RIYA Week 4 Presentation

Frequency Domain Analysis

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Tasks accomplished

- Performed calibration of the FFT code using a pure sinusoid function
- Attempted to improve the FFT results of the non-linear system

FFT Calibration

Acceleration signal = Sinusoid with frequency 250 Hz and RMS value 0.1g

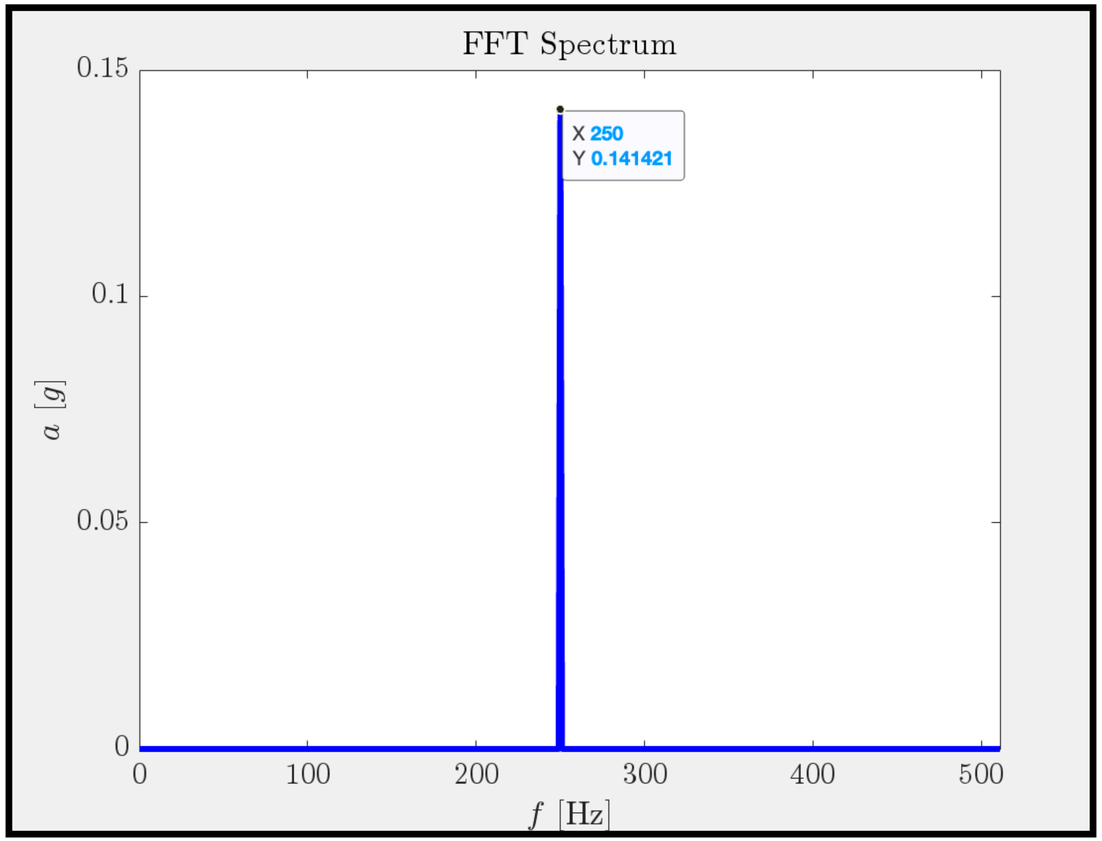
```
%% Case 3

fs3 = 1024; % Sampling frequency
duration3 = 30; % Duration of signal
N3 = fs3 * duration3; % Number of samples
t3 = 0:1/fs3:duration3-1/fs3; % Time vector
f3 = 0.1*sqrt(2)*sin(250*2*pi*t3); % Vector respresenting 250 Hz sinusoidal signal with 0.1g RMS
```

