[PHYS-GA2000] Problem Set 8

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Problem 1

Methods Results

In this exercise we load two waveforms from a piano and a trumpet respectively, perform a fast Fourier transform and analyze the harmonics to identify the notes being played. The waveforms are shown in figures (1) and (3), with the corresponding Fourier transforms plotted in figures (2) and (4). The frequency with the maximum Fourier component is highlighted in red. Taking the maxima, I found the piano's main frequency was about 525 Hz, corresponding to an octave above middle C (C5). The trumpet has maximum frequency of 1045 Hz, or approximately a C6.
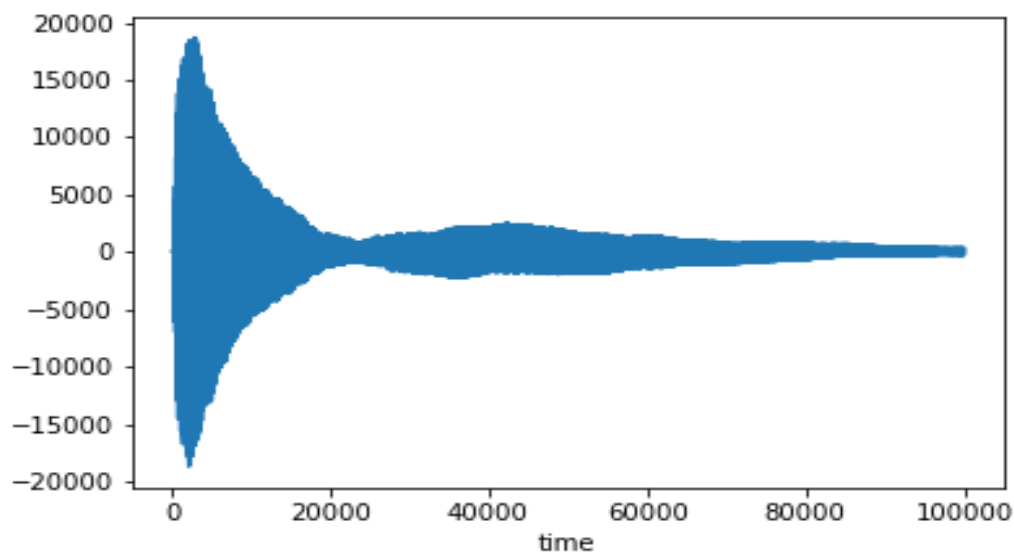
Figures

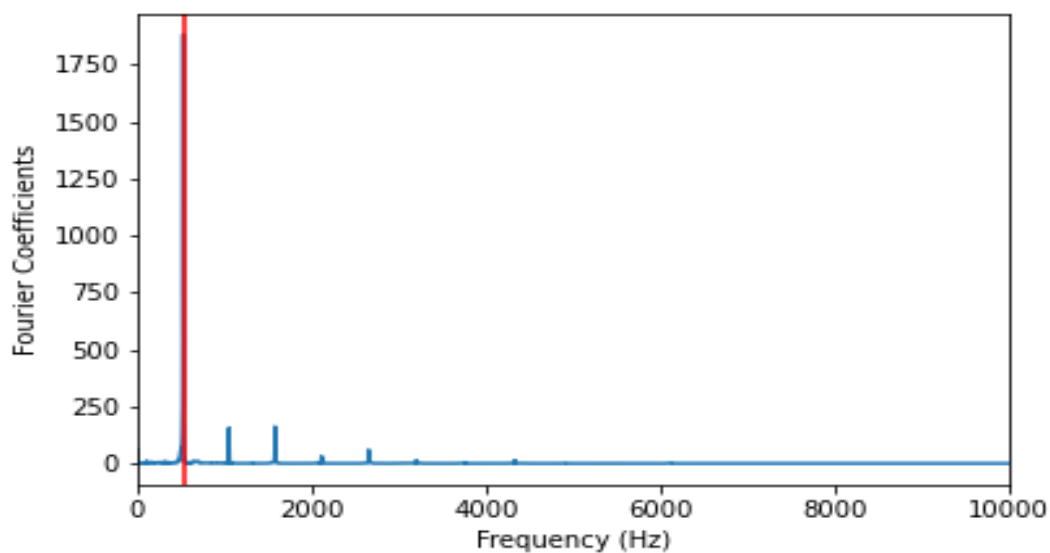Figure 1: Piano waveform, sampling frequency=44100 Hz

Figure 2: Piano Fourier transform, sampling frequency=44100 Hz. Peak frequency = 524.79 Hz.

