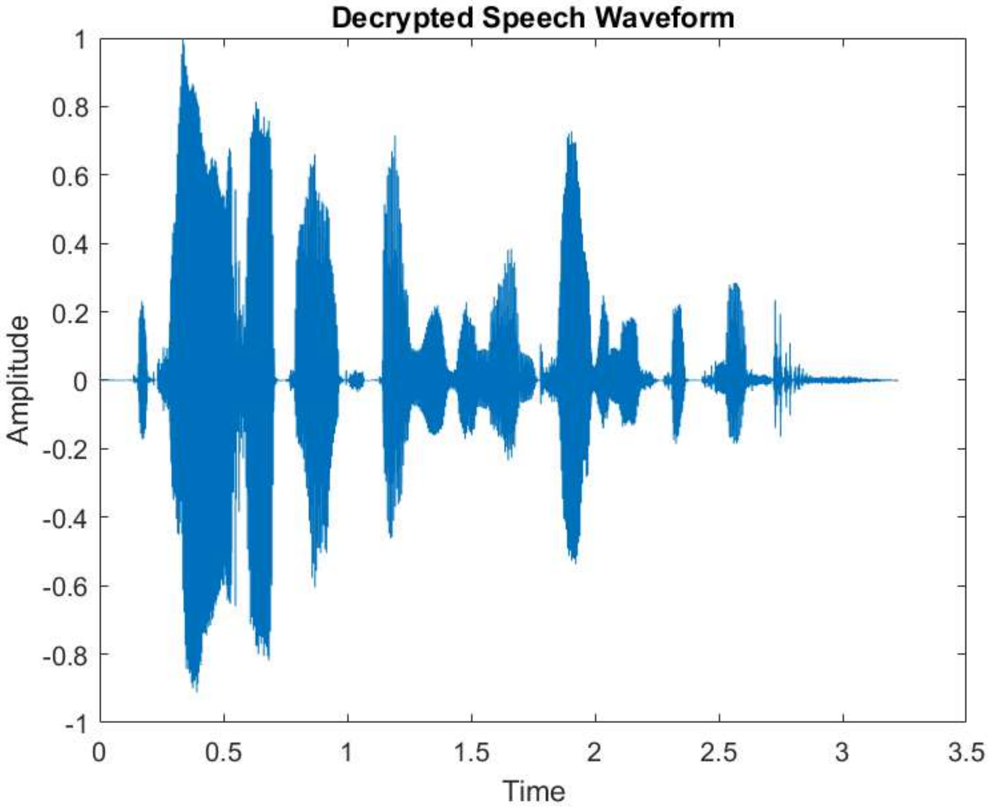

Encrypted Speech Waveform
Amplitude
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
0
0.5
1
1.5
2
2.5
3
3.5
Time