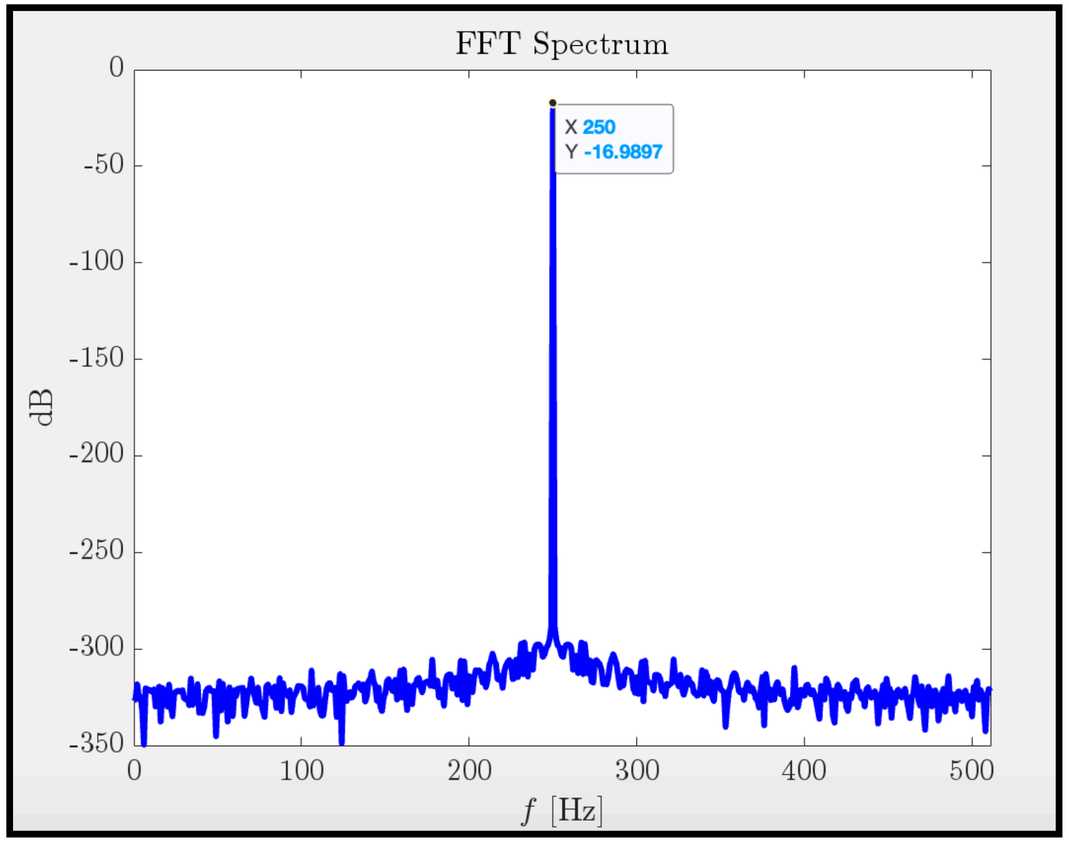
DSP parameters (in **seconds/ Hz** appropriately **)**

```
DSP Parameters
    "Time resolution"    "0.00097656"

    "Time record"    "29.999"

    "Sampling frequency"    "1024"

    "Frequency resolution"    "1"

    "Number of points"    "1024"
```

