

EXPERIMENT 8: Enhancement of Audio and Speech Signals

```
clc; clear; close all;

%% Load Speech Signal
[audio, fs] = audioread('Jingle.wav'); % Load speech file

%% Add White Noise
noise_white = 0.02 * randn(size(audio));
audio_noisy_white = audio + noise_white;

%% Add Background Noise (Simulated Low-Frequency Noise)
t = (0:length(audio)-1) / fs;
background_noise = 0.01 * sin(2 * pi * 50 * t(:));
audio_noisy_bg = audio + background_noise;

%% Noise Reduction using Spectral Subtraction
N = length(audio);
Y = fft(audio_noisy_white);
N_est = fft(noise_white); % Estimate noise spectrum
Y_denoised = Y - N_est;
audio_denoised_ss = real(ifft(Y_denoised)); % Inverse FFT to recover signal

%% Noise Reduction using Wiener Filtering
clean_signal = wiener2(audio_noisy_white, [5 5]); % Wiener filter for speech enhancement

%% Plot Original, Noisy, and Enhanced Signals
figure;
subplot(4,1,1); plot(audio); title('Original Speech Signal'); xlabel('Samples');
ylabel('Amplitude');
subplot(4,1,2); plot(audio_noisy_white); title('White Noise Added');
xlabel('Samples'); ylabel('Amplitude');
subplot(4,1,3); plot(audio_denoised_ss); title('Denoised Speech (Spectral Subtraction)');
xlabel('Samples'); ylabel('Amplitude');
subplot(4,1,4); plot(clean_signal); title('Enhanced Speech (Wiener Filter)');
xlabel('Samples'); ylabel('Amplitude');
```