PS-8

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November 26, 2023

Abstract

In this problem set, we perform a fast Fourier transform on two signals and solve an ordinary differential equations system. Code scripts are available at `https://github.com/Leen-Alrawas/phys-ga2000/tree/main/ps-8`.

1 Methods and Results

1. We are asked to find the discrete Fourier transform for two musical signals (a piano signal and a trumpet signal). The solution was obtained using `ftt` from `scipy`. Plots of the piano signal and its Fourier transform are shown in figures 1 and 2. Similarly for the trumpet signal in figures 3 and 4. We can conclude that the piano produces one dominant frequency while the trumpet enhances the sound at several frequencies. In addition, the piano has an amplitude that is lower compared to the trumpet sound. A tables of musical notes show that they are playing C5, C6, G6, C7, E7, G7, A7, and C8.
2. A solution to Lorentz equations with the given initial conditions was found using the fourth-order Runge Kutta method. Plots are available in figures 5 and 6.

$$\frac{dx}{dt} = \sigma(y - x)$$

$$\frac{dy}{dt} = rx - y - xz$$

$$\frac{dz}{dt} = xy - bz$$

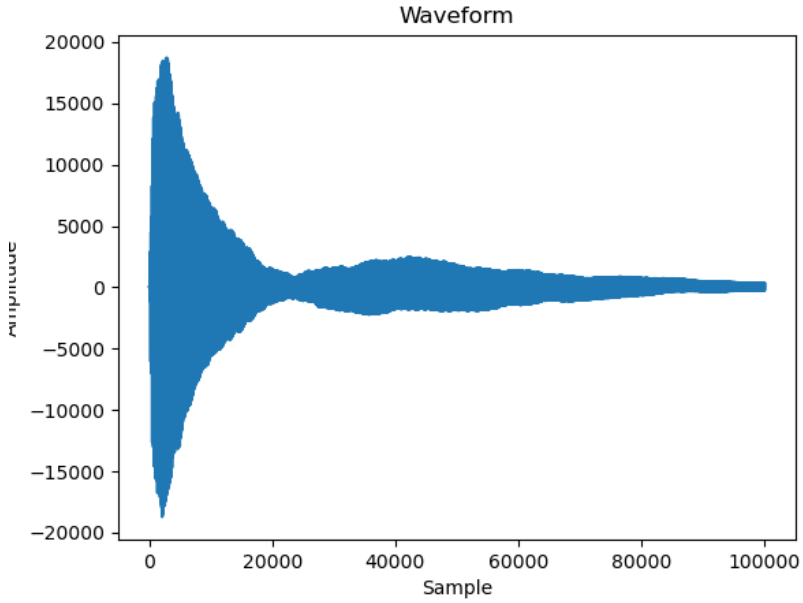

Figure 1: The signal of a piano musical note describing the amplitude over time.

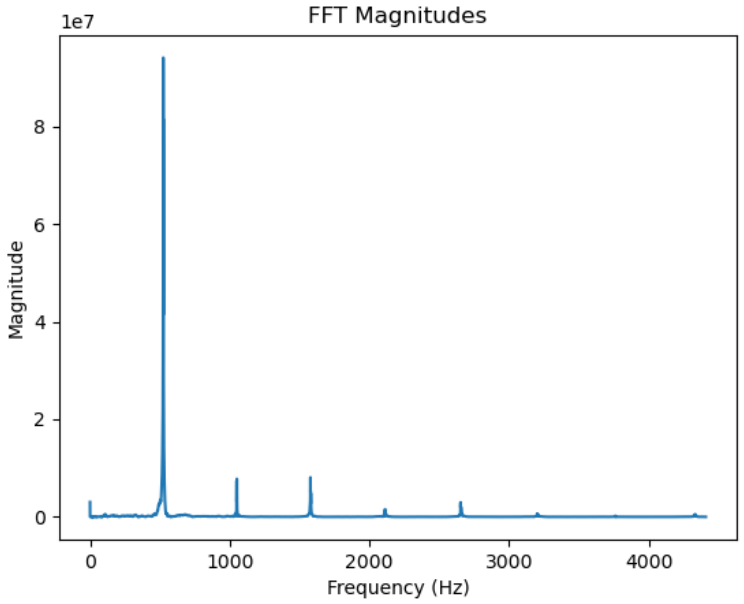

Figure 2: The discrete Fourier transform of the piano signal.

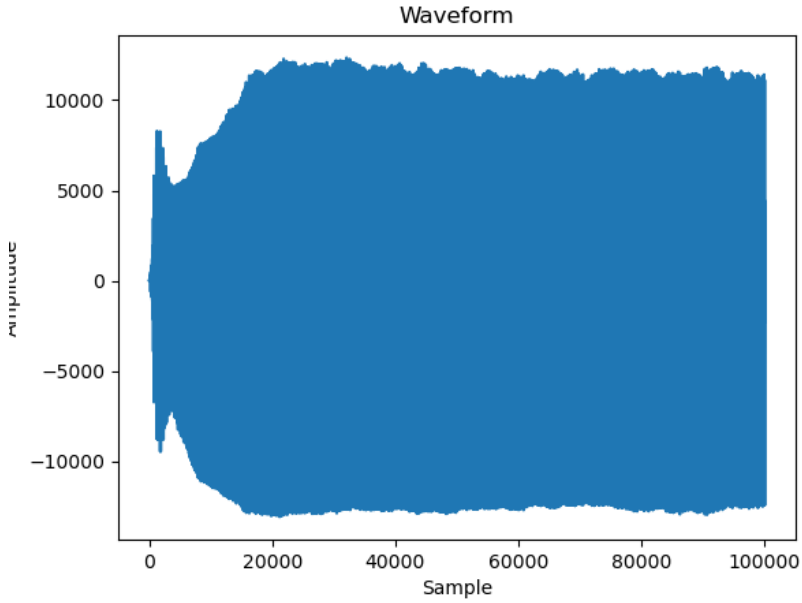

Figure 3: The signal of a trumpet musical note describing the amplitude over time.

