PHY407: Lab 4

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October 14th, 2022

Work Distribution: We worked on this assignment together in-person, so it was split quite evenly. We brainstormed pseudocodes, and then the base code for each question was collaborated upon. We reused the code we wrote as necessary to answer all of the questions. We alternated between parts for these questions, and then switched and checked each other's work at the end.

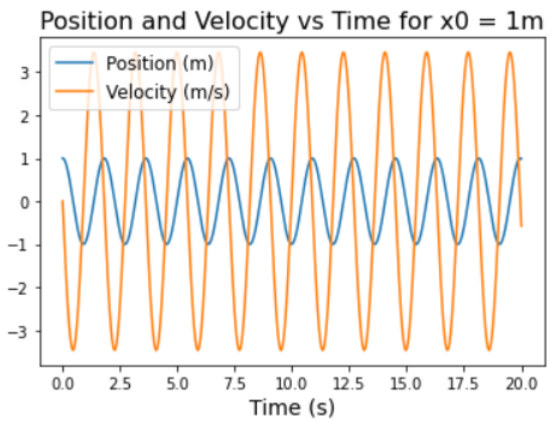
*All Python code and outputs are included in the Quercus submission as .py files.

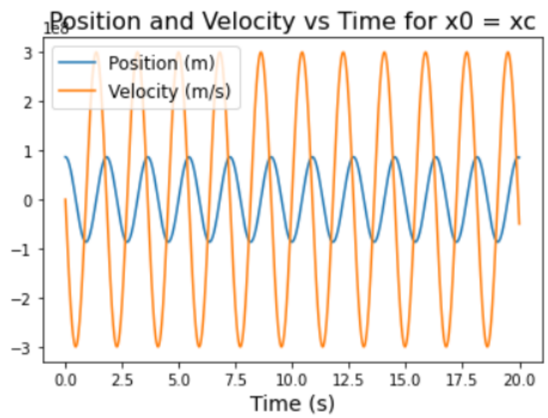
Question 1

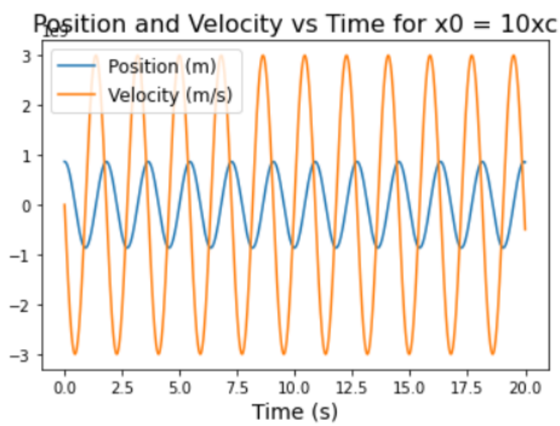
PseudoCode

1.import libraries
2. Define constants
3. Create arrays to store the updated times, positions, and velocities
4. Set initial position
5. Apply the Euler Cromer method to update the times, positions and velocities
6. Plot the results
7. Repeat but with the initial position as xc
8. Repeat but with the intitial position as 10*xc
9. Calculate the Fourier transforms and the frequencies (x-axis) for each set of position data
10. Define the function g from Lab 3 with x0 = 1m
11. Define N
12. Set integration bounds
13. Calculate the sample points and weights, then map them to the required integration domain for N
14. Perform the integration
15. plot the Foureier series and the calculated Frequency
16. Repeat but for x0 = xc
17. Repeat but for x0 = 10*xc