Problem 2

Methods Results

This exercise involves solving the Lorenz equations by integration. The equations are given by $\frac{dx}{dt} = \sigma(y-x)$, $\frac{dy}{dt} = rx - y - xz$, $\frac{dz}{dt} = xy - bz$. We choose $\sigma = 10$, $r = 28$, $b = 8/3$ with initial
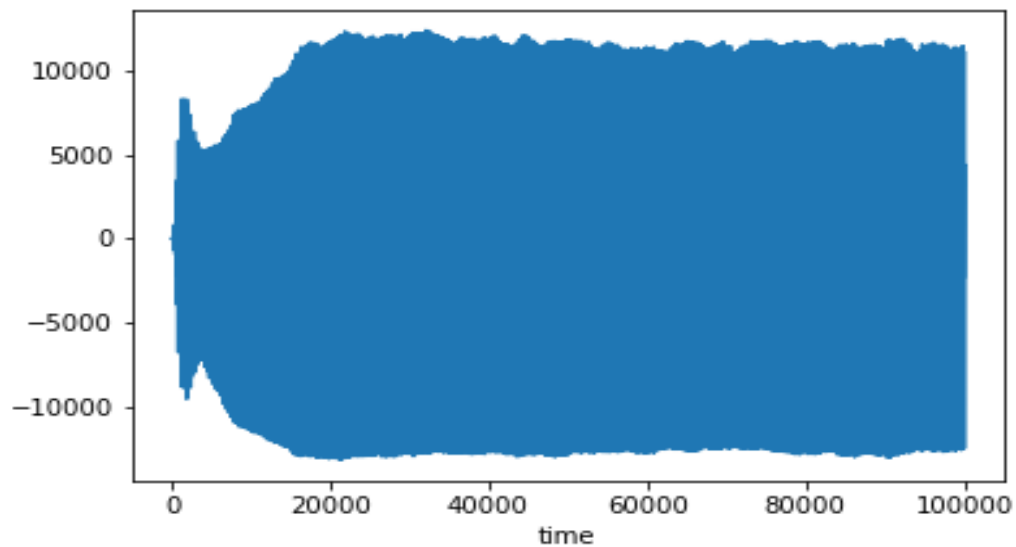
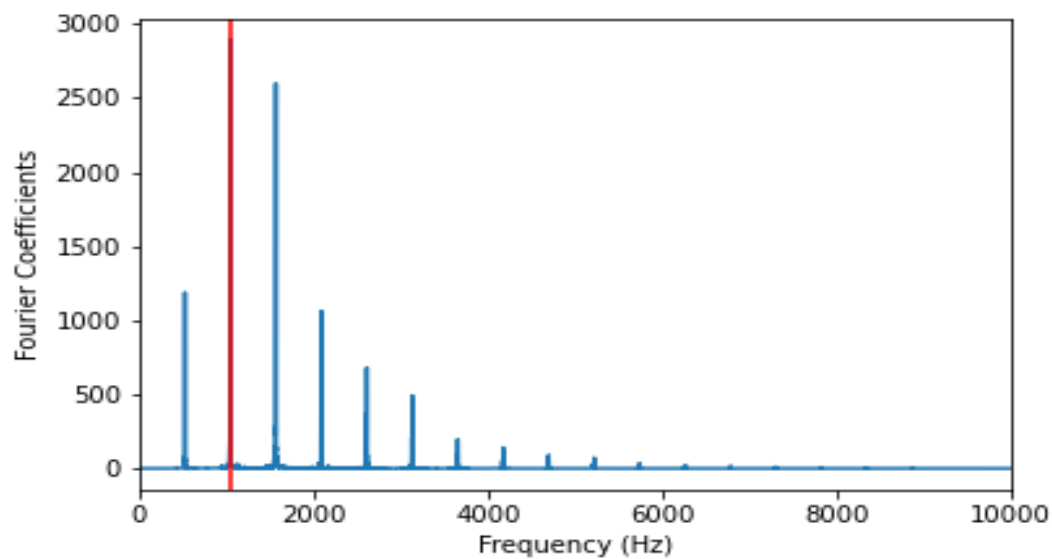Figure 3: Trumpet waveform, sampling frequency=44100 Hz

