

PHYS-UA 210 Computational Physics

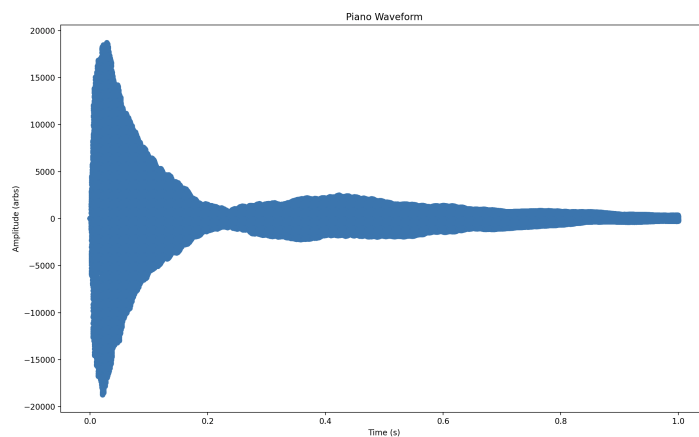
Problem Set 08

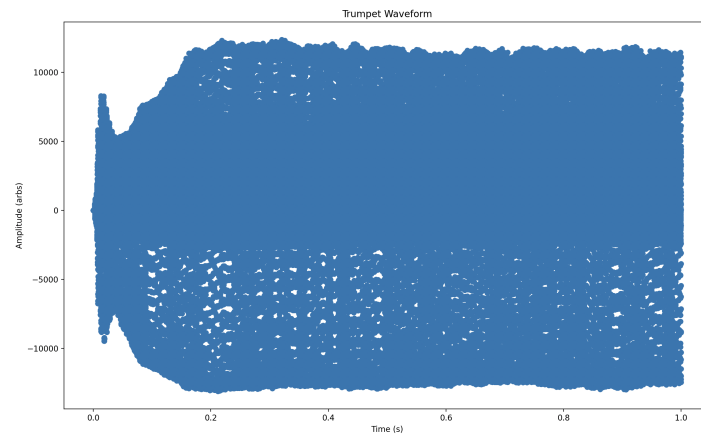
Sandhya Sharma

December 1, 2023

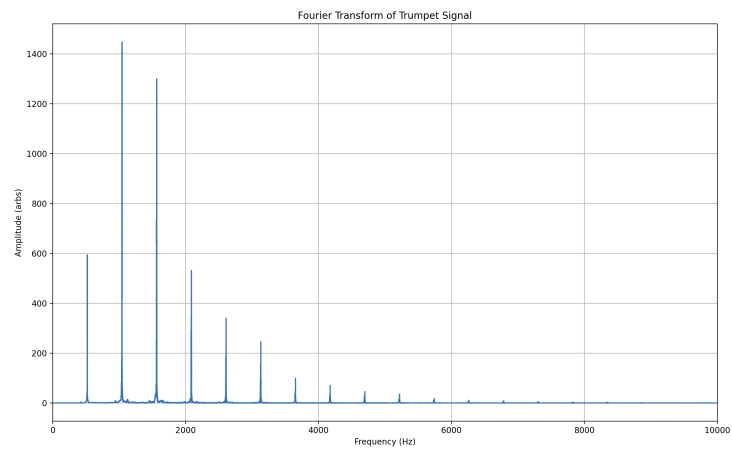
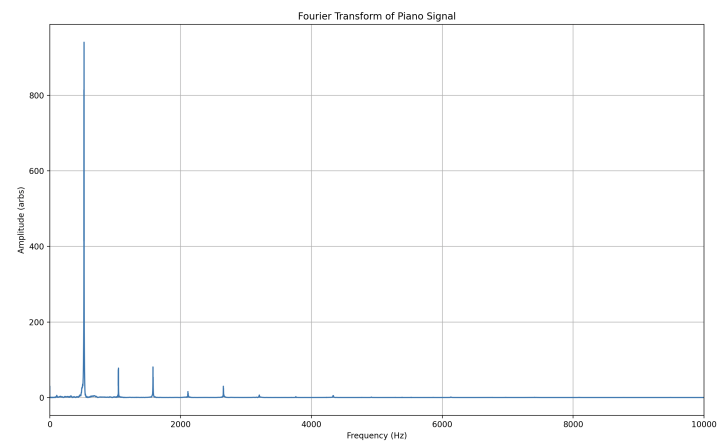
Question 1: Discrete Fourier Transform (Newman 7.3)