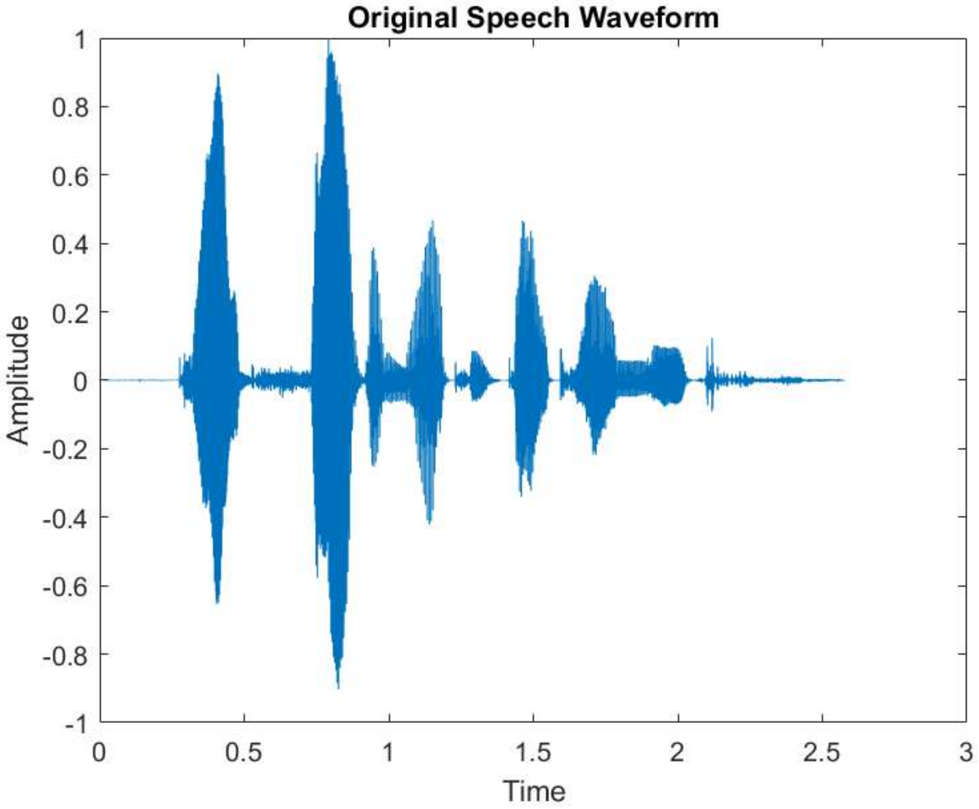
```
audio sample number : 7
```

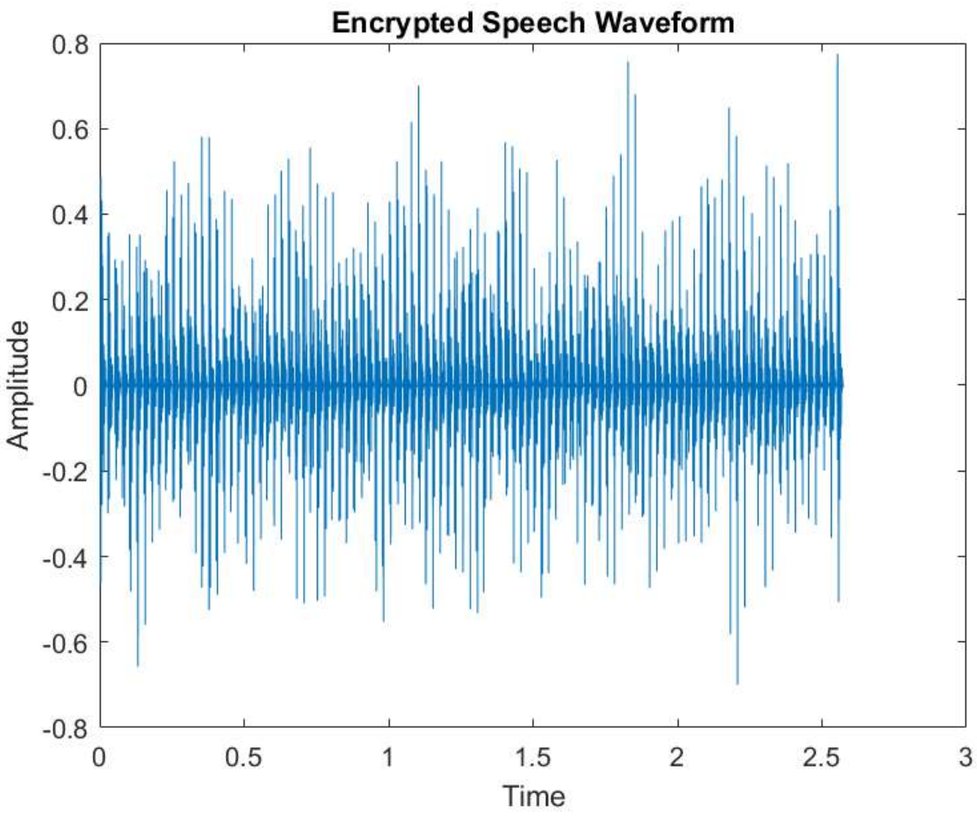

Original Speech Waveform
Amplitude
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
0.5
1
1.5
2
2.5
3
3.5
Time

