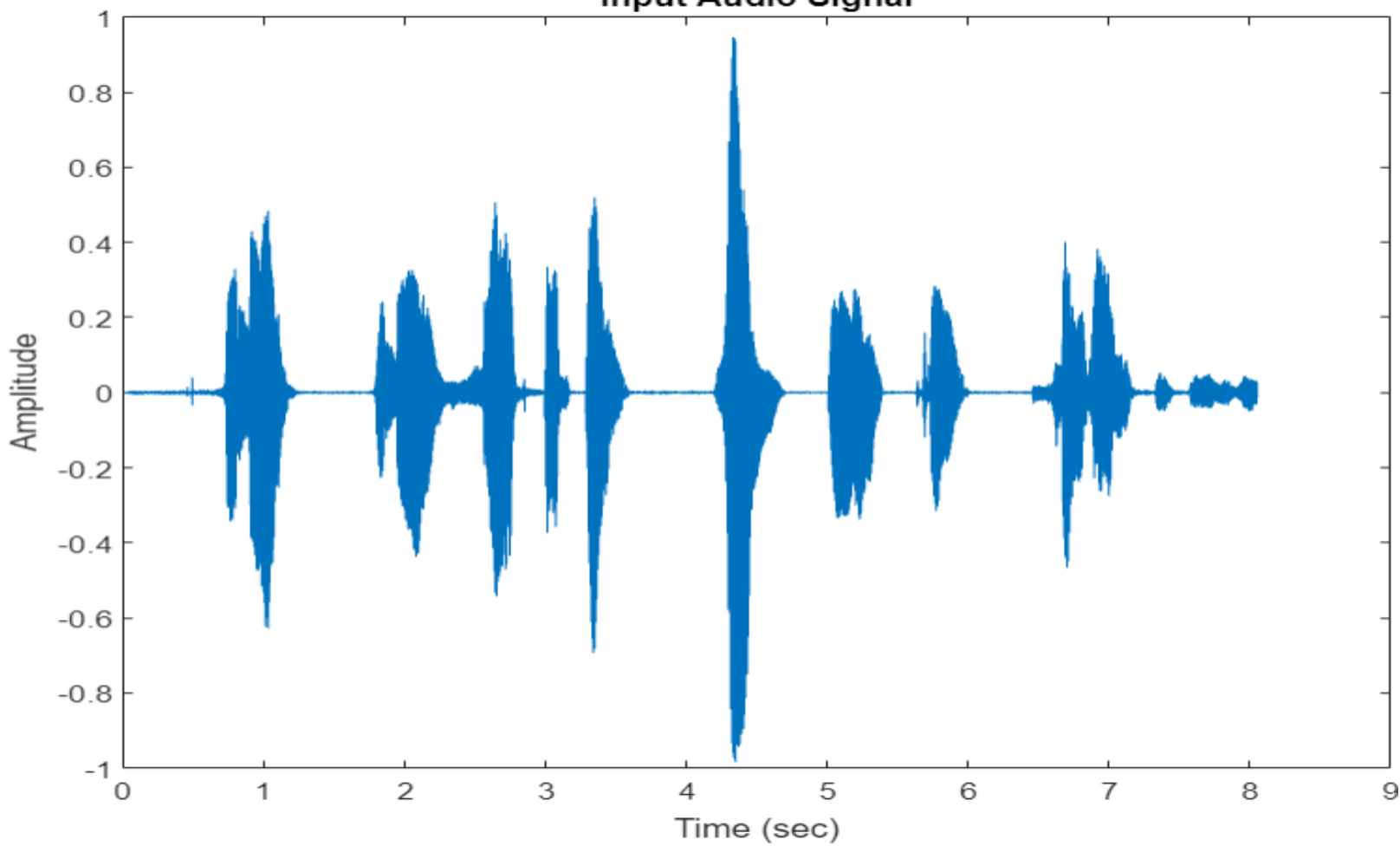