Plotting the waveform produced by the piano and the trumpet





Applying Fast Fourier Transform



Calculating the note played by the instruments

Dominant frequency of piano (Hz): 524.79
 Dominant frequency of trumpet (Hz): 1043.847

Here, the dominant frequency of trumpet is given as 1043.8 Hz since it has the highest magnitude after applying FFT. This is a multiple of the fundamental frequency of 521.7 Hz (roughly) from the plot above.

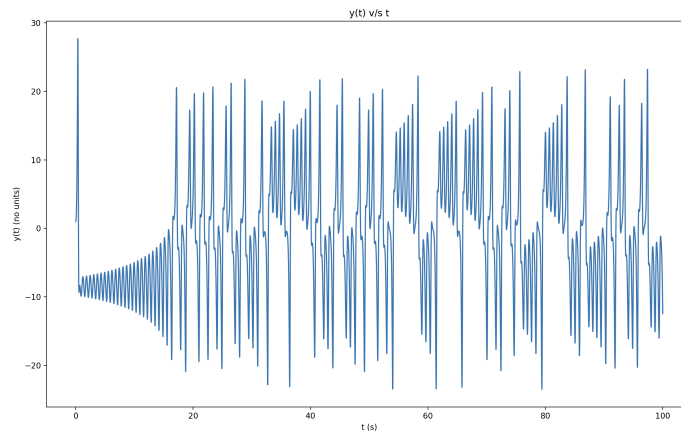
Using an online resource to convert frequency to note, frequency of about 521 - 524 Hz corresponds to the note C5 (middle C is named as C4 according to this convention).

Question 2: Lorentz Equations

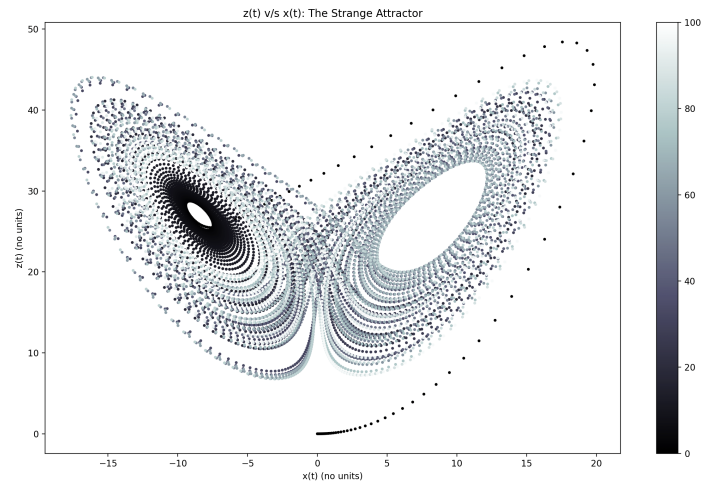
The Lorentz equation is given as follows:

$$\frac{dx}{dt} = \rho(y - x), \frac{dy}{dt} = rx - y - xz, \frac{dz}{dt} = xy - bz$$

After, solving the equation for $\rho = 10$, $r = 28$, $b = \frac{8}{3}$ in the range from $t = 0$ to $t = 50$ with initial conditions $(x, y, z) = (0, 1, 0)$, the plot of $y(t)$ against t :



Plot of $z(t)$ against $x(t)$



The Lorenz equation is known to have chaotic solutions for certain parameters and initial conditions. One of them is the 'Lorenz Attractor' shown in the figure above,

Please find my GitHub repository through this: [link](#).