Homework 8 Write-up

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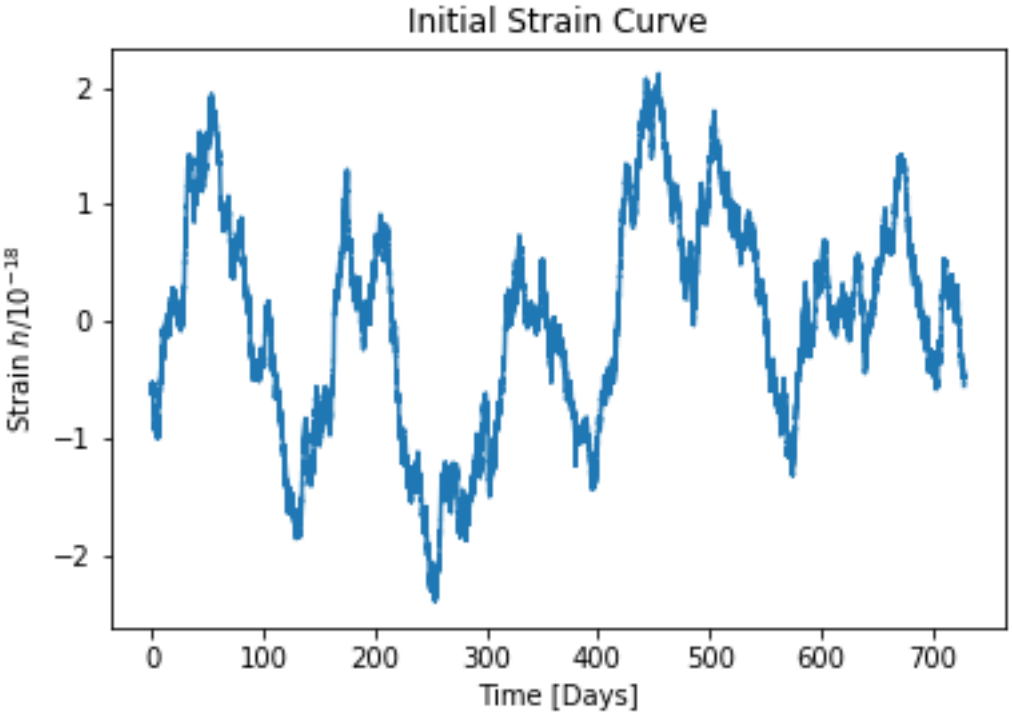
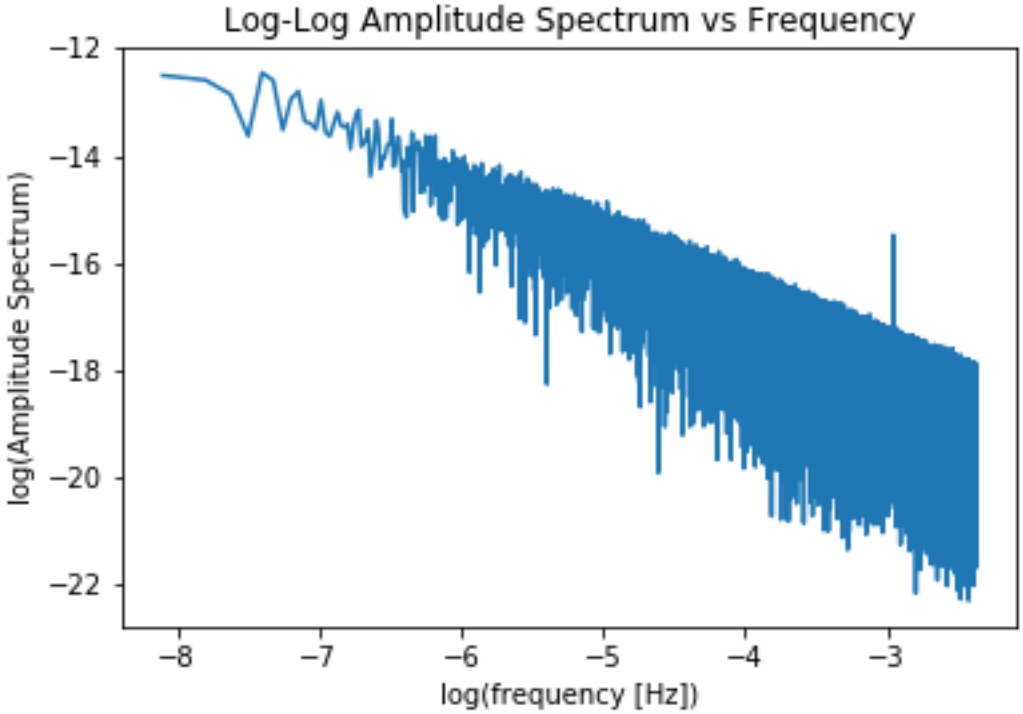
The goal of this assignment was to take the simulated data of the strain as a gravitational wave that is plotted below and use a Fast Fourier Transform to find the spike in the data that is the the frequency of the gravitational wave in the signal. The plot below is this simulated strain curve:



To find the frequency of the gravitational wave I made a function that implements a Fourier transform of the data. Following the Cooley-Turkey Algorithm notes and the the link at the bottom, I was able to perform the Fourier transform on the data to get the following plot. The spike in the data is the frequency and amplitude value for the wave considering there isn't any instrumental noise. The plot is a log-log plot to see the values better. The value of this peak is
$|\tilde{H}(f)|$: 2.12×10^{-16}
Frequency: 0.00316 [Hz]
FFT demo I followed: `https://inst.eecs.berkeley.edu/~ee123/sp16/Sections/FFT_Demo.html`



With the two values found in the plot, I can calculate the the total mass and the separation using the following equations:

$$h \sim \frac{(GM)^2}{4\pi^2 c^4 DR} \approx 2.6 * 10^{-21} \frac{M^2}{DR} \tag{1}$$

$$f_{GW} \sim \frac{1}{2\pi}\left(\frac{GM}{R^3}\right)^{1/2} \approx 10^{-4}(M^{1/2})(R^{-3/2}) \tag{2}$$

where $D = 12[pc]$ and rearranging these equations and relating them to solve them gets:

$$R = \sqrt{\frac{Dh10^{-4}}{2.6 \times 10^{-21} f_{GW}}} \tag{3}$$

$$M = \left(\frac{f_{GW} R^{3/2}}{10^{-4}}\right)^2 \tag{4}$$

The resulting values from my calculations where:
Total Mass (M): 5.45×10^9 $[M_\odot]$
Separation (R): 175.98 $[R_\odot]$
The Mass seems high for a binary white dwarf system and the separation seems very small because its less then 1 AU. I think that my problem comes from the value I got from the Fourier transform and the conversion from time to frequency. My plot only has the same shape as the plot in the homework and my values seem to be off compared to the peak on that one.