Dhirubhai Ambani Institute of
Information and Communication
Technology

ADSP

LAB – 9 : Noise based Analysis

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EXERCISES

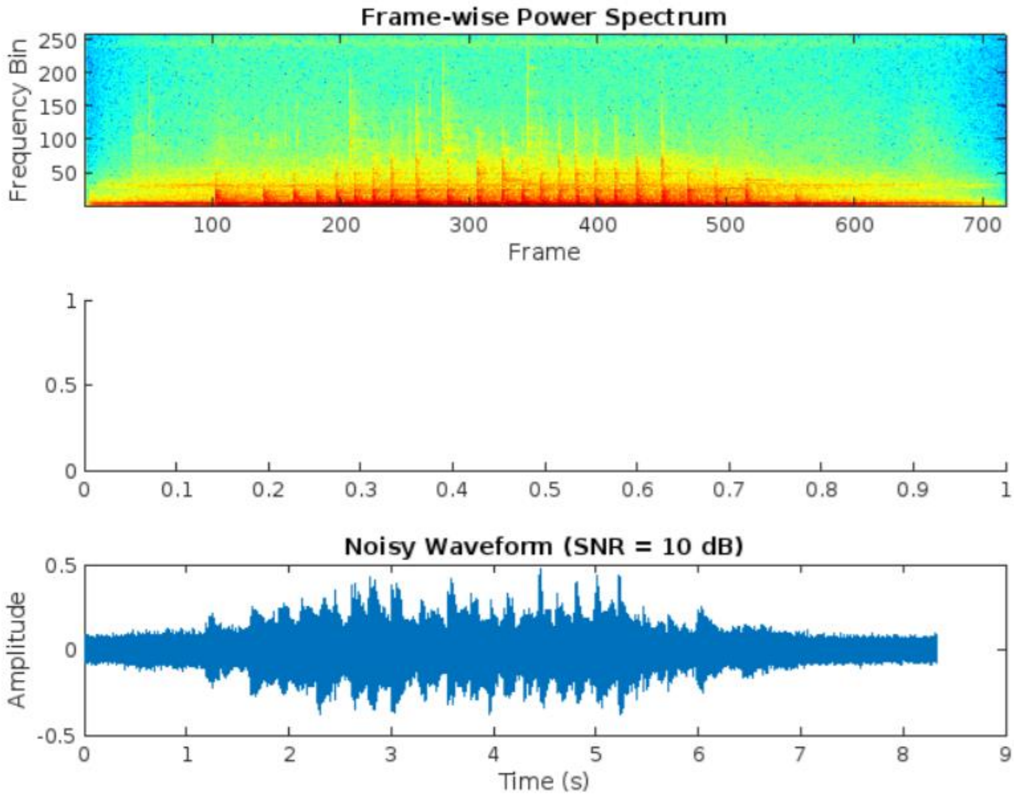
Question)