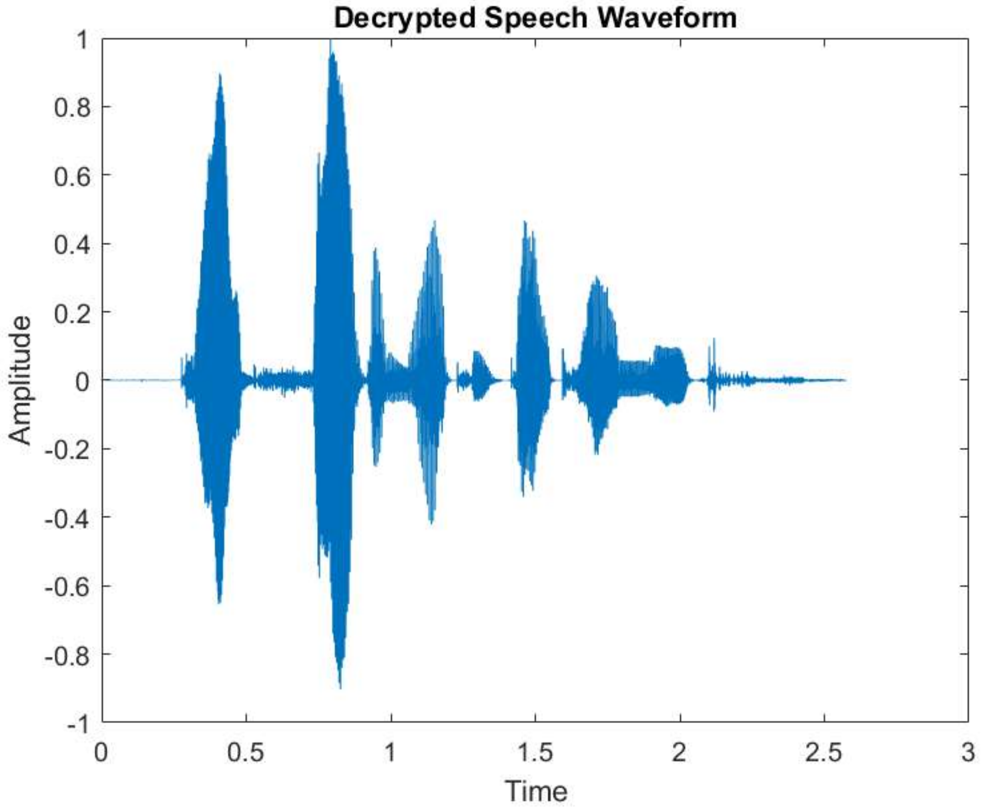

Encrypted Speech Waveform
Amplitude
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
0.5
1
1.5
2
2.5
3
3.5
Time