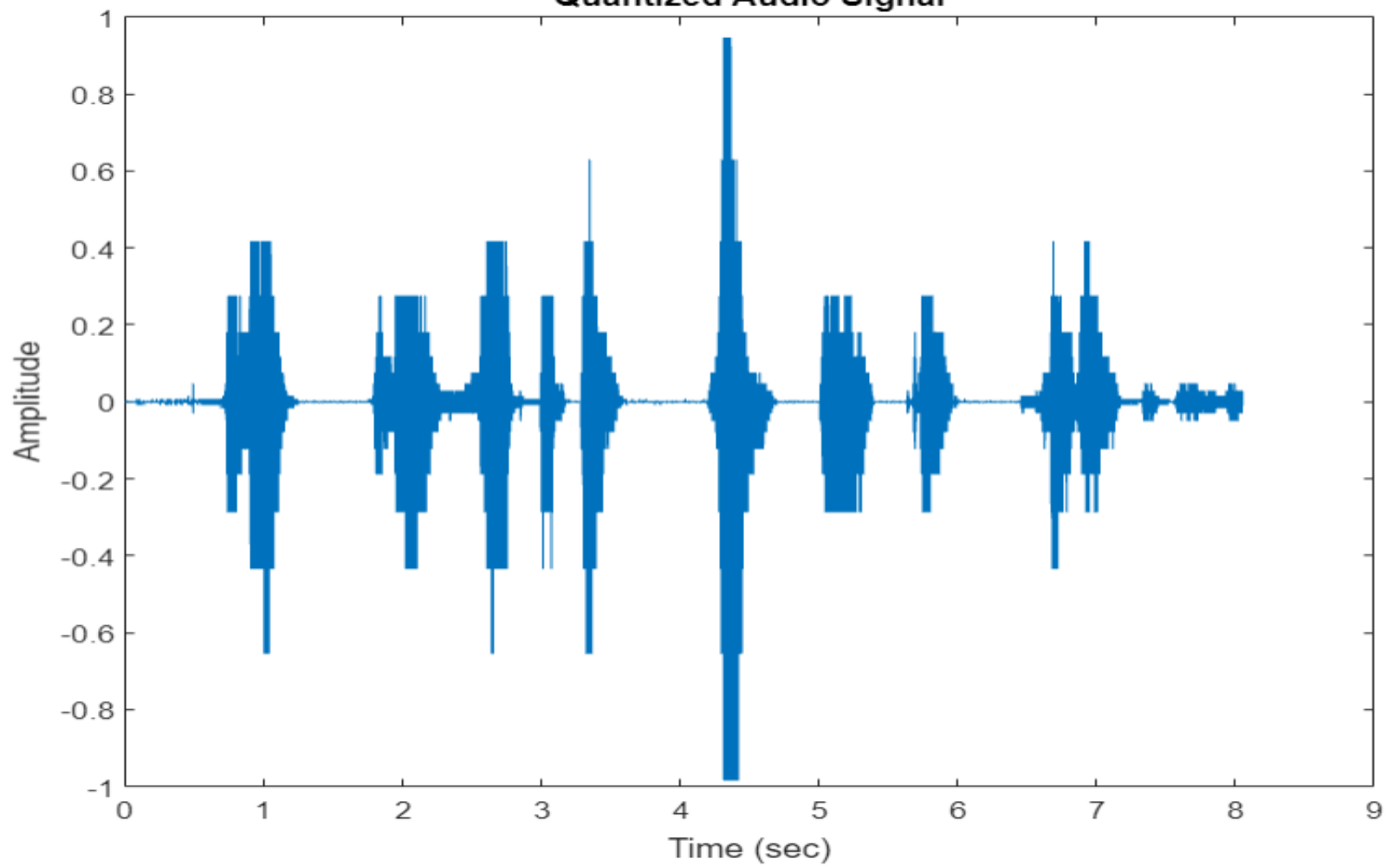


