

ZOOM FFT MATLAB EXAMPLE

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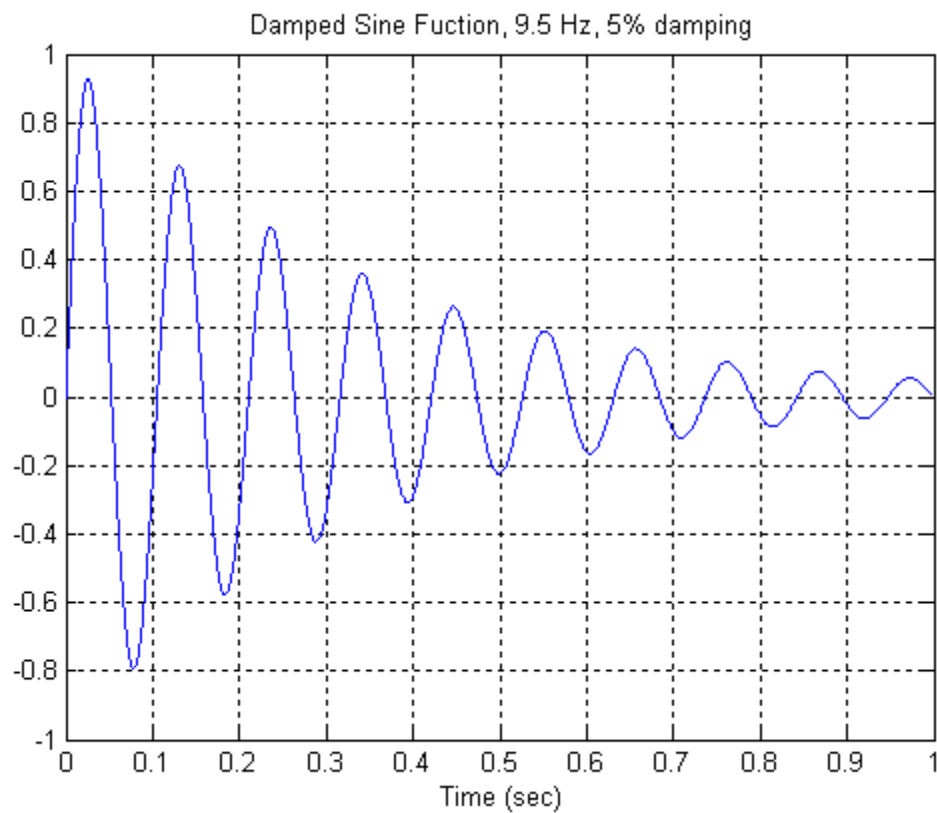


Figure 1.

Consider the damped sine function in Figure 1. The ASCII filename is: d9p5.txt.

The sample rate is 4096 samples per second. The duration is 1 second. The frequency increment for the Fourier transform is thus 1 Hz, which is the inverse of the duration. The Fast Fourier Transform (FFT) is shown in Figure 2.

