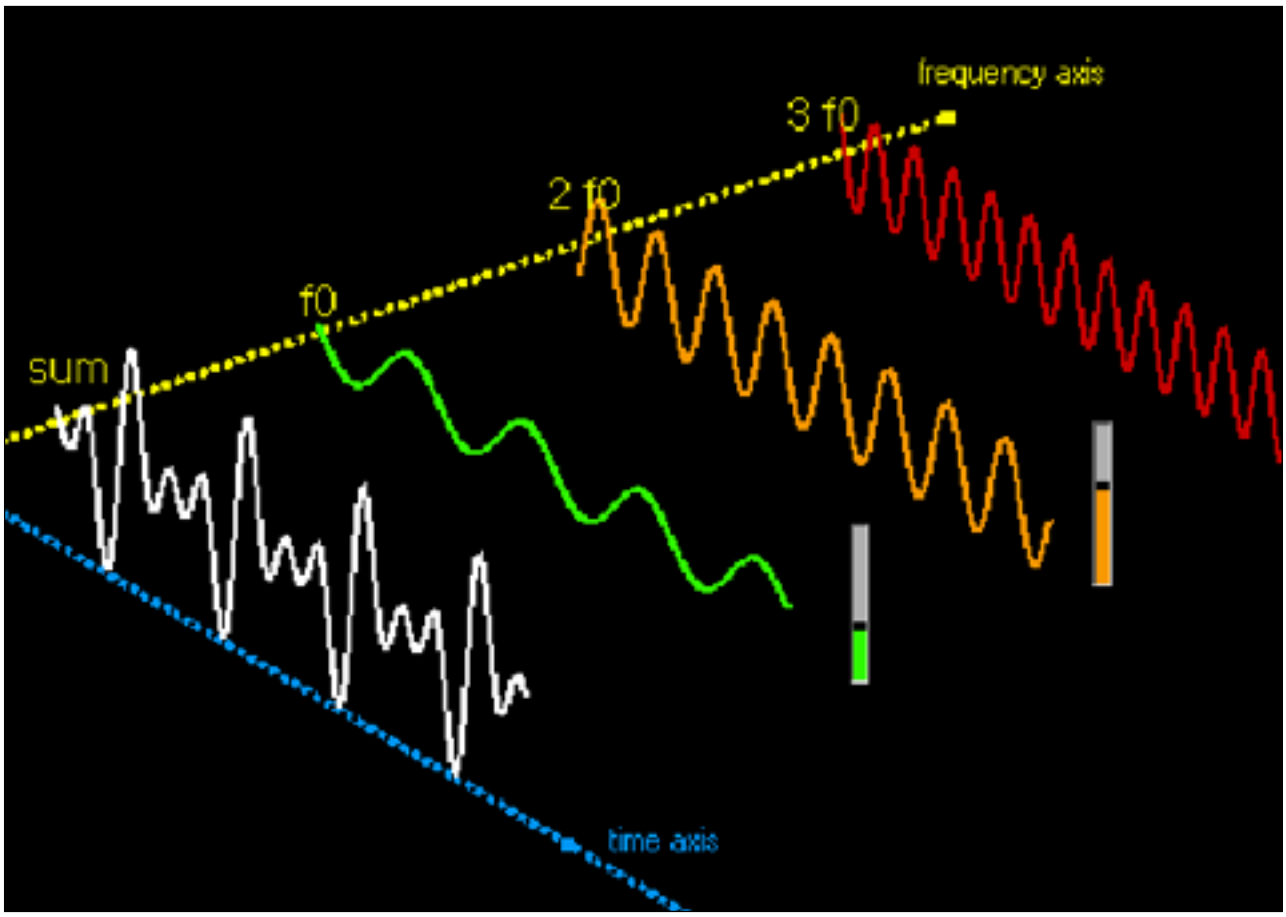
Image Recognition

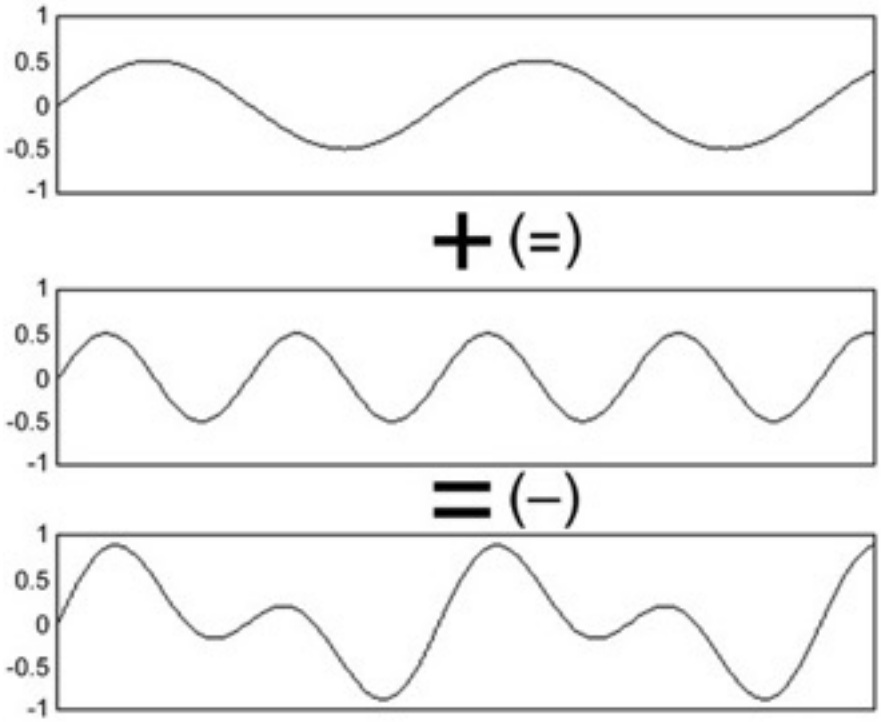
Using Fourier Transforms

Mathematics Project Report



Introduction

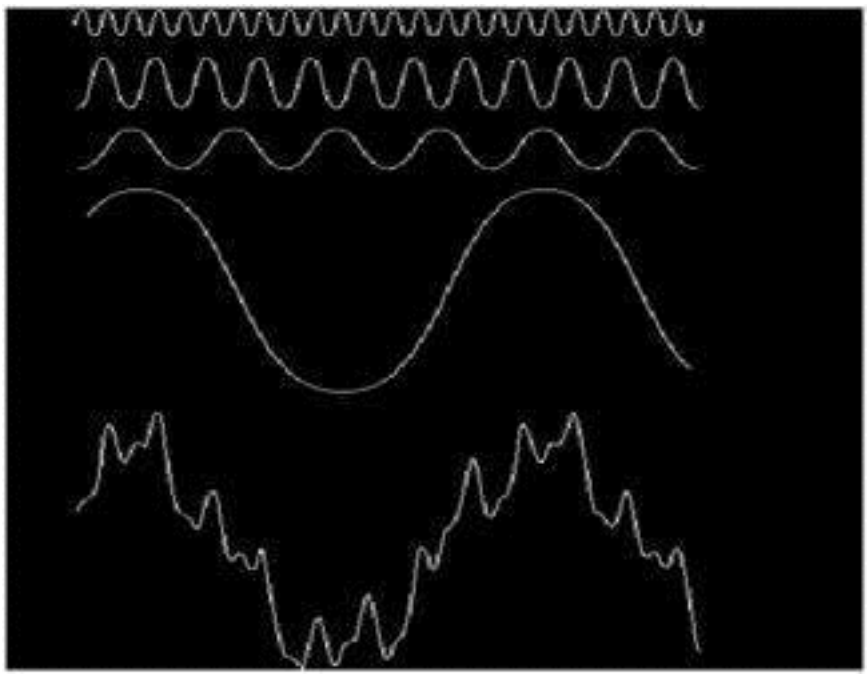
Almost every imaginable signal can be broken down into a combination of simple waves. This fact is the central philosophy behind Fourier transforms. Fourier transforms (FT) take a signal and express it in terms of the frequencies of the waves that make up that signal. When sound is recorded digitally the strength of the sound wave itself *can* be recorded (this is what a ".wav" file is), but more often these days the Fourier transform is recorded instead. At every moment a list of the strengths of the various frequencies is "written down" (like in the picture above). This is more or less what an mp3 is (with lots of other tricks). It's not until a speaker has to physically play the sound that the FT is turned back into a regular sound signal.



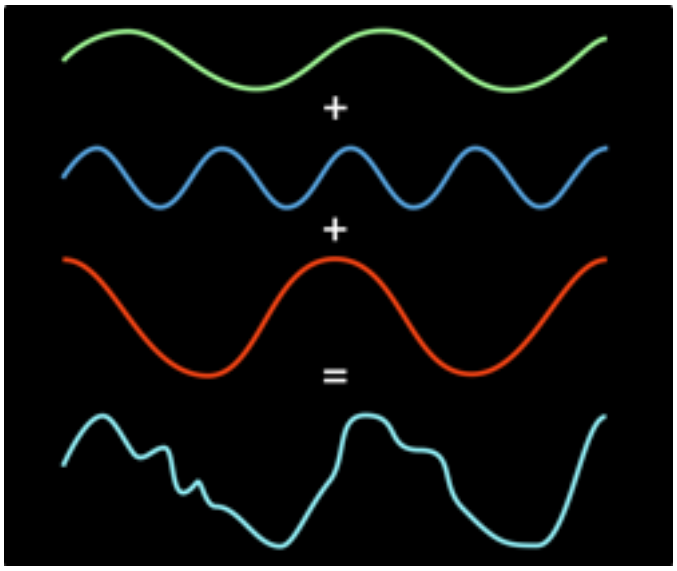
In the form of an FT it's easy to filter sound. For example, when you adjust the equalizer on your sound system, like when changing the bass or treble, what you're really doing is telling the device to multiply the different frequencies by different amounts before sending the signal to the speakers. So when the base is turned up the lower frequencies get multiplied by a bigger value than the higher frequencies.

However, acoustics are just the simplest application of FT's. An image is another kind of signal, but unlike sound an image is a "two dimensional" signal. A different kind of FT can be still found, and it is likewise two dimensional. When this was first done on

computers it was found that, for pretty much any picture that isn't random static, most of the FT is concentrated around the lower frequencies. In a nutshell, this is because most pictures don't change quickly over small distances, so the higher frequencies aren't as important. This is the basic idea behind ".jpeg" encoding and compression.



In the above signal, the last signal is actually the sum of all the above signals. This was the idea of the Fourier.



Discrete fourier transform

Since we are dealing with images, and in fact digital images, so for digital images we will be working on discrete fourier transform.