Post-Calibration results

For the previous sinusoid acceleration signal, used for calibration





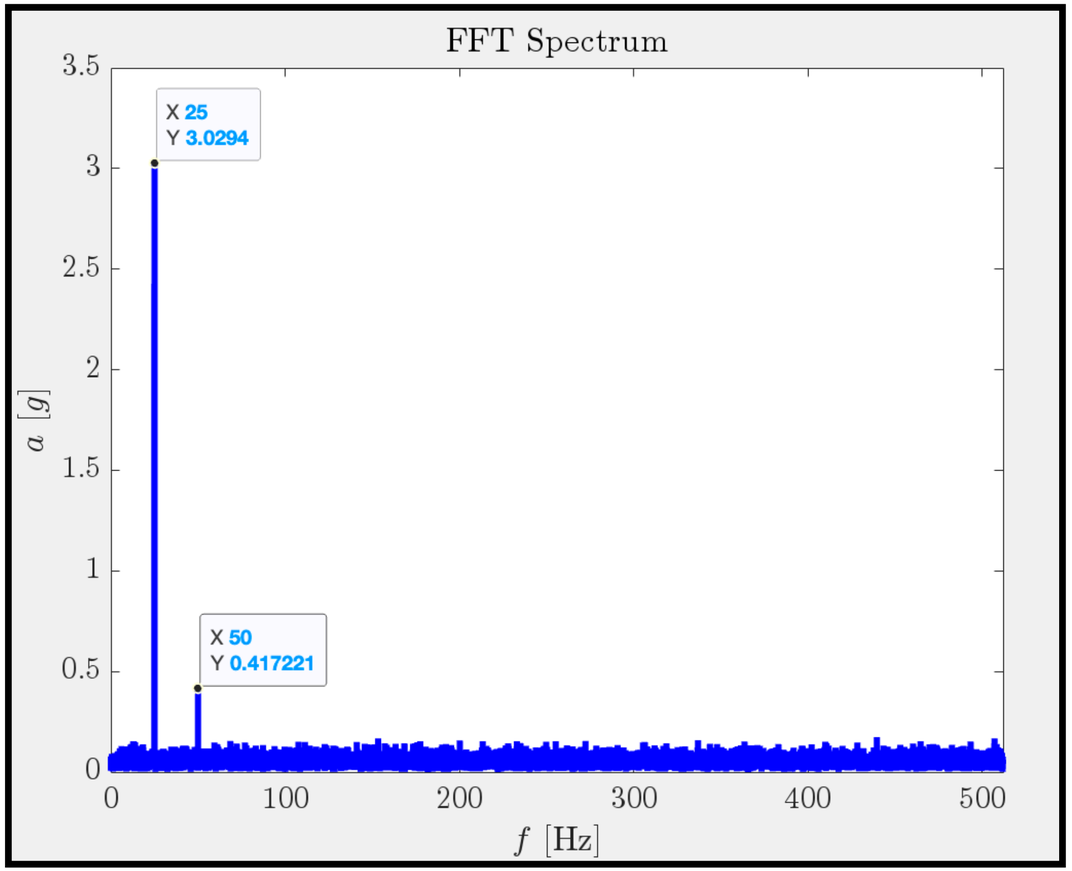
Post-Calibration results

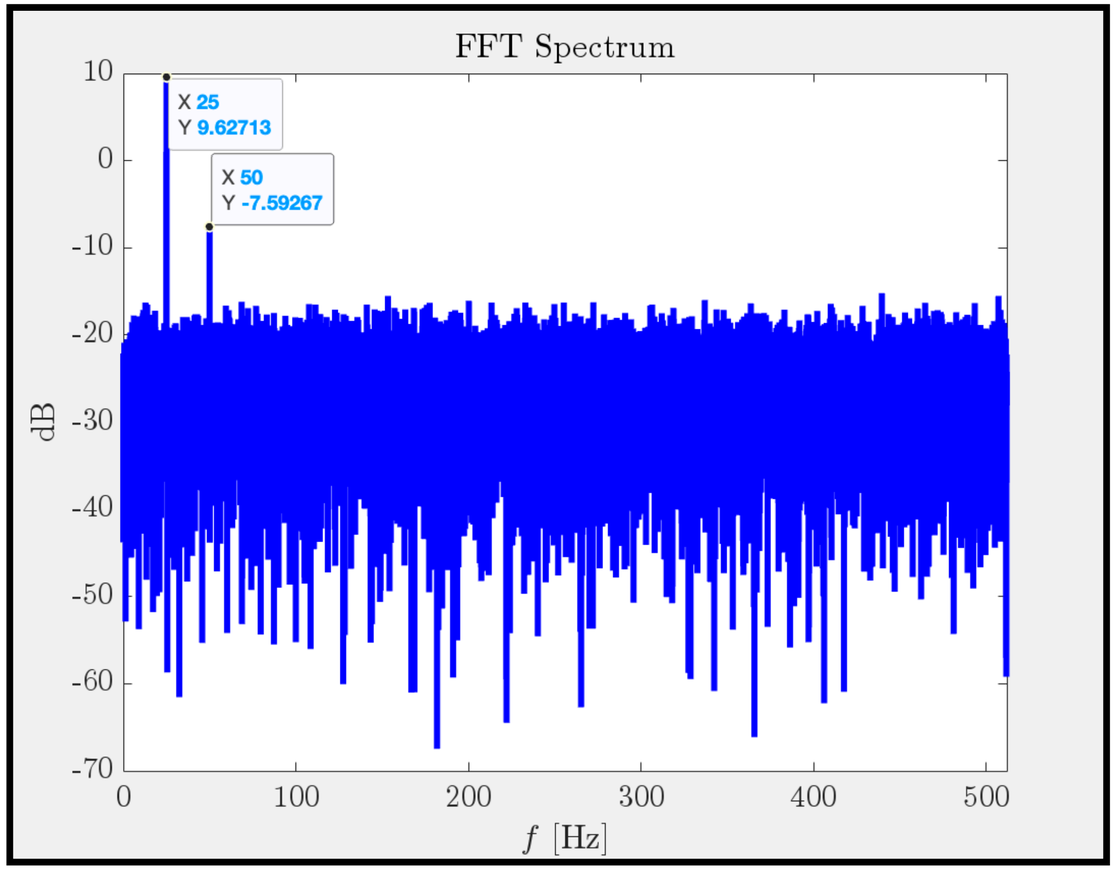
Example 2

```
fs2 = 1024;
duration2 = 30;
N2 = fs2 * duration2;
t2 = 0:1/fs2:duration2-1/fs2;
f2 = 3*sin(25*2*pi*t2) + 0.4*sin(50*2*pi*t2 - 49*pi/180) + 5*(randn(size(t2)));
```

```
DSP Parameters
    "Time resolution"    "0.00097656"

    "Time record"    "29.999"

    "Sampling frequency"    "1024"

    "Frequency resolution"    "0.033333"

    "Number of points"    "30720"
```

