% Title: Fast Fourier Transform of given signals

% Aim: To prove that FFT can not identify change in sequence of signal.

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

% Frequency signals declarations

fs = 1000; % Sampling frequency

f1 = 10; % 10 Hz

f2 = 50; % 50 Hz

f3 = 100; % 100 Hz

% Signal duration declarations

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

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

dt1 = 0:ts:((2-ts)/3); % Signal duration 1

dt2 = ((2-ts)/3):ts:(2\*(2-ts)/3); % Signal duration 2

dt3 = (2\*(2-ts)/3):ts:2-ts; % Signal duration 3

% Amplitude [V] declarations

A = 10; % in Volts

B = 10; % in Volts

C = 10; % 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);

% Generating Signal II

x1 = A\*sin(2\*pi\*f1\*dt1) + B\*sin(2\*pi\*f2\*dt1) + C\*sin(2\*pi\*f3\*dt1);

% Generating Signal III

p1 = A\*sin(2\*pi\*f1\*dt1);

p2 = B\*sin(2\*pi\*f2\*dt2);

p3 = C\*sin(2\*pi\*f3\*dt3);

x2 = [p1 p2 p3];

% Applying FFT

nfftX = length(X);

nfftX1 = 2^nextpow2(nfftX);

Y = fft(X,nfftX1);

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

Y1 = Y(1:nfftX1/2); % FFT of Signal I

nfftx1 = length(x1);

nfftx11 = 2^nextpow2(nfftx1);

y1 = fft(x1, nfftx11);

xy1 = fs\*(0:nfftx11/2-1)/nfftx11;

y12 = y1(1:nfftx11/2); % FFT of Signal II

nfftx2 = length(x2);

nfftx21 = 2^nextpow2(nfftx2);

y2 = fft(x2, nfftx21);

xy2 = fs\*(0:nfftx21/2-1)/nfftx21;

y21 = y2(1:nfftx21/2); % FFT of Signal III

% Main figure details

figure('Name','FFT of Signals');

% Plotting Figure I and its FFT

subplot(2,3,1);

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

xlabel("Time [S]");

ylabel("Amplitude [V]");

title("Signal X in Time Domain");

subplot(2,3,4);

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

xlabel("Frequency [Hz]");

ylabel("Magnitude");

title("FFT of Signal X");

% Plotting Figure II and its FFT

subplot(2,3,2);

plot(dt1,abs(x1),'r');

xlabel("Time [S]");

ylabel("Amplitude [V]");

title("Signal x1 in Time Domain");

subplot(2,3,5);

plot(xy1, abs(y12),'r');

xlabel("Frequency [Hz]");

ylabel("Magnitude");

title("FFT of Signal x1");

% Plotting Figure III and its FFT

subplot(2,3,3);

plot(abs(x2),'r');

xlabel("Time [S]");

ylabel("Amplitude [V]");

title("Combined Signal x2 in Time Domain");

subplot(2,3,6);

plot(xy2, abs(y21),'r');

xlabel("Frequency [Hz]");

ylabel("Magnitude");

title("FFT of Signal x2");

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