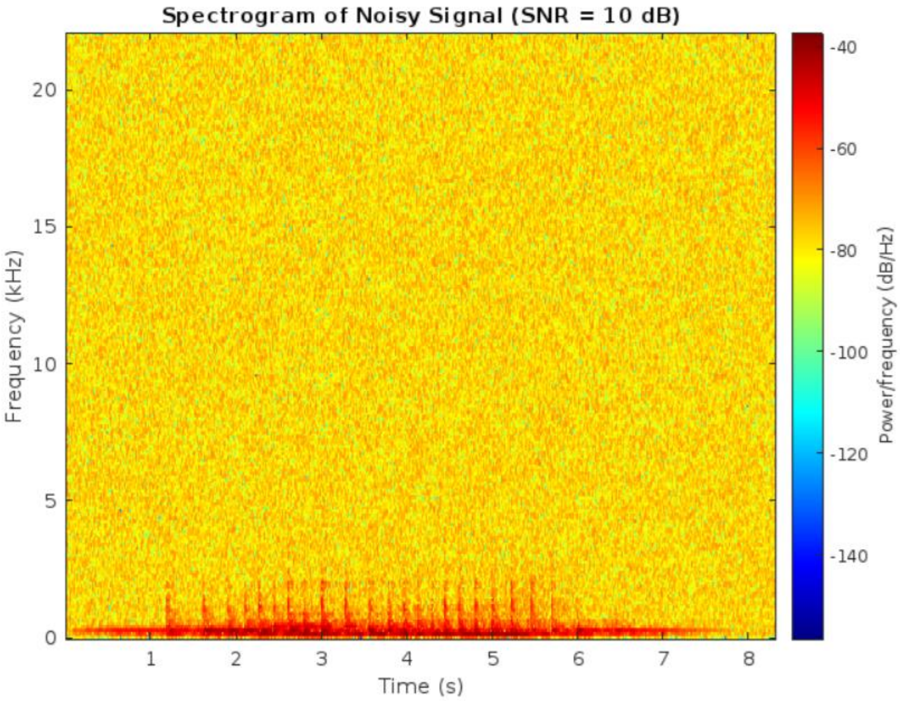
1) **Plot waveform**
2) **Divide into frames of 512 samples / frame**
3) **For each frame, find magnitude square of fourier transform**
4) **Add noise of different SNR level**
5) **Plot spec of noise**

CODE

```
% 202411012

% Parameters
[x, Fs] = audioread('BAK.wav');        % Load audio
x = x(:,1);                            % Use one channel if stereo
frame_len = 512;                       % Frame length
N = length(x);                         % Total samples
num_frames = floor(N / frame_len);    % Number of complete frames
window = hanning(frame_len);          % Optional: smooth windowing
t = (0:N-1) / Fs;                      % Time vector

%% 1) Plot waveform
```

```matlab
figure;
subplot(3,1,1);
plot(t, x);
title('Original Waveform'); xlabel('Time (s)'); ylabel('Amplitude');

%% 2 & 3) Frame-wise magnitude squared Fourier Transform (Power Spectrum)
framewise_power = zeros(frame_len/2, num_frames);

for i = 1:num_frames
    frame = x((i-1)*frame_len + 1 : i*frame_len) .* window;
    X = fft(frame);
    P = abs(X(1:frame_len/2)).^2;     % Magnitude square (one-sided)
    framewise_power(:,i) = P;
end

% 3D Spectrogram-like plot (linear scale)
subplot(3,1,2);
imagesc(10*log10(framewise_power));
axis xy; colormap jet;
title('Frame-wise Power Spectrum'); xlabel('Frame'); ylabel('Frequency Bin');

%% 4) Add noise of different SNR levels (e.g., 10 dB)
snr_dB = 10;
x_noisy = awgn(x, snr_dB, 'measured');  % Add white Gaussian noise

%% 5) Plot noisy waveform & spectrum
subplot(3,1,3);
plot(t, x_noisy); title(['Noisy Waveform (SNR = ' num2str(snr_dB) ' dB)']);
xlabel('Time (s)'); ylabel('Amplitude');

% Optional: Plot noise spectrum
figure;
spectrogram(x_noisy, window, frame_len/2, frame_len, Fs, 'yaxis');
title(['Spectrogram of Noisy Signal (SNR = ' num2str(snr_dB) ' dB)']);
colormap jet;
```


Frame-wise Power Spectrum
Frequency Bin
250
200
150
100
50
100
200
300
400
500
600
700
Frame
1
0.5
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Noisy Waveform (SNR = 10 dB)
Amplitude
0.5
0
-0.5
0
1
2
3
4
5
6
7
8
9
Time (s)


Spectrogram of Noisy Signal (SNR = 10 dB)
Frequency (kHz)
20
15
10
5
0
1
2
3
4
5
6
7
8
Time (s)
-40
-60
-80
-100
-120
-140
Power/frequency (dB/Hz)

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