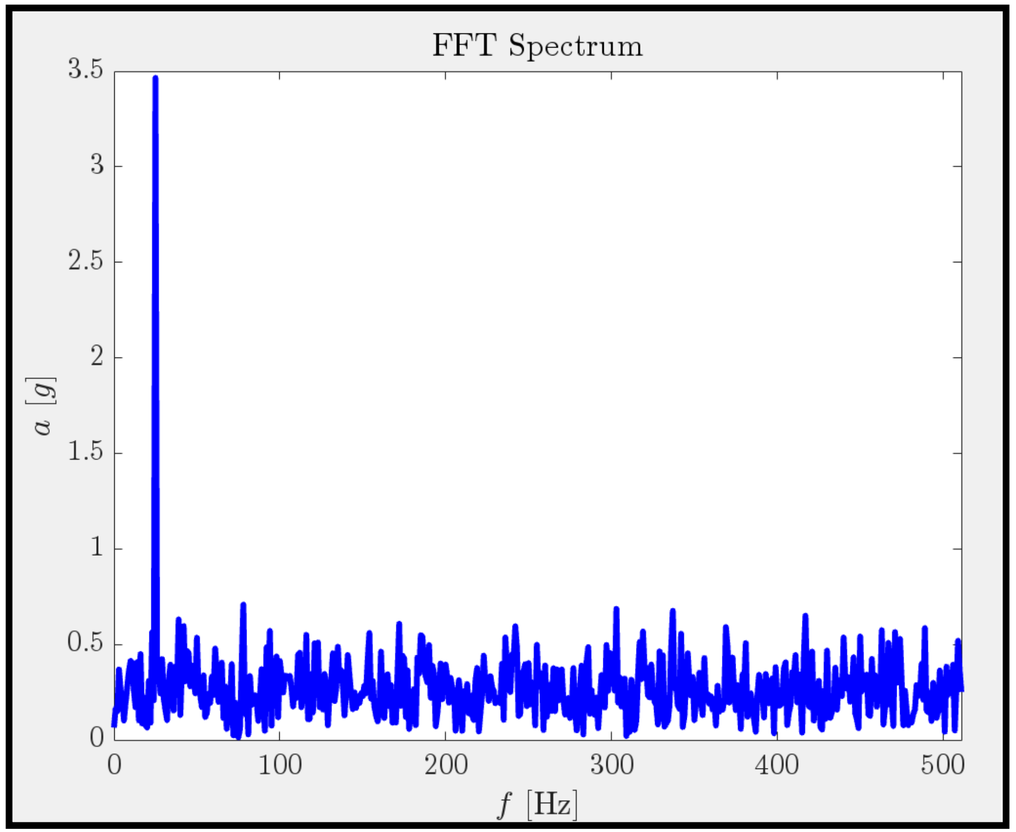
Post-Calibration results

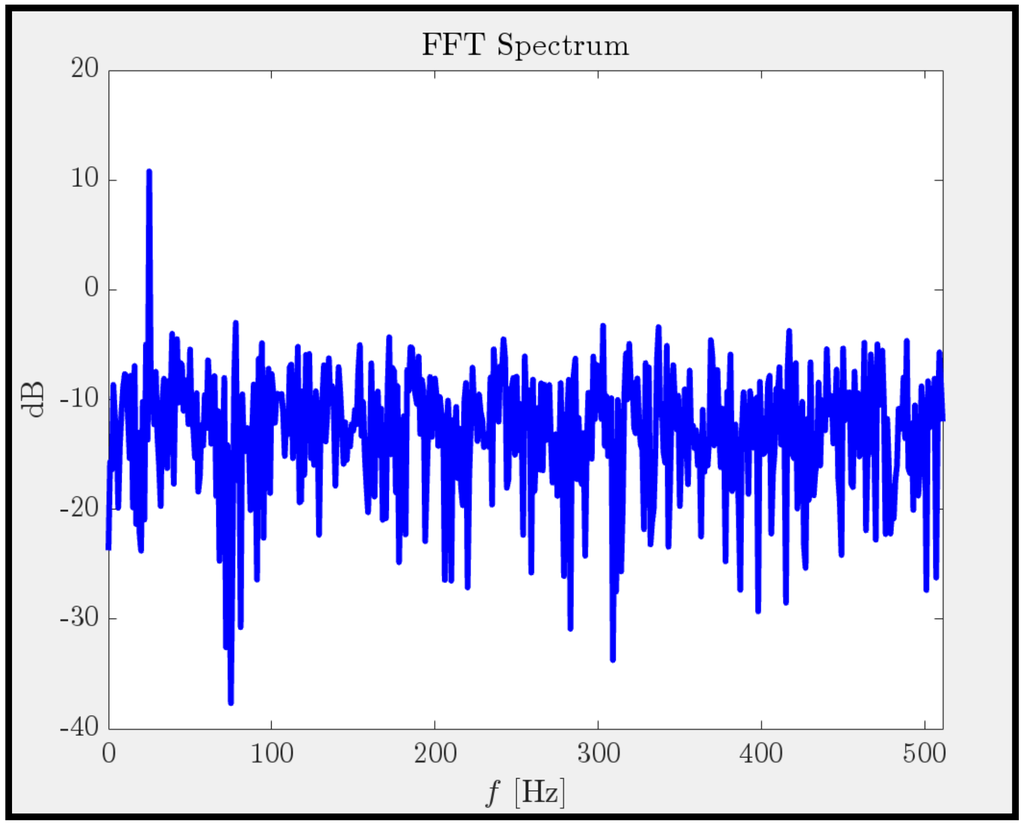