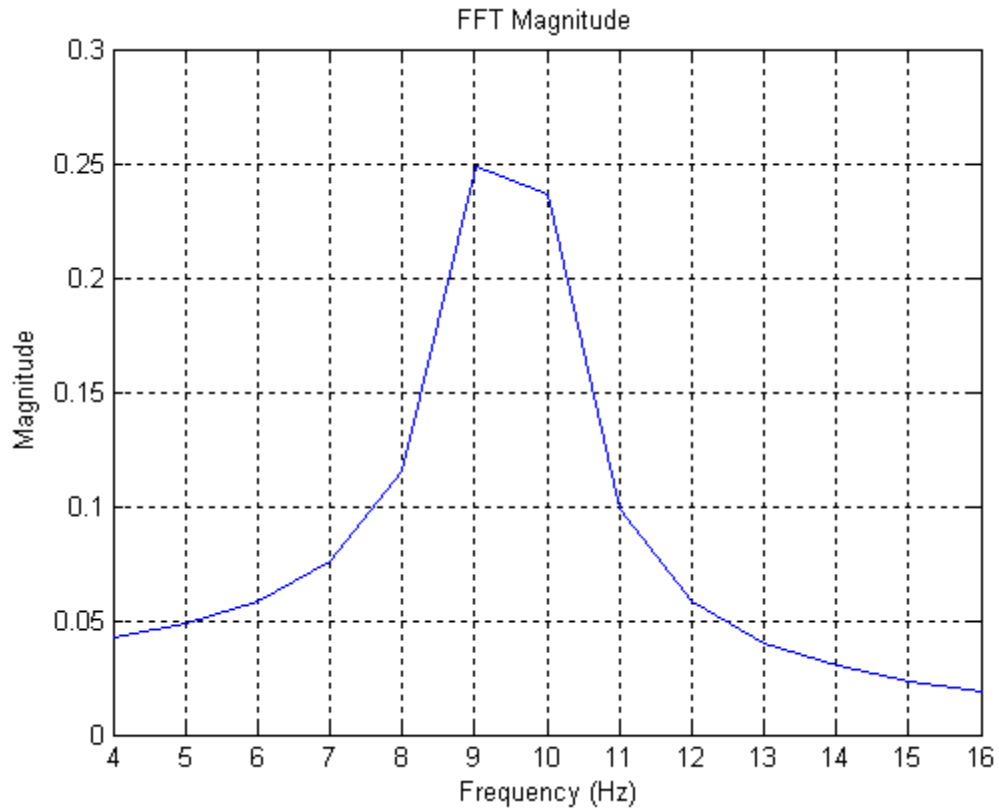


Figure 2.

Figure 2 shows the FFT of the damped sine function over the 4 to 16 Hz domain.

The FFT has its peak value at 9.0 Hz. Again, the FFT increment is 1 Hz. The FFT cannot represent the frequency of the damped sine function with the desired accuracy.

The zoom FFT can give a finer frequency resolution.

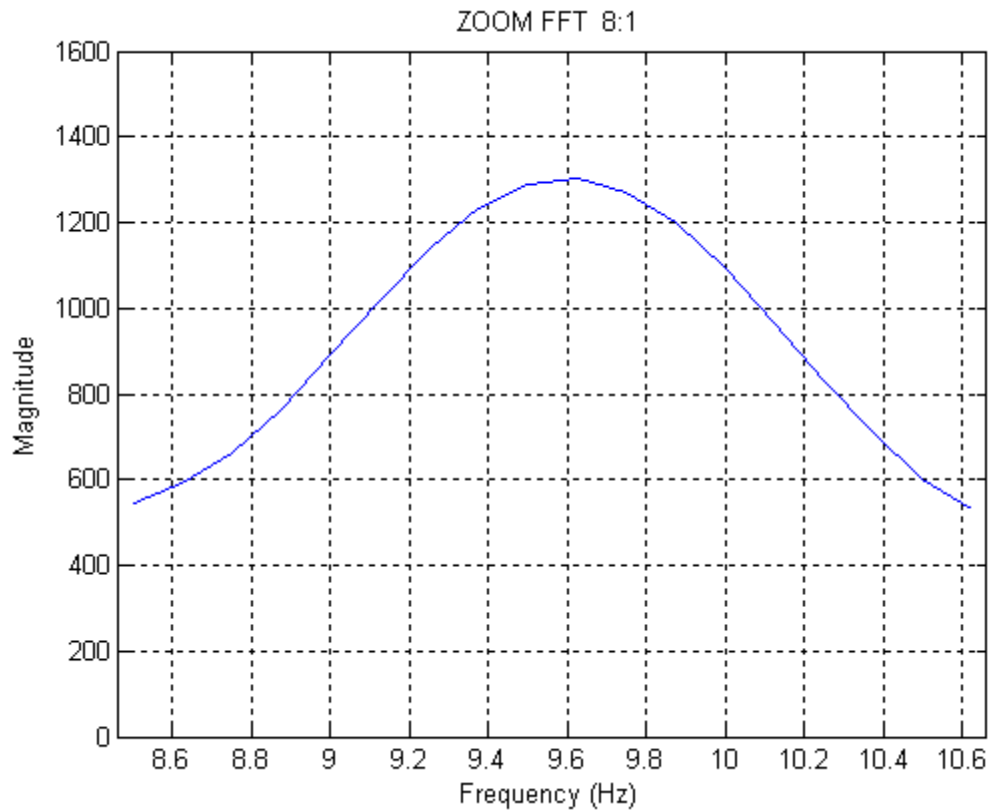


Figure 3.

The 8:1 Zoom FFT is shown in Figure 3. The frequency increment is 0.125 Hz. The peak value occurs at 9.6 Hz, which is very close to the actual frequency of 9.5 Hz.

The zoomFFT was calculated using:

zoomFFT - version 1.3, October 13, 2006

The input is shown in Appendix A.