a) Plots, Brief Description

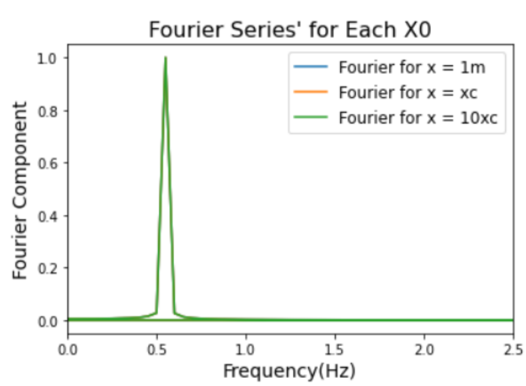






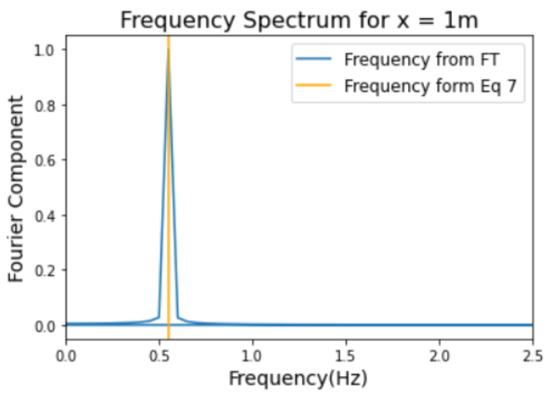
We used the same m and k values as in Lab03. We also used a time step of 0.0001s to get a smooth sinusoidal curve and an end time of 20s to get enough periods to compare the plots.

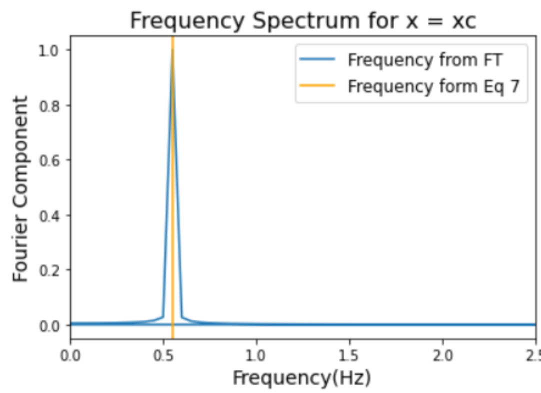
b) Plots and Written Answers

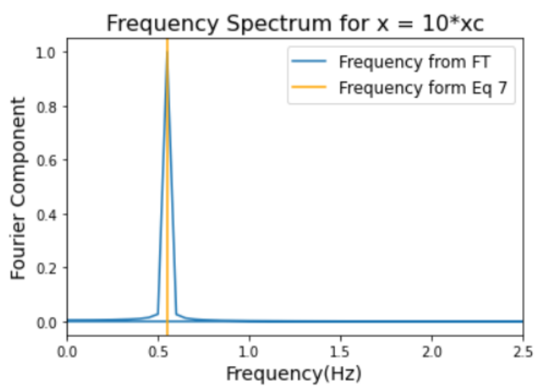


Notice that the plots overlap. This means the frequencies at which the springs move is independent of the starting positions at which they are dropped from. This makes sense because we are assuming the springs are only under the influence of gravity and the spring force, which are equal for all the x0 values used.

c) Plots and Written Answers







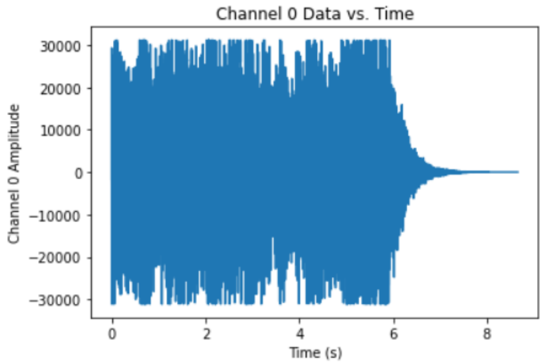
Notice that the Frequency from the Gaussian Quadrature (Vertical lines) matches that of the frequencies of the peak in the Fourier series (Blue peak). This means both methods can be used to find the frequencies of the springs.