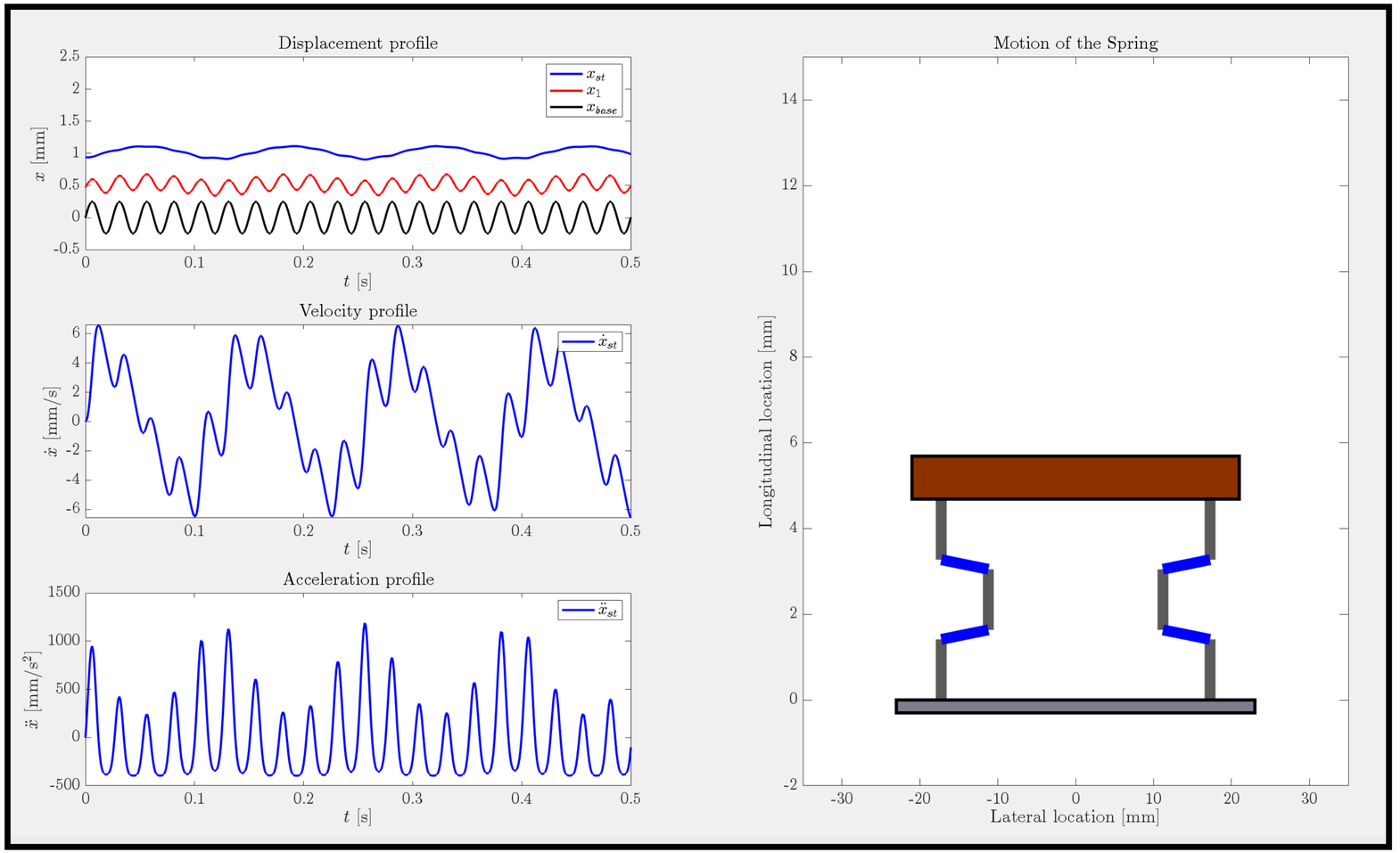
Post-Calibration results

When **NFFT = 1024**, where is the other peak ??