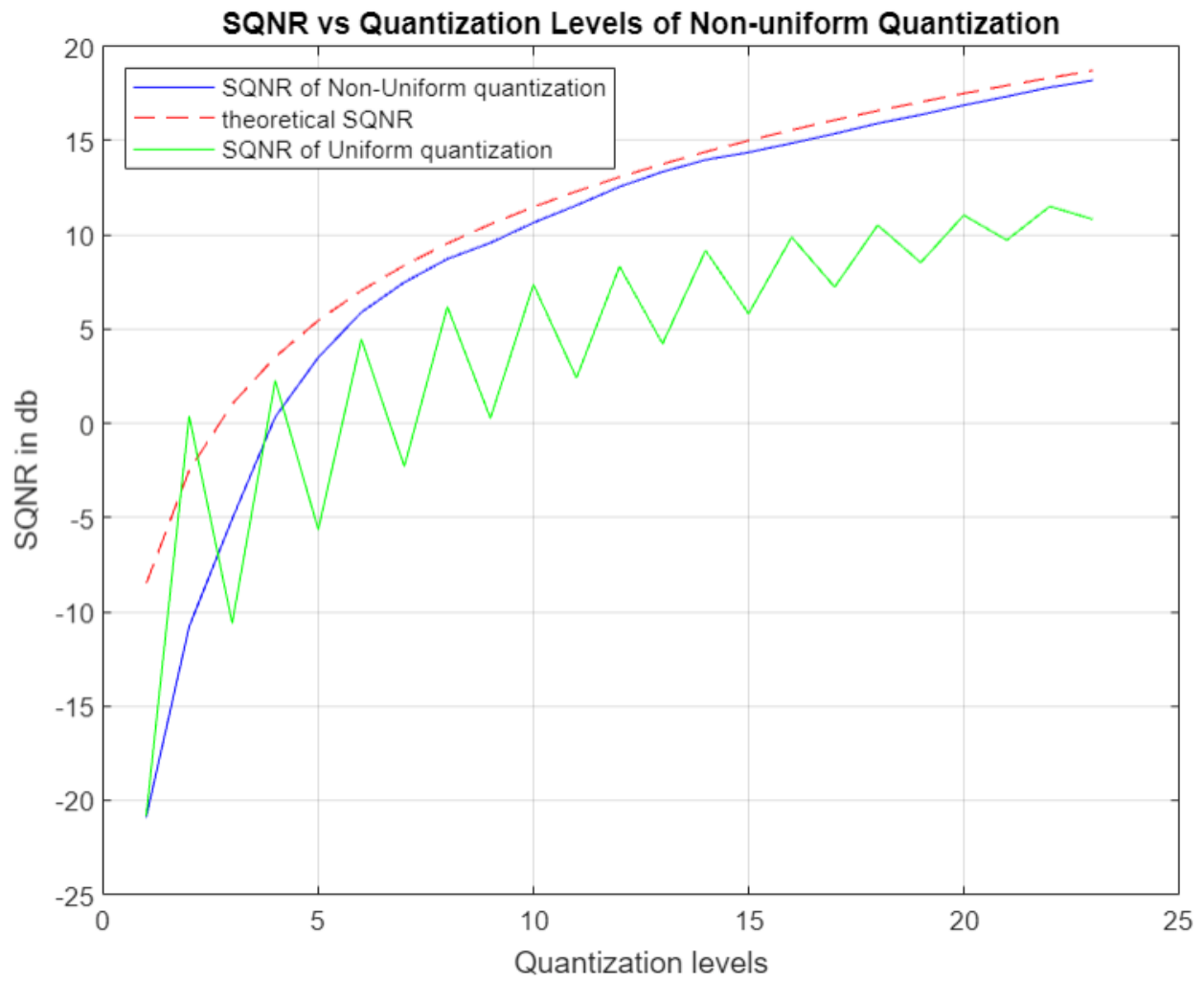
**Input Audio Signal**



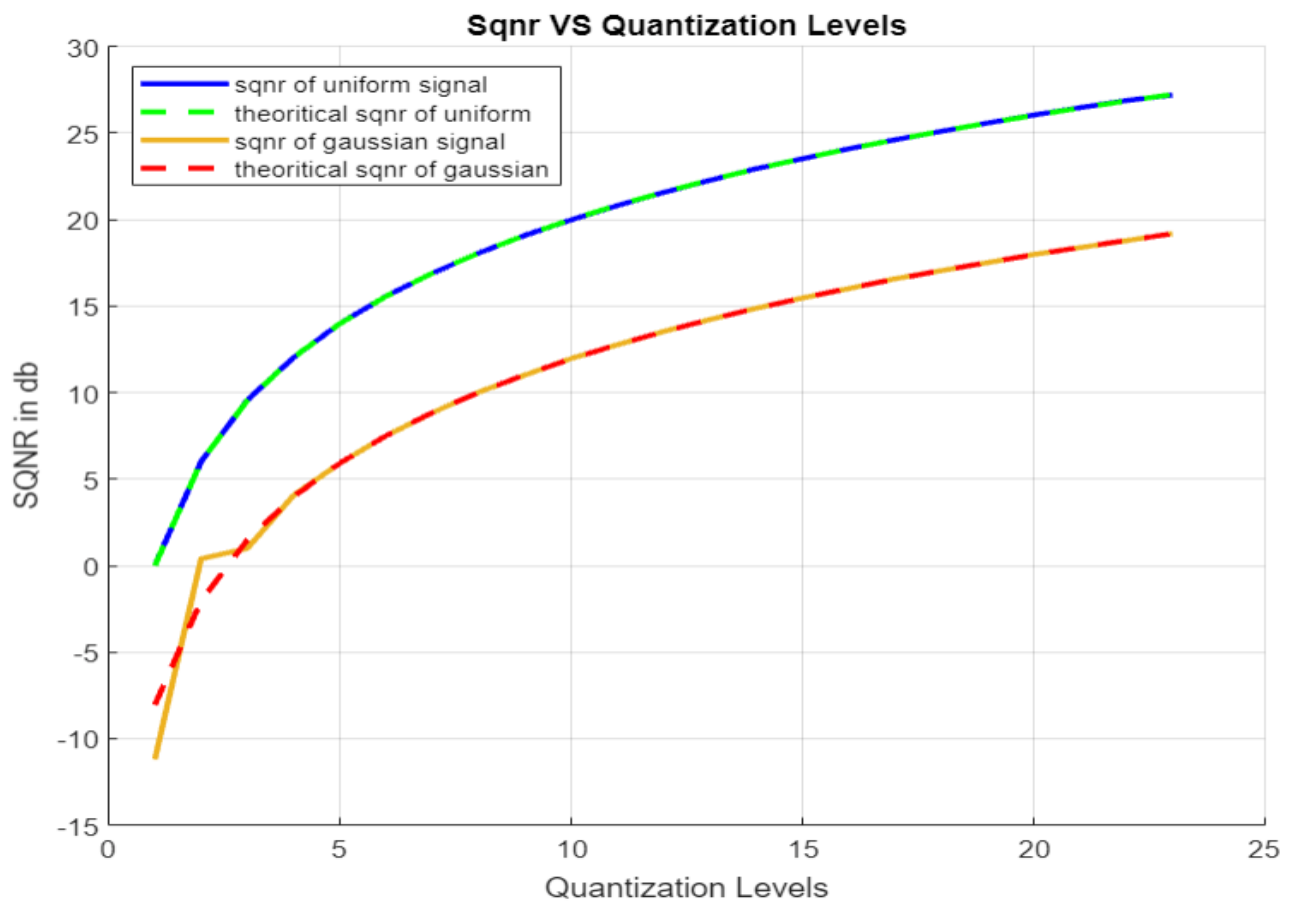
**Quantized Audio Signal**



# Output



# Output



## Input

```
close all;
clc;
levels = 23;
u = 100;
[x, Fs] = audioread('Sample_rec_dc.wav');

plot(x);
title('input audio');

maxs = max(x);
mins = min(x);
compressed_signal = maxs.*sign(x).*(log10(1+u.*(abs(x)./maxs))/log10(1+u));
mx = max(compressed_signal);
mn = min(compressed_signal);
%quantized_signal = compressed_signal;
expanded_signal = compressed_signal;
% Quantization noise for different quantization level
noise_pow = zeros(1, levels);
SNQR = noise_pow;
unif_noise = zeros(1, levels);
unif_SQNR = unif_noise;
% Uniform Quantization
for i = 1:levels
    step = (mx - mn)/i;
    index = round((compressed_signal - mn)./step);
    xq = (index.*step) + mn;
    expanded_signal = maxs* sign(compressed_signal)./u.*((10).^(log10(1+u).*abs(xq)./maxs)-1);
    noise_pow(i) = sum((x - expanded_signal).^2)/length(x);
end
```

```

% uniform
unif_step=(maxs-mins)/i;
unif_index=round((x-mins)./unif_step);
unif_xq = (unif_index.*unif_step)+mins;
unif_noise(i) = sum((x - unif_xq).^2)/length(x);
end

plot(expanded_signal);
title('quantized audio signal');