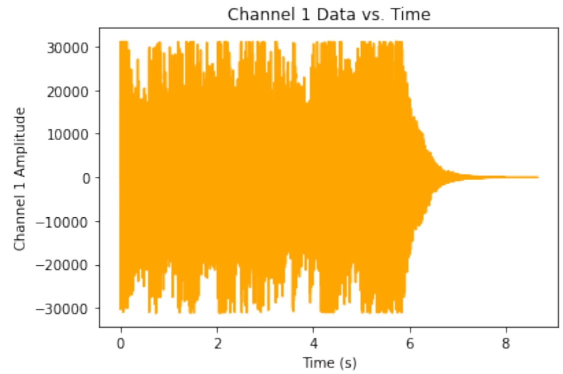
Question 2

a) Nothing to Submit

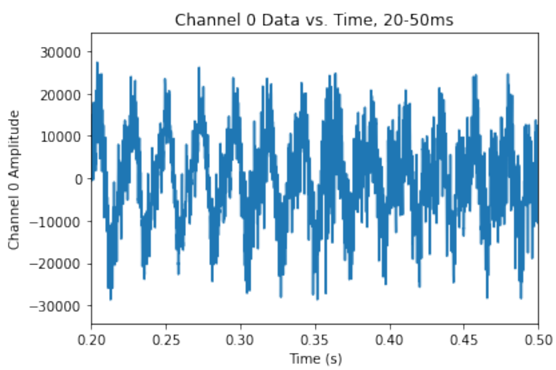
b) Pseudocode and Plots

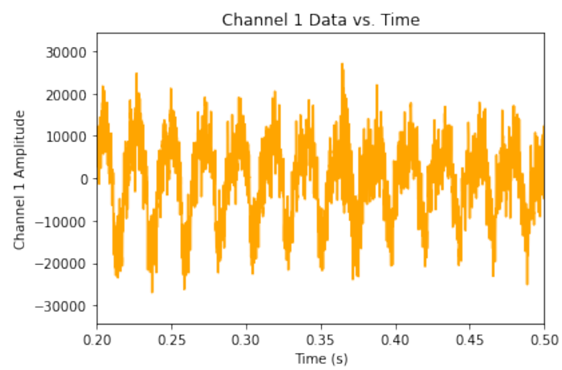
1. Read in sound data and split into channels
2. Find the time domain for the input data
3. Plot both sets of data on the time domain





c) Plots

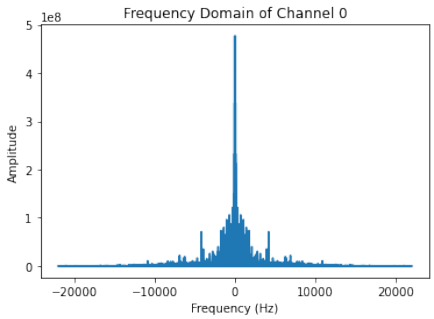


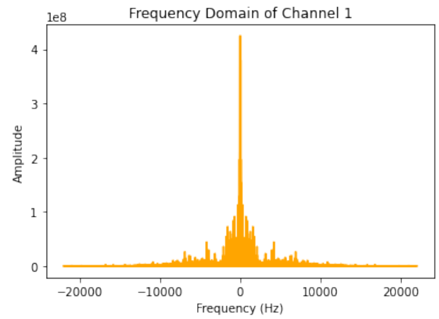


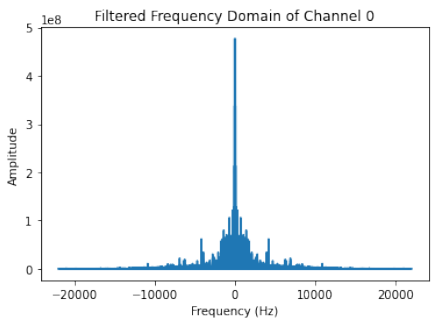
d) Pseudocode and Plots

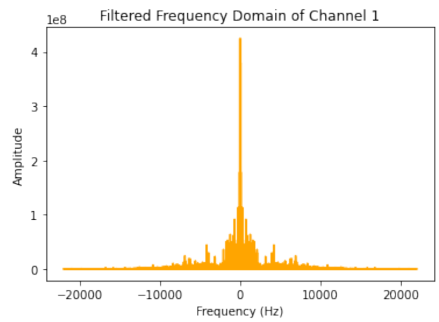
1. Fourier Transform each channel
2. Find the frequencie domains for each channel
3. Plot the amplitude of the non-filtered data for each channel
4. Set any frequency higher than 800Hz to 0Hz in each channel
5. Plot the filtered frequency domain of each channel
6. Convert each channel back to the time domain
7. Plot the original and filtered time domains