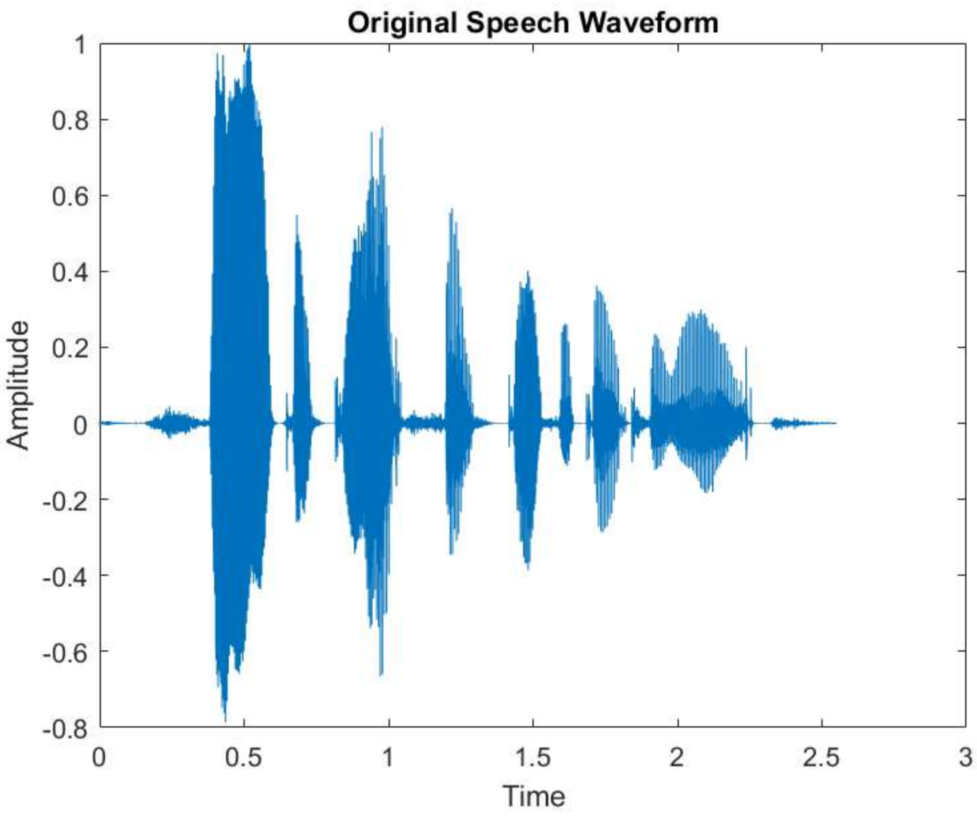
```
audio sample number : 8
```

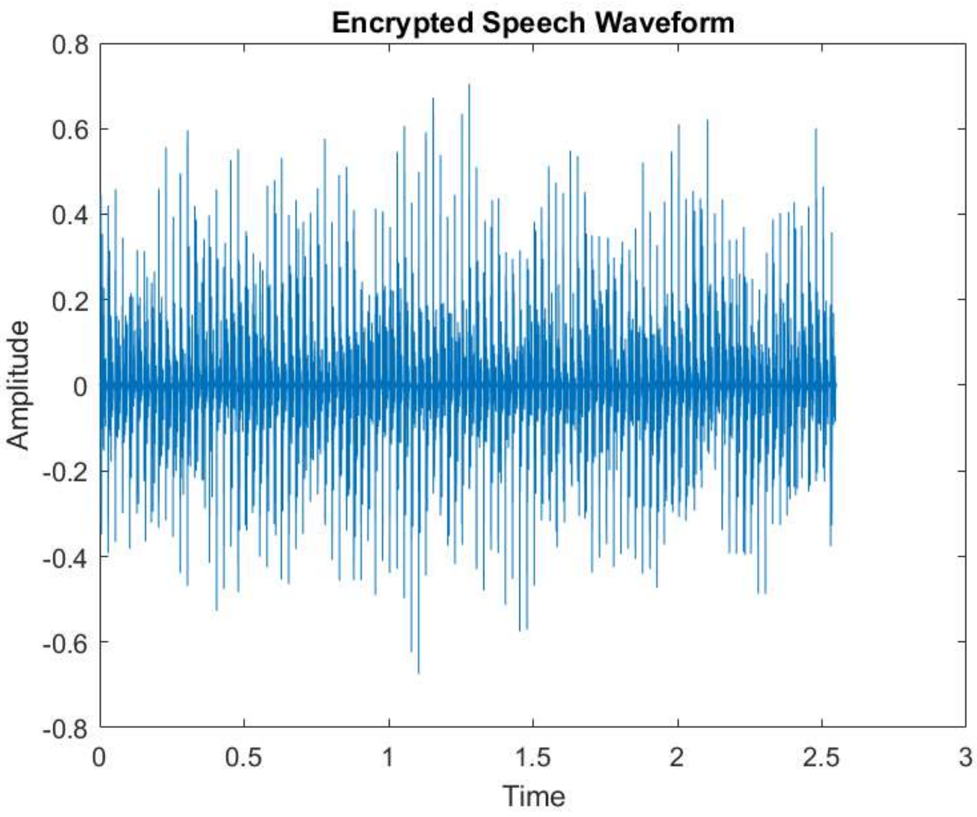

Original Speech Waveform
Amplitude
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