FFT analysis for Disc spring stack



Height/Thickness ratio

$$\frac{h_1}{\tau} = \frac{h_2}{\tau} = \sqrt{2}$$

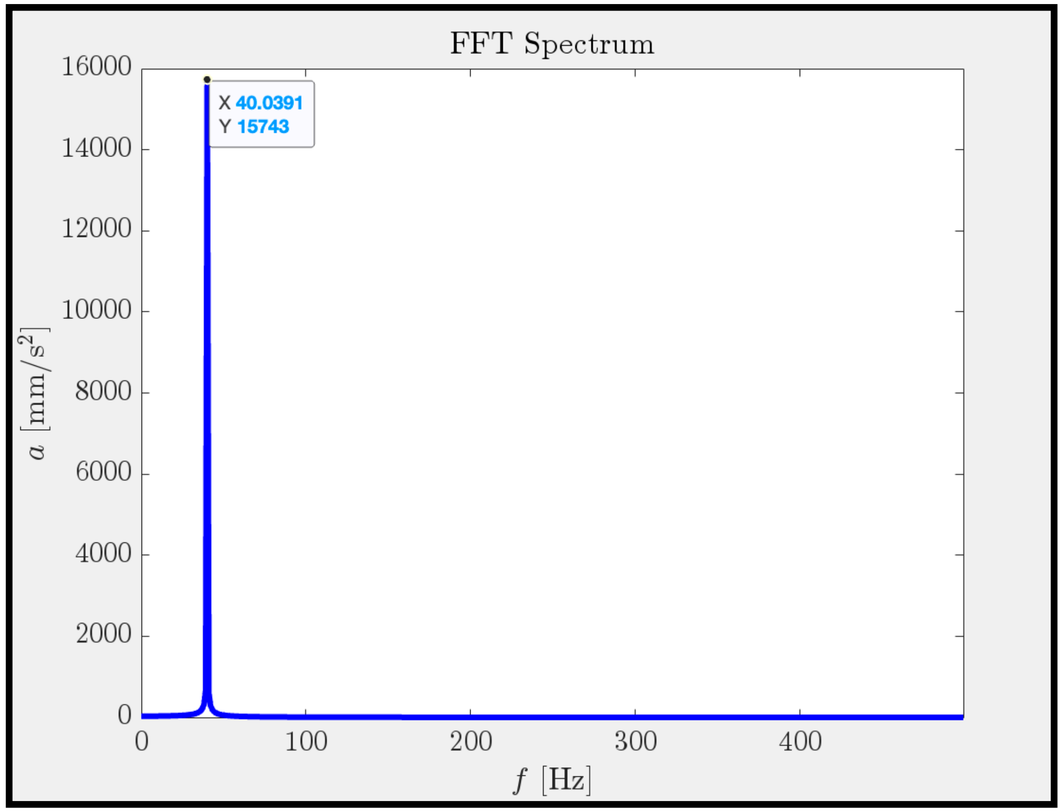
Base displacement

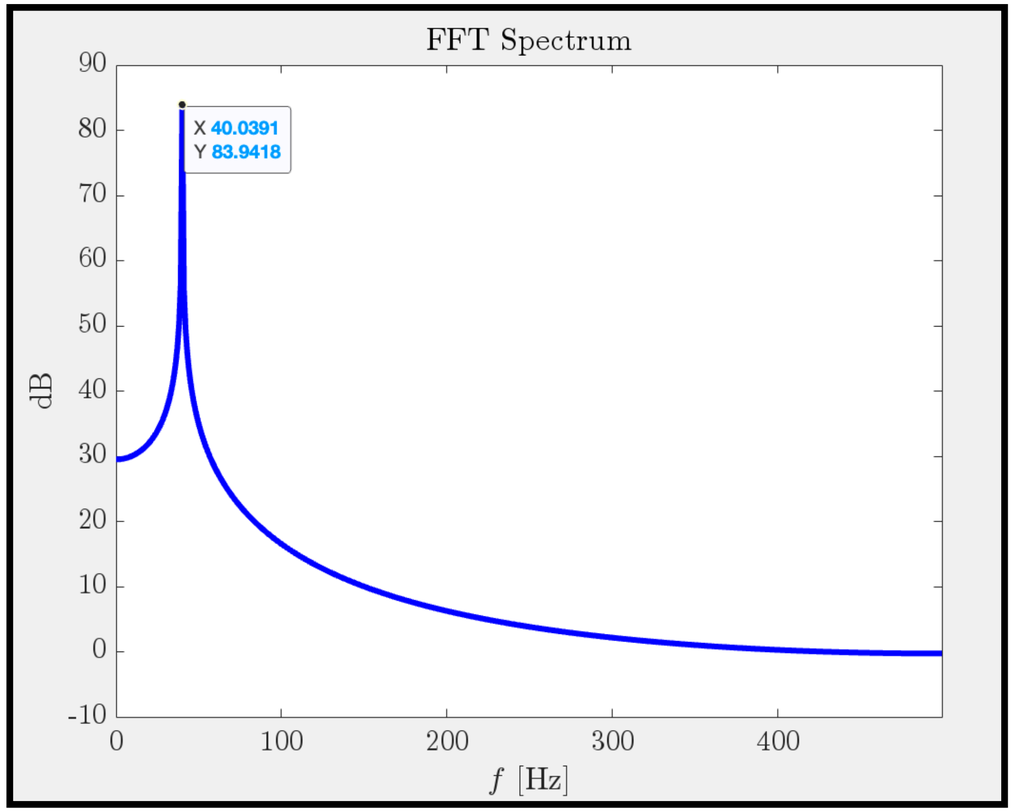
$$x_{base}(t) = 0.25\sin(80\pi t)$$

5-6 cycles of input displacement for one cycle of output !

