

## Fourier Transform using Spring-Mass System

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Fourier transform converts an amplitude over frequency data set into an amplitude over frequency data set. An example of its application is the equalizer in a sound system. The equalizer takes a sample of the sound and converts it into an amplitude over frequency bar graph. Every sample of an analog wave form can be broken down into a set of sine waves. It is even possible to make something as complex as a square wave by combining multiple sine waves together. There are many mathematical models and algorithms to accomplish this task, however there aren't many mechanical analogies for the process.

Using a mechanical analogy Fourier transform can be accomplished by setting up a row of tuning forks which pick up sound from a piano as seen in Figure 1. You can set up a tuning fork for each note which will resonate with the music. When you press the C key, the tuning fork which resonates with the C key will begin to vibrate while the others are at a stand still.

In order to simulate a tuning fork inside of a computer program, the software engineer must create a model which works the same way. The best and most simple method is to simulate a spring-mass system which also has the property of having a mechanical resonance and behaves the same way as a tuning fork. In Figure 2, you can see a model of a springmass tuning fork analogy. Using Hooke's law and a particle simulation, you will have all the elements necessary to make the simulation work. Each spring-mass element will be fed an analog signal and will resonate if it is exposed to a sine wave component which matches it. Amplitude over frequency can be established by measuring the average sinusoidal velocity of the mass connected to the spring which then is used as the output of the transform.

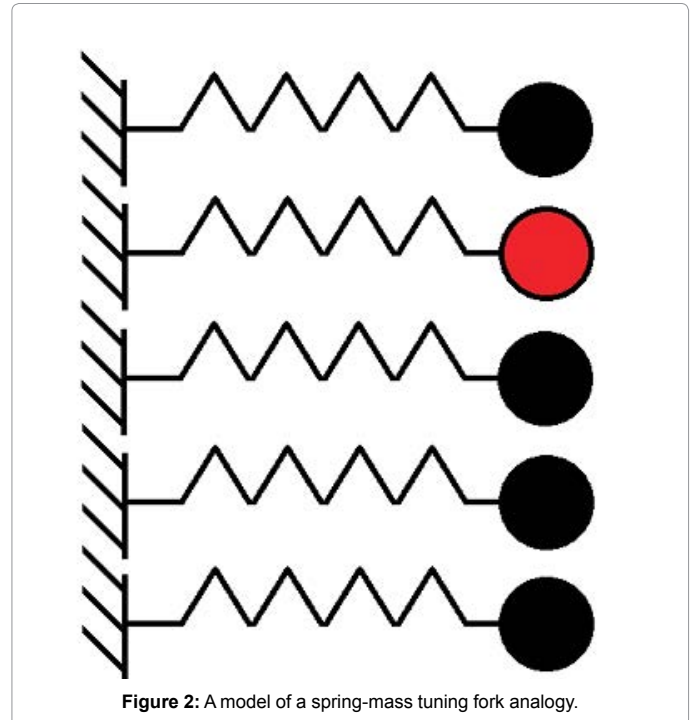


Figure 2: A model of a spring-mass tuning fork analogy.

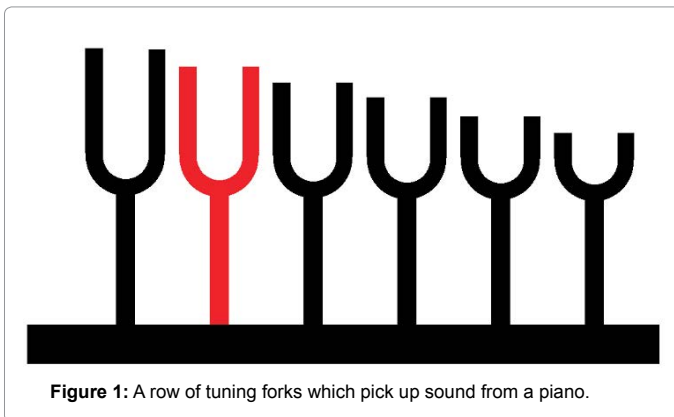


Figure 1: A row of tuning forks which pick up sound from a piano.

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