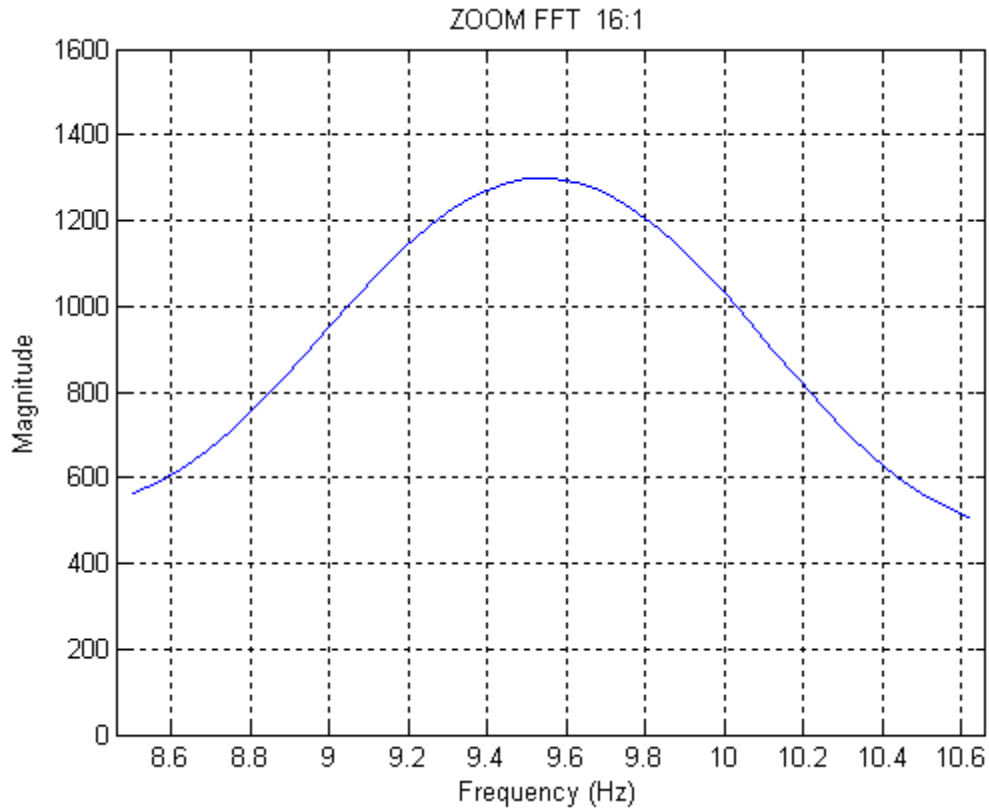


Figure 4.

The 16:1 Zoom FFT is shown in Figure 4. The frequency increment is 0.0625 Hz. The peak value occurs at 9.5 Hz, which is the true frequency.

Additional Notes

The example shown in this tutorial was for a simplified case. The Zoom FFT requires some trial-and-error and engineering judgment. It may not be appropriate for a given time history. It is more suitable for shorter data segments, where the time history only captures a few cycles, say less than 20 cycles.

The example in Figure 1 had almost 10 cycles.

APPENDIX A

Input to zoomFFT Program

```
>> zoomFFT
```

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This program calculates the non-destructive zoom
Fast Fourier transform of a time history.

The input file must be time(sec) and amplitude(units)

The format is free, but no header lines allowed.

Please enter the input filename.

Select file input method

1=external ASCII file

2=file preloaded into Matlab

1

time history length = 4096

samples used for FFT = 4096

dt= 0.0002441 sec sr= 4096 Hz

df= 1 Hz

Enter frequency (Hz) of interest

9.5

Choose Zoom Factor

1 = 1:1

2 = 2:1

3 = 4:1

4 = 8:1

5 = 16:1

4

begin FFT

accumulator

** See Figure 1 **

Change frequency limits on plot? 1=yes 2=no
2

y_{max} =

2000

Repeat with different zoom factor? 1=yes 2=no
1

time history length = 4096

samples used for FFT = 4096

dt= 0.0002441 sec sr= 4096 Hz

df= 1 Hz

Enter frequency (Hz) of interest
9.5

Choose Zoom Factor

1 = 1:1

2 = 2:1

3 = 4:1

4 = 8:1

5 = 16:1

5

begin FFT

accumulator

** See Figure 1 **

Change frequency limits on plot? 1=yes 2=no
2

y_{max} =

2000

Repeat with different zoom factor? 1=yes 2=no
2

Time history retained as matrix: time_history