0.5
1
1.5
2
2.5
3
Time

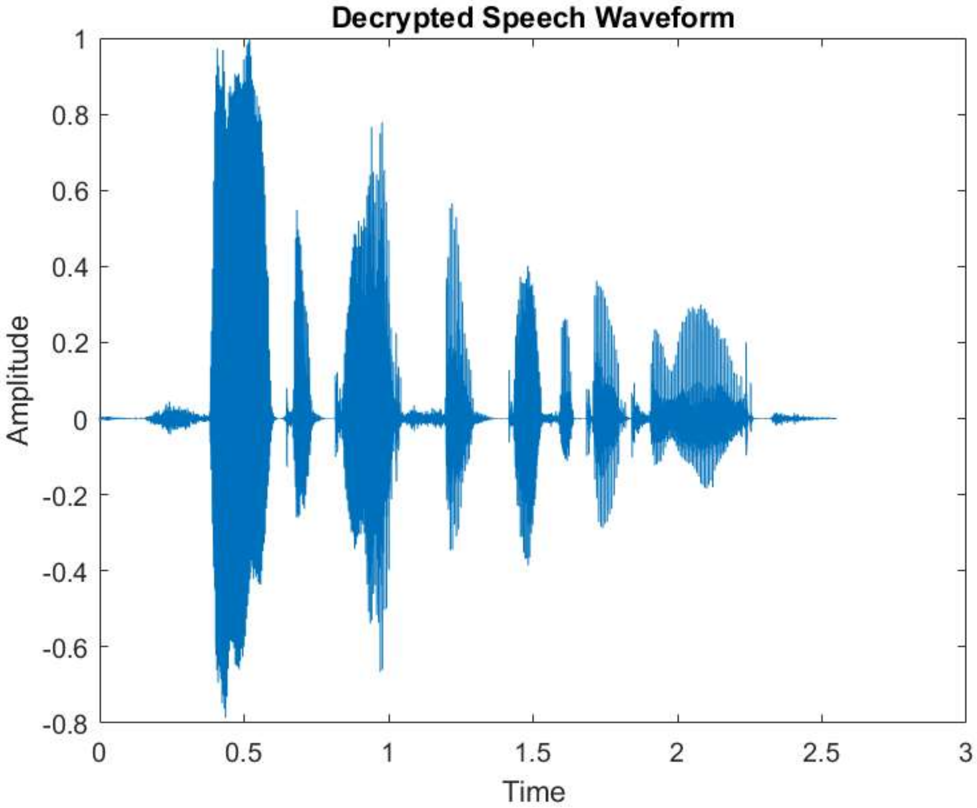

Encrypted Speech Waveform
Amplitude
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
Time
0
0.5
1
1.5
2
2.5
3



