

### Lab Experiment 3 Short time domain analysis of audio and speech Signals

```
clear; clc; close all;

% Load the audio signal
[audioSignal, fs] = audioread('Conference.wav'); % Replace with your audio file
audioSignal = audioSignal(:, 1); % Use the first channel if stereo

% Time vector for plotting
t = (0:length(audioSignal)-1) / fs;

% Plot the original waveform
figure;
subplot(3,1,1);
plot(t, audioSignal);
xlabel('Time (seconds)');
ylabel('Amplitude');
title('Time Domain Representation of the Audio Signal');
grid on;

%% Short-Time Energy (STE) Calculation
frameSize = 0.02 * fs; % 20ms frame
frameOverlap = 0.01 * fs; % 10ms overlap

numFrames = floor((length(audioSignal) - frameOverlap) / (frameSize - frameOverlap));
STE = zeros(1, numFrames);

for i = 1:numFrames
    startIdx = (i-1) * (frameSize - frameOverlap) + 1;
    endIdx = min(startIdx + frameSize - 1, length(audioSignal));
    frame = audioSignal(startIdx:endIdx);
    STE(i) = sum(frame.^2); % Compute short-time energy
end

% Time axis for STE
steTime = linspace(0, max(t), numFrames);

% Plot Short-Time Energy
subplot(3,1,2);
plot(steTime, STE, 'r');
xlabel('Time (seconds)');
ylabel('Energy');
title('Short-Time Energy (STE)');
grid on;

%% Short-Time Fourier Transform (STFT)
windowSize = 256; % Define window size
overlap = 128; % Define overlap samples
nfft = 512; % Number of FFT points

figure;
spectrogram(audioSignal, windowSize, overlap, nfft, fs, 'yaxis');
title('Spectrogram of the Audio Signal');
```

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%% Feature Extraction: Zero Crossing Rate (ZCR)
ZCR = zeros(1, numFrames);
for i = 1:numFrames
    startIdx = (i-1) * (frameSize - frameOverlap) + 1;
    endIdx = min(startIdx + frameSize - 1, length(audioSignal));
    frame = audioSignal(startIdx:endIdx);
    ZCR(i) = sum(abs(diff(sign(frame)))) / (2 * length(frame)); % Compute ZCR
end

% Plot Zero Crossing Rate
figure;
plot(steTime, ZCR, 'b');
xlabel('Time (seconds)');
ylabel('Zero Crossing Rate');
title('Zero Crossing Rate (ZCR)');
grid on;
disp('Short-Time Analysis Completed.');
```