FFT analysis for Disc spring stack

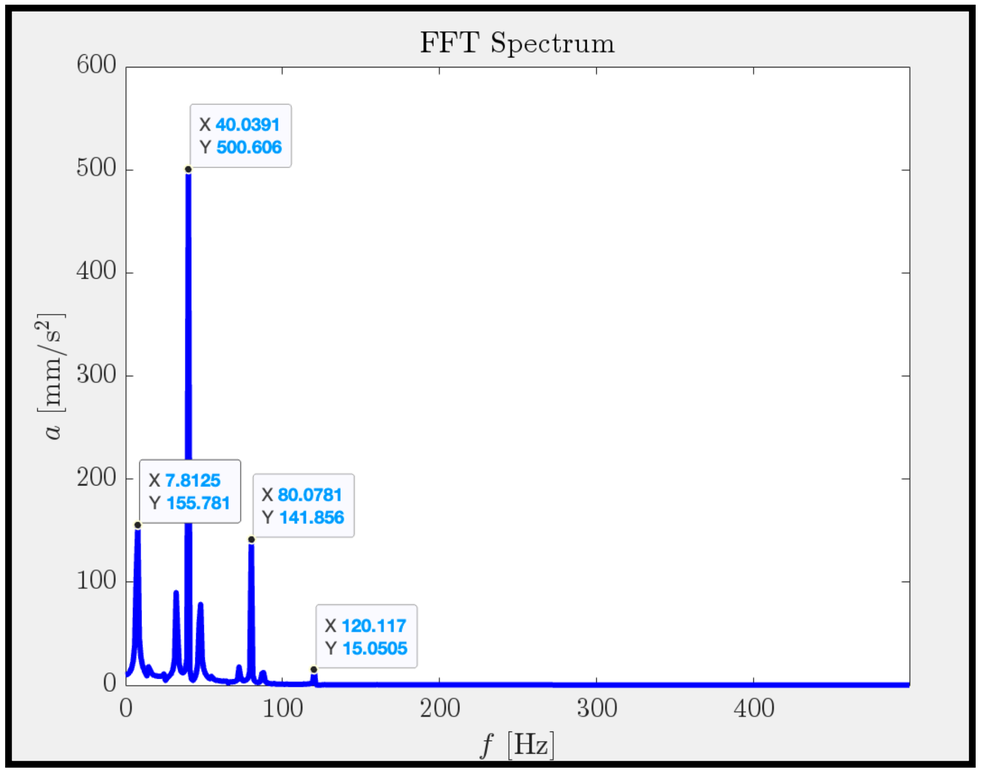
FFT spectrum for input signal

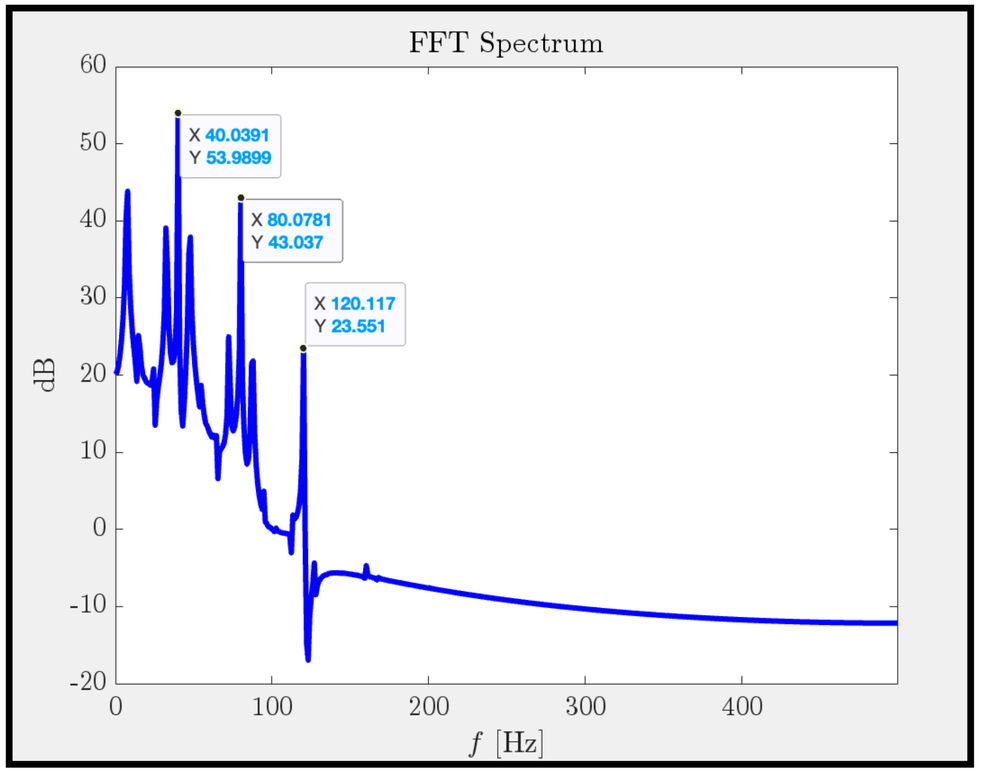




FFT analysis for Disc spring stack

FFT spectrum for output signal





Spectral leakage even after windowing ! Need to investigate further

Future work

- Continue working on the “spectral leakage” problem
- Study the Dynamics of the linearized system in time and frequency domains
- Study for more combinations of h/τ ratios, especially cases with multiple solutions and are not numerically “nice”.
- Study effects of damping and hysteresis due to snap-through events and other non-linearities