Figure 4: Trumpet Fourier transform, sampling frequency=44100 Hz. Peak frequency = 1043.847 Hz.

conditions $x = 0, y = 1, z = 0$. The plots for $y(t)$ and $z(x)$ are shown in Figures (5) and (6); these agree with the known solutions to the equation, particularly the strange attractor.
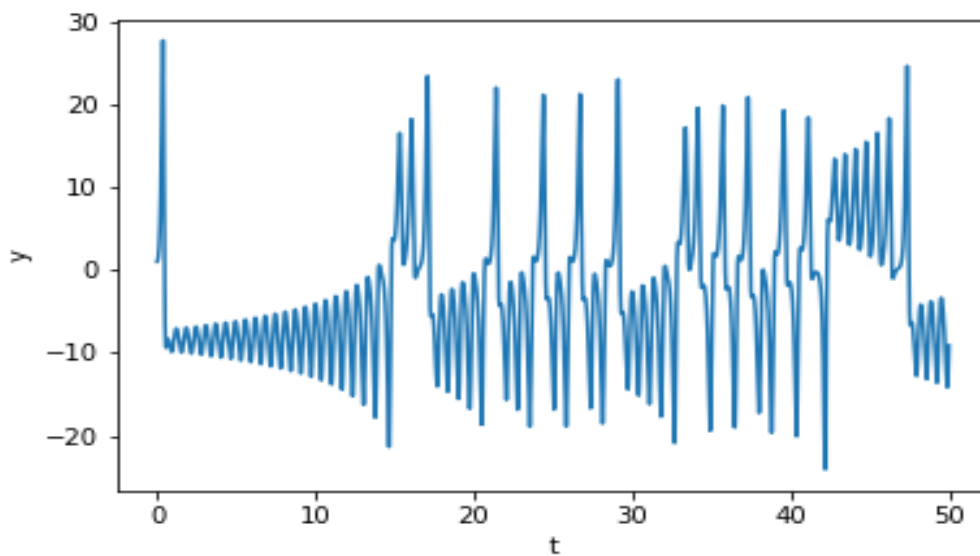
Figures
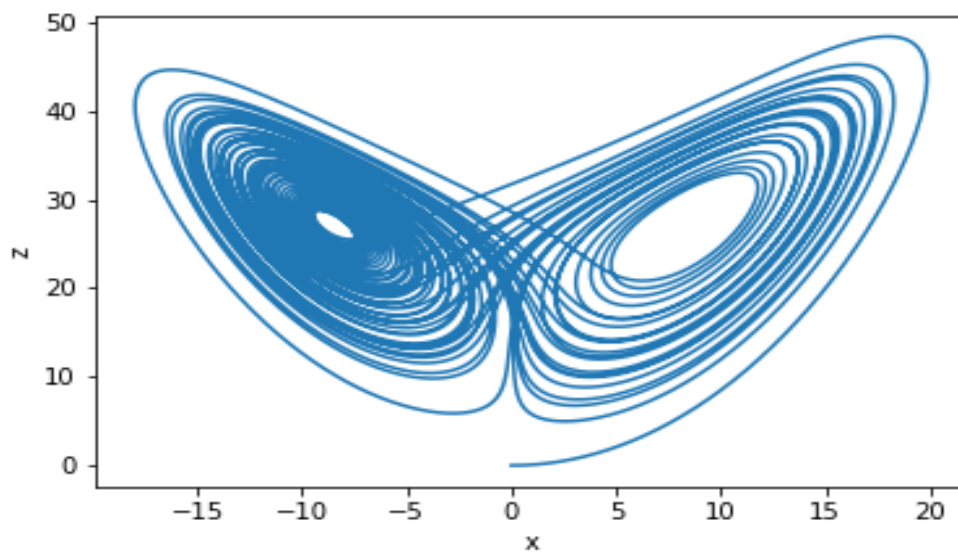

Figure 5: $y(t)$ Solution to the Lorenz equation

Figure 6:   Strange attractor, $z(x)$ solutions to Lorentz equation.