Example 8-15: DFT Computation of Fourier series.

Purpose:

At a sampling rate of 50 sample/s, the number of samples generated by a periodic signal with period $T_0 = 0.2$ s and $f_{\max} = 25$ Hz is $N = f_s T_0 = 50 \times 0.2 = 10$ samples. Compute the Fourier-series coefficients of $x(t)$, given its sampled values: $\{\underline{9}, 0.117, -5.195, 1.859, 11.53, 9, -4.585, -12.8, -5.75, 6.827\}$.

Inputs:

X=samples of one period of signal.
fs=sampling rate in sample per s.

Outputs:

Line spectrum of $x(t)$ computed using DFT.

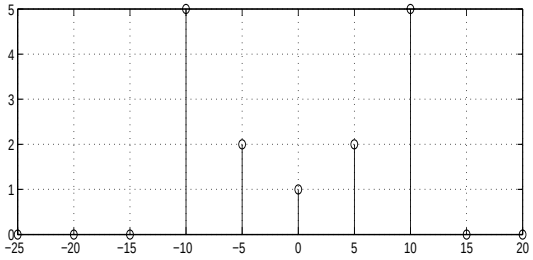

Figure 1: DFT-computed line spectrum.

Comments:

- A stem plot is used since the spectrum is computed only at discrete points.
- `fftshift` is used to shift dc (Ω=0) to the middle of the two-sided spectrum.

Program:

```
clear;fs=50;P=0.2;
t=[0:1/fs:P-1/fs];L=P*fs;
X=1+4*sin(2*pi*5*t);
X=X+10*cos(2*pi*10*t+0.6435);
f=[-(L/2):(L/2-1)]*fs/L;
FX=fft(X)/L;subplot(211),
stem(f,fftshift(abs(FX))),grid on
```