HW8

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1 Problem 1

Figure 1 and 2 shows the original data of the recording of piano and trumpet sound. Figure 3 and 4 shows the FFT transformed date for those recordings.

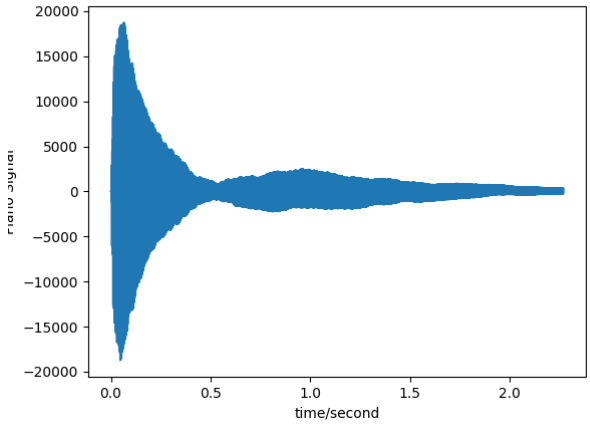

Figure 1: Original recording signal of piano

I also found the maximum intensity signal frequency of each instruments. For piano, the maximum signal frequency is at: 524.79Hz; for trumpet, the maximum signal frequency at: 1043.85Hz. Since the middle C is at 261Hz, and 524 Hz is about twice its value, 1043Hz is about four times of it, I suspect that piano is playing C that's an octave higher than middle C, and trumpet is playing at two octave higher than middle C.

2 Problem 2

The Lorenz equation looks like:

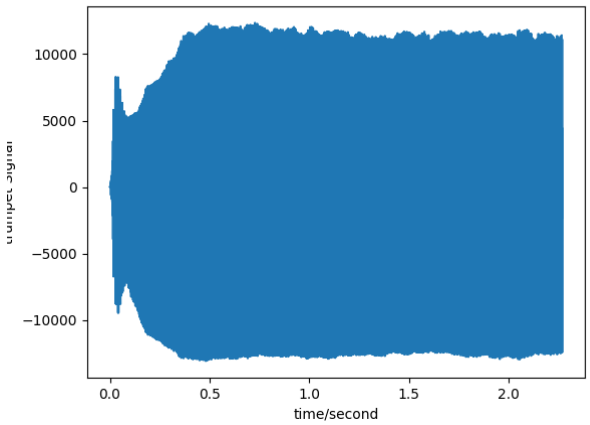

Figure 2: Original recording signal of trumpet

$$\begin{aligned} \frac{dx}{dt} &= \sigma y - x \\ \frac{dy}{dt} &= rx - y - xz \\ \frac{dz}{dt} &= xy - bz \end{aligned} \tag{1}$$

Here we use fourth-order Runge-Kutta method to solve those differential equations. Using the constant given in the problem, we can solve for the equations from t=0 to t=50. Figure 5 shows the plot of y as function of time. Figure 6 shows the plot of z versus x, which shows the famous attractor.

3 Github

username: robertXi6 link: https://github.com/robertXi6/phys-ua210

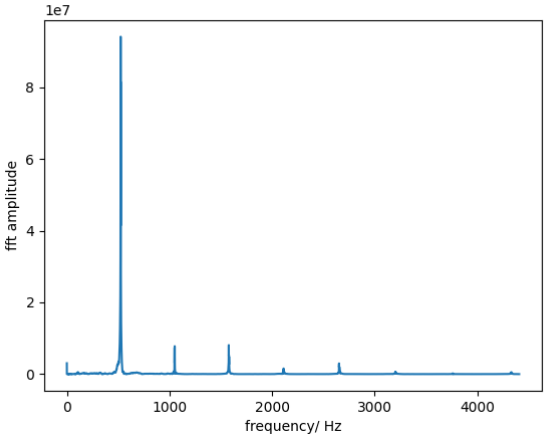

Figure 3: FFT of piano signal

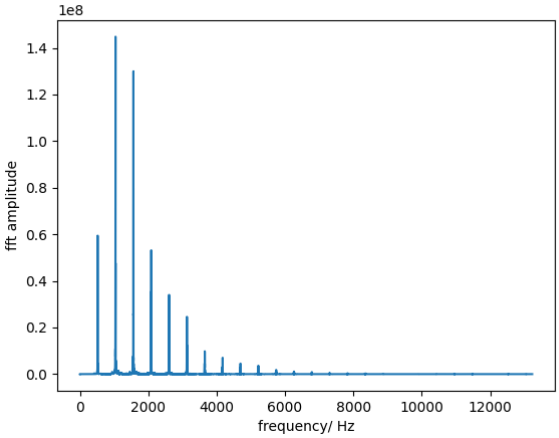

Figure 4: FFT of trumpet signal

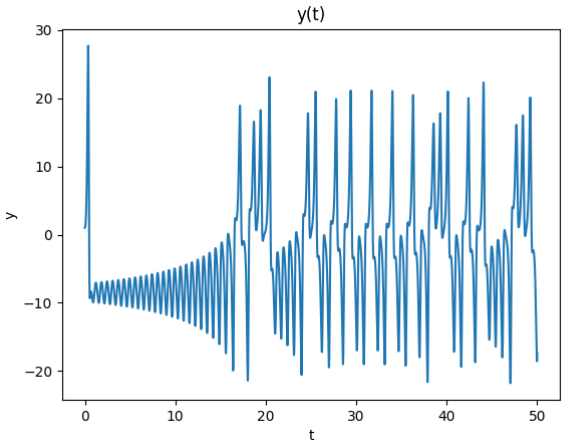

Figure 5: solution of Lorentz equation. y as function of time

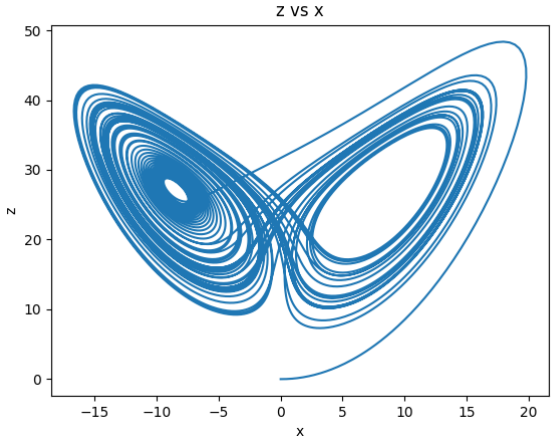

Figure 6: solution of Lorentz equations for t less than 50. This plot z against x, showing the famous attractor image