% playing original audio vs companded audio
sound(x,Fs);
sound(expanded_signal,Fs);
% average signal power
Signal_pow = sum((x).^2)/length(x);
% SQNR in DB : 10log10(Signal_power/noise_power)
SQNR = 10*log10(Signal_pow./noise_pow);
unif_SQNR = 10*log10(Signal_pow./unif_noise);
theoreticalSQNR = 6.02*log2(1:levels) + 4.77 - 20*log10(log(1+u)) ;
% plot
plot((1:levels), SQNR, 'b', (1:levels), theoreticalSQNR, 'r--');
hold on;
plot((1:levels),unif_SQNR , 'g');
ylabel('SQNR in db');
xlabel('Quantization levels');
title('SQNR vs Quantization Levels of Non-uniform Quantization')
legend('SQNR of Non-Uniform quantization' , 'theoretical SQNR','SQNR of Uniform quantization', 'location','northwest');
grid;

```

<u>Calculated SQNR (db)</u>		<u>Theoretical SQNR(db)</u>	
1	-20.918	1	-8.5137
2	-10.781	2	-2.4937
3	-5.0647	3	1.0278
4	0.34306	4	3.5263
5	3.4967	5	5.4643
6	5.8893	6	7.0478
7	7.4856	7	8.3866
8	8.7274	8	9.5463
9	9.5785	9	10.569
10	10.651	10	11.484
11	11.57	11	12.312
12	12.557	12	13.068
13	13.348	13	13.763
14	13.985	14	14.407
15	14.381	15	15.006
16	14.866	16	15.566
17	15.372	17	16.093
18	15.917	18	16.589
19	16.373	19	17.059
20	16.883	20	17.504
21	17.345	21	17.928
22	17.829	22	18.332
23	18.198	23	18.718