Problem Set 7

Jason Li

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Contents

Problem 1

(a) The Fourier transform shows the frequency components present in the sound. The first 10,000 coefficients are plotted in the figures below. The Fourier coefficients indicate the harmonic structure of the piano and the trumpet instruments, and the spikes in amplitude indicate the harmonic frequencies.

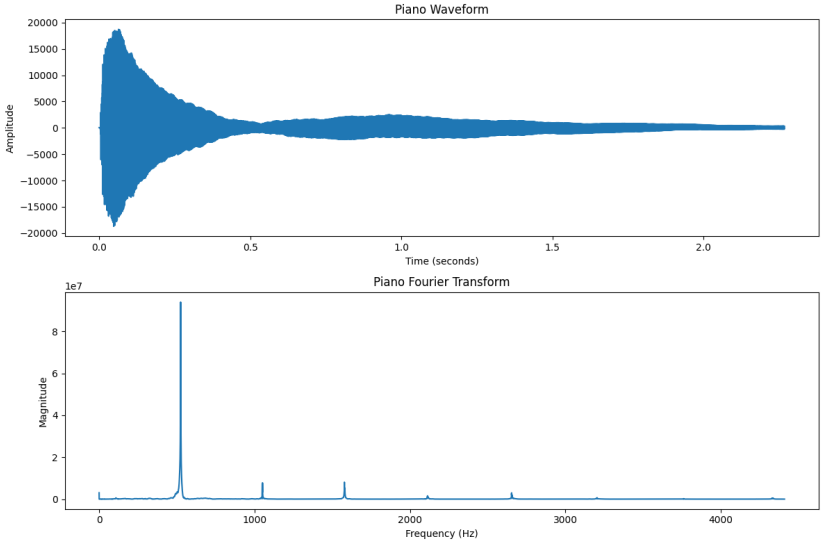

Figure 1: Piano Waveform

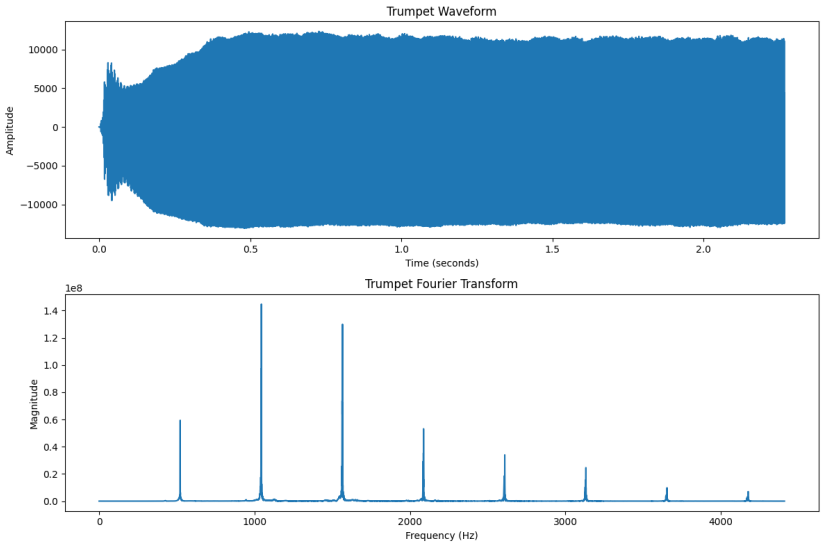

Figure 2: Trumpet Waveform

The piano and the trumpet, as observed above, have different harmonic structures. Results are from **newman_7.3.py**.

(b) The frequencies for the piano and trumpet, as determined from their Fourier transform results, as obtained in **newman_7.3.py** are

Piano: 524.79 Hz
Trumpet: 1043.847 Hz
Since these are approximately multiples of the middle note C_4, it can be determined that they are playing the same note, just on different octaves.

Problem 2

(a) The plot below shows the behavior of the y variable as a function of time for the Lorenz system with parameters $\sigma = 10, r = 28$ and $b = \frac{8}{3}$ in the range from $t = 0$ to $t = 50$ with initial conditions $(x, y, z) = (0, 1, 0)$. Results are obtained in **newman_8.3.py**.

(b) Results are obtained in **newman_8.3.py**.

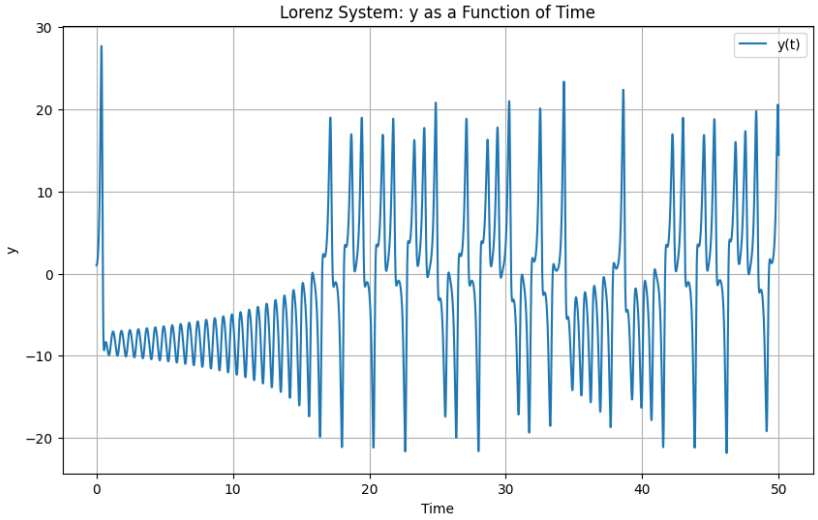

Figure 3: Lorenz System

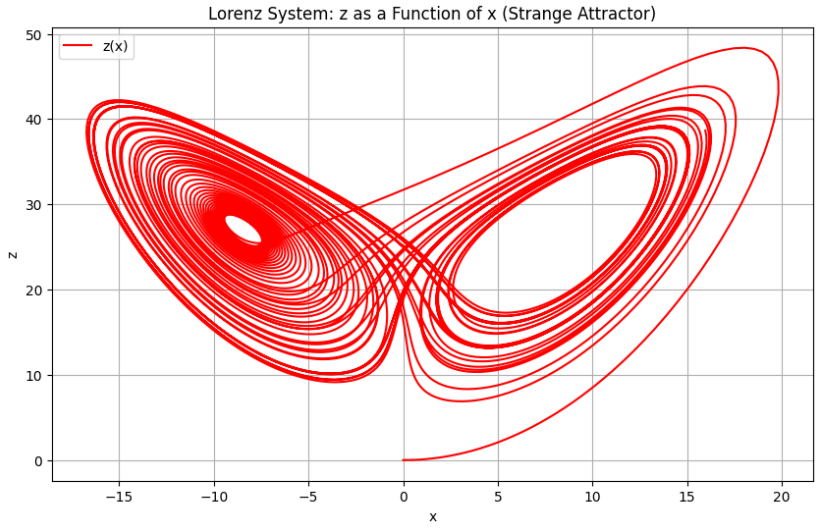

Figure 4: Lorenz System