% Title: Write a program for STFT and plot spectrogram.

% Aim: To learn STFT and Spectrogram.

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% \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*Program starts here\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

% Frequency signals declarations

fs = 1000; % Sampling frequency

f1 = 10; % 10 Hz

f2 = 100; % 50 Hz

f3 = 200; % 100 Hz

% Signal duration declarations

ts = 1/fs; % Sampling period or signal duration

dt = 0:ts:2-ts; % Signal duration

% Amplitude [V] declarations

A = 10; % in Volts

B = 20; % in Volts

C = 30; % in Volts

% Signal description

% Generating Signal I

X = A\*sin(2\*pi\*f1\*dt) + B\*sin(2\*pi\*f2\*dt) + C\*sin(2\*pi\*f3\*dt);

% Calculating STFT and plotting Spectrogram

Nx = length(X); % Length of the signal x

nsc = floor(Nx/4.5); % Window length in integer

nov = floor(nsc/2); % No. of overlapped samples

nfft = max(256,2^nextpow2(nsc)); % No. of DFT points

t = spectrogram(X,hamming(nsc),nov,nfft); % Calculating STFT

% here hamming(nsc) provides window of length nsc

% this instruction uses nfft sampling points to calculate the discrete Fourier transform

figure('Name','Spectrogram of Signal X');

spectrogram(X,hamming(nsc),nov,nfft,'yaxis'); % Plotting Spectrogram

axis tight;

% view(0, );

% Calculating FFT of signal X

nfftX = length(X);

nfftX1 = 2^nextpow2(nfftX);

Y = fft(X,nfftX1);

xY = fs\*(0:nfftX1/2-1)/nfftX1;

Y1 = Y(1:nfftX1/2);

% Plotting Signal X in time domain and frequency domain

figure('Name','FFT of Signal X');

subplot(2,1,1);

plot(dt,abs(X),'r');

axis tight;

xlabel("Time [S]");

ylabel("Amplitude [V]");

title("Signal X in Time Domain");

subplot(2,1,2);

plot(xY, abs(Y1),'r');

axis tight;

xlabel("Frequency [Hz]");

ylabel("Magnitude");

title("FFT of Signal X");

% \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*Program ends here\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*