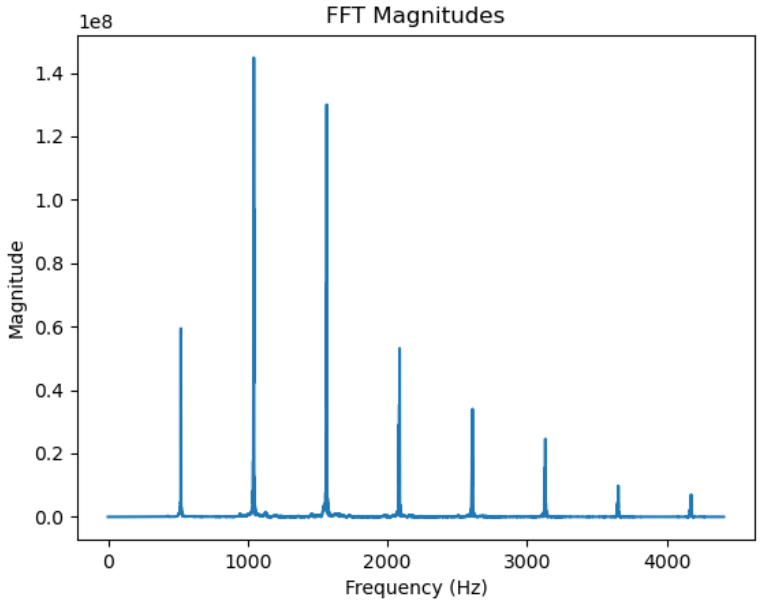

Figure 4: The discrete Fourier transform of the trumpet signal.

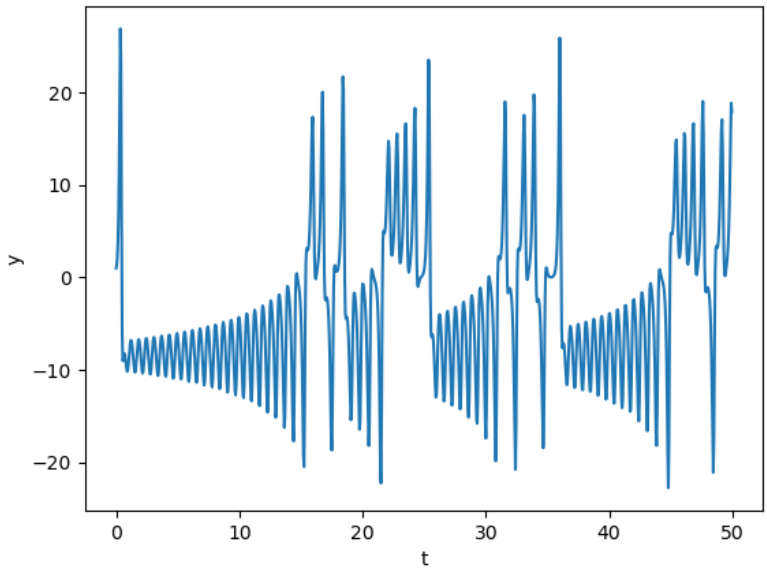

Figure 5: the solution $y(t)$ of Lorentz equations.

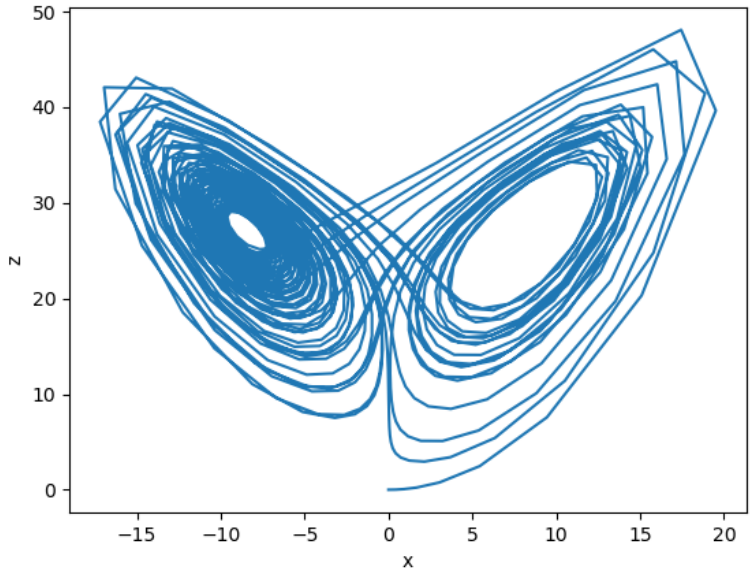

Figure 6: the solution $z(x)$ of Lorentz equations.