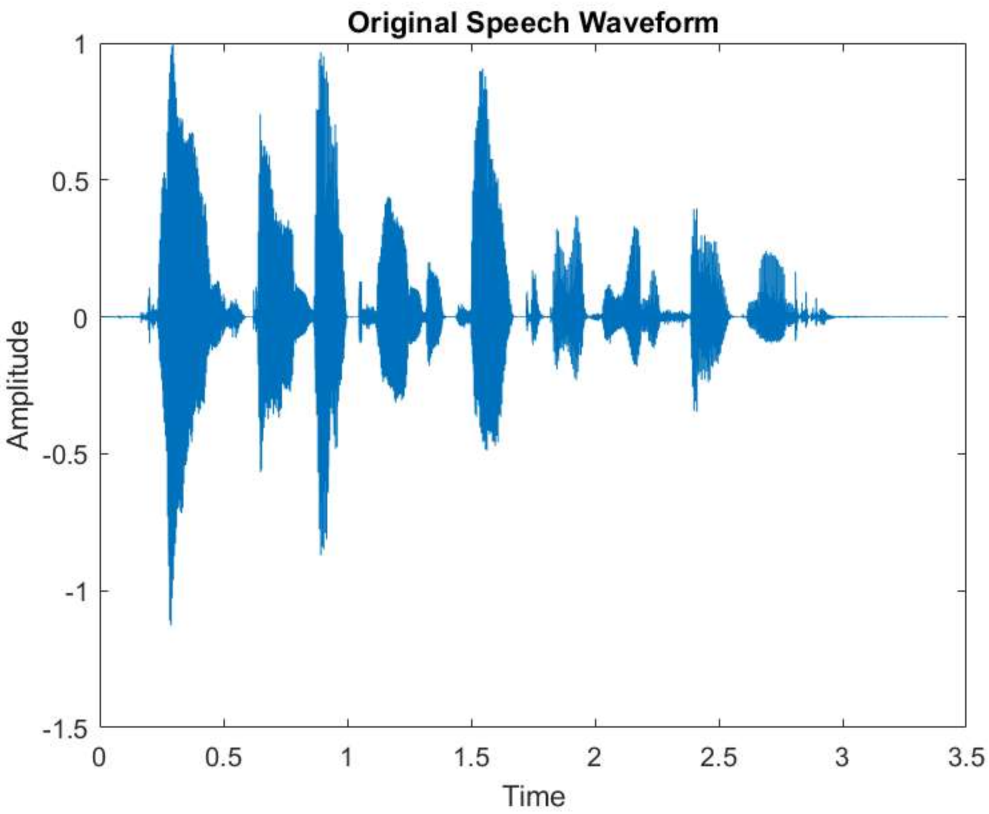
```
audio sample number : 9
```

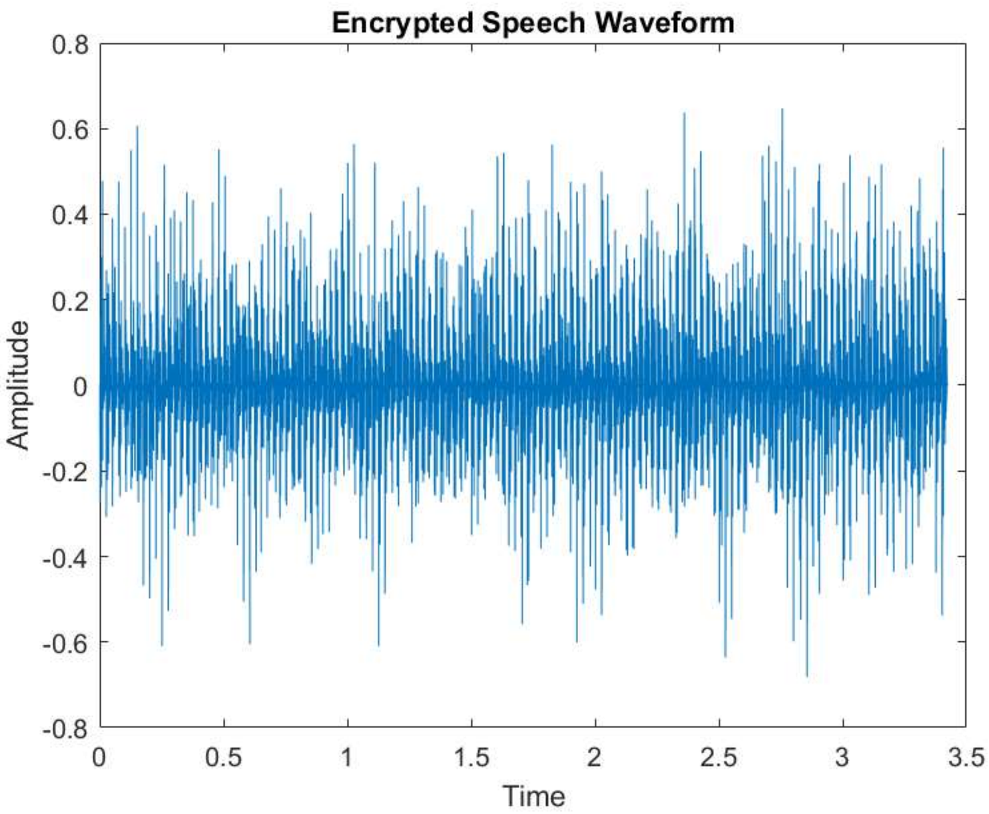

Original Speech Waveform
Amplitude
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
0.5
1