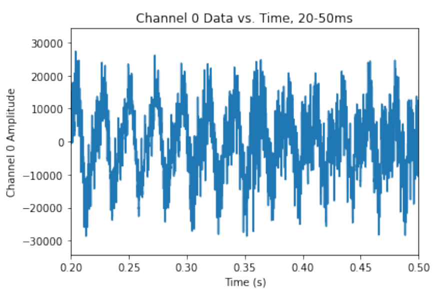
Plots

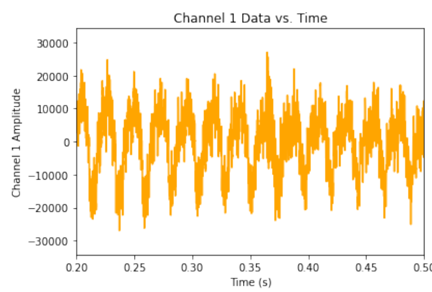


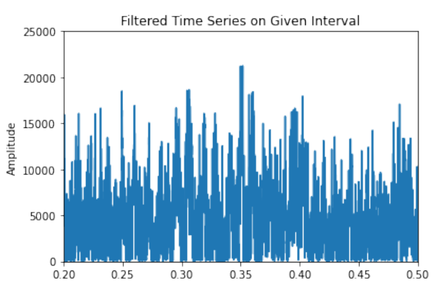


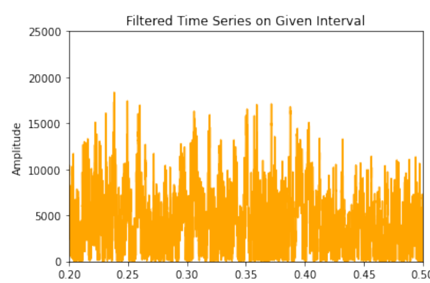










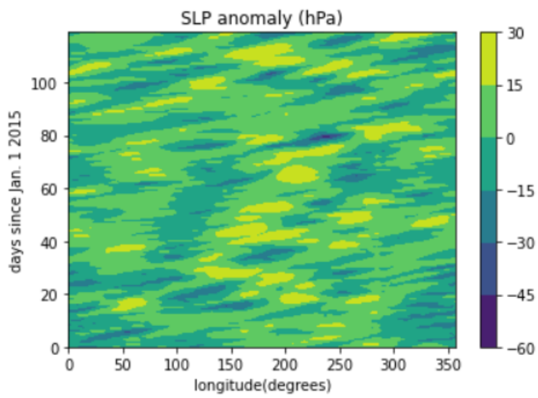


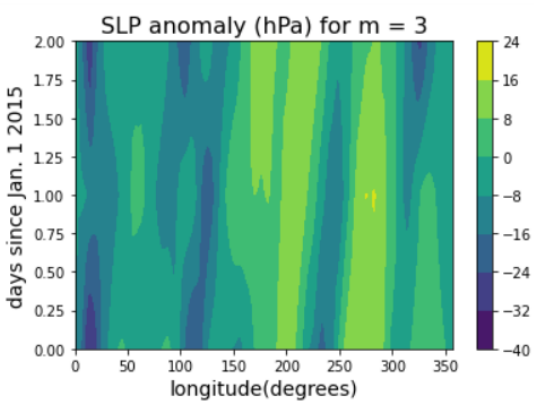
e) .wav file submitted

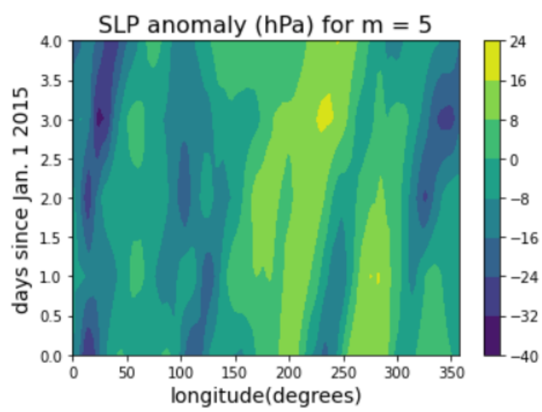
Question 3

a) Pseudocode and Plots

1. import libraries
2. Load data from text files
3. Plot contour of data
4. Get wavenumbers
5. Plot contours for the wavenumbers m=3 and 5







b) Written Answers

Notice that the high pressure areas are surrounded by low pressure areas. They create "Spirals of pressure." It is also noticeable that the wave disturbances do propagate in a dispersive manner.