1.5
2
2.5
3
Time

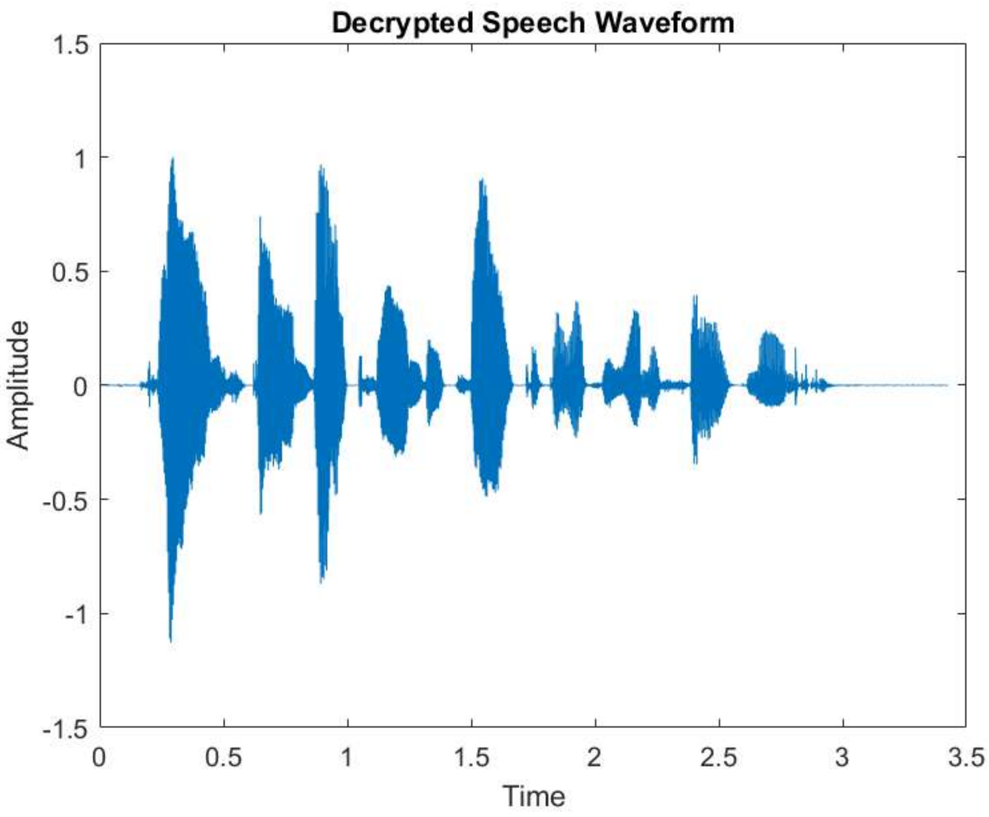

Encrypted Speech Waveform
Amplitude
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
0.5
1
1.5
2
2.5
3
Time



```
audio sample number : 10
```


Original Speech Waveform
1
0.5
0
-0.5
-1
-1.5
Amplitude
0
0.5
1
1.5
2
2.5
3
3.5
Time


Encrypted Speech Waveform
Amplitude
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
0.5
1
1.5
2
2.5
3
3.5
Time



FUNCTION DEFINITIONS

ENCRYPTION:

```
function [Encrypted_speech_1D, Chaotic_map] = encryption(sample_sound, frame_length)
```

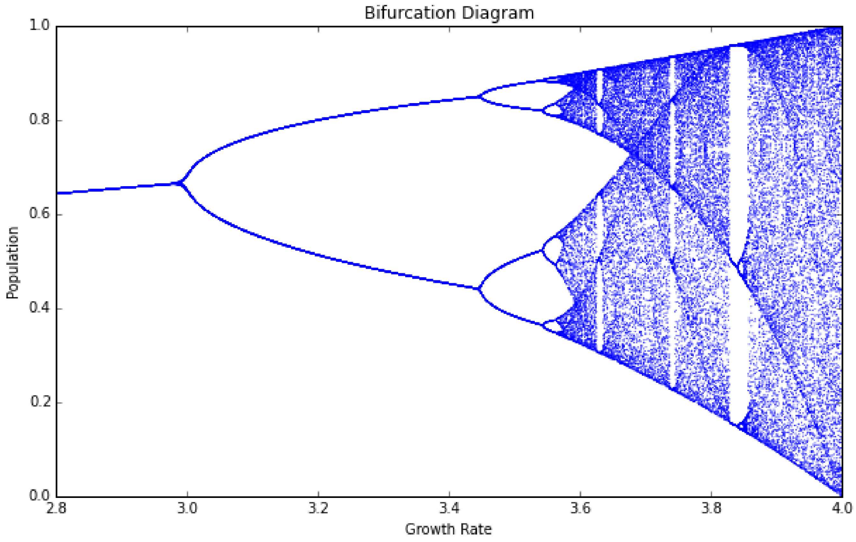
FRAME AND CONVERT TO 2D

```
    frames_matrix = reshape(sample_sound, (length(sample_sound)/frame_length), frame_length);
```

DCT

```
    frames_dct = dct(frames_matrix);

    Transformed_frames = frames_dct;
```

CHAOTIC MAPPING



```
    x1 = 0.1;
    r = 4;

    for k = 1: size(frames_matrix, 1)
        for j = 1:size(frames_matrix, 2)
            Chaotic_map(k, j) = r*x1*(1-x1);
            x1 = Chaotic_map(k, j);
        end
    end

    Randomized_matrix = Transformed_frames.*Chaotic_map;
```

IDCT

```
    Encrypted_speech_2D = idct(Randomized_matrix);
```

CONVERT TO 1-D

```
    Encrypted_speech_1D = reshape(Encrypted_speech_2D',[],1); % convert matrix to column vector
end
```

DECRYPTION

```
function [Original_1D_matrix] = decryption(Encrypted_speech_1D, Chaotic_map, frame_length)
```

FRAME AND CONVERT TO 2D

```
    Received_speech_2D = reshape(Encrypted_speech_1D, frame_length, (length(Encrypted_speech_1D)/frame_length));
    Received_speech_2D = Received_speech_2D';
```

DCT

```
    Transformed_Encrypted_speech_2D = dct(Received_speech_2D);
```

INVERSE CHAOTIC MAPPING

```
    Unrandomized_matrix = Transformed_Encrypted_speech_2D./Chaotic_map;
```

IDCT

```
    Original_2D_matrix = idct(Unrandomized_matrix);
```

CONVERT TO 1-D

```
    Original_1D_matrix = reshape(Original_2D_matrix,[],1);
end
```