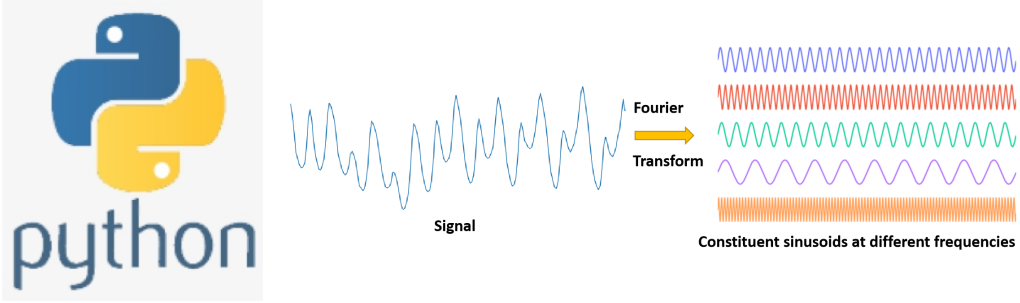


Basic Concepts on Fourier Transform

Shouke Wei, Ph.D. Professor

Email: shouke.wei@gmail.com

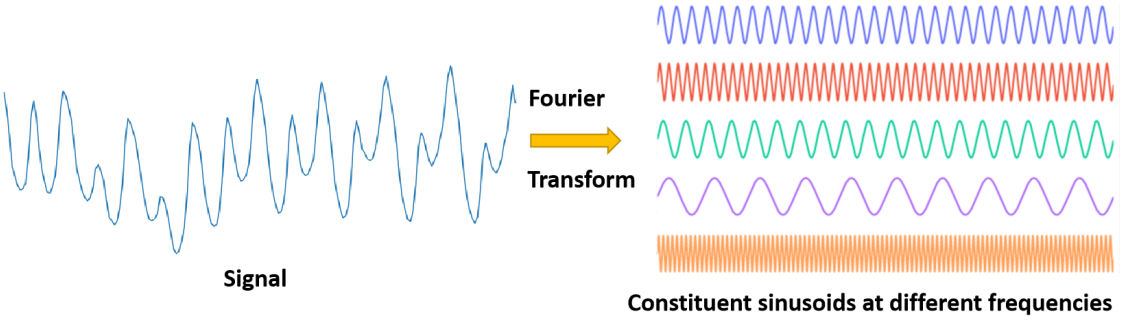
Objective

- glance over briefly some basic concepts on Fourier Transform (FT)

1. Fourier Transform

$$F(\omega) = \int_{-\infty}^{\infty} f(t)e^{i\omega t}\,dt$$

- A signal can be expressed as the sum of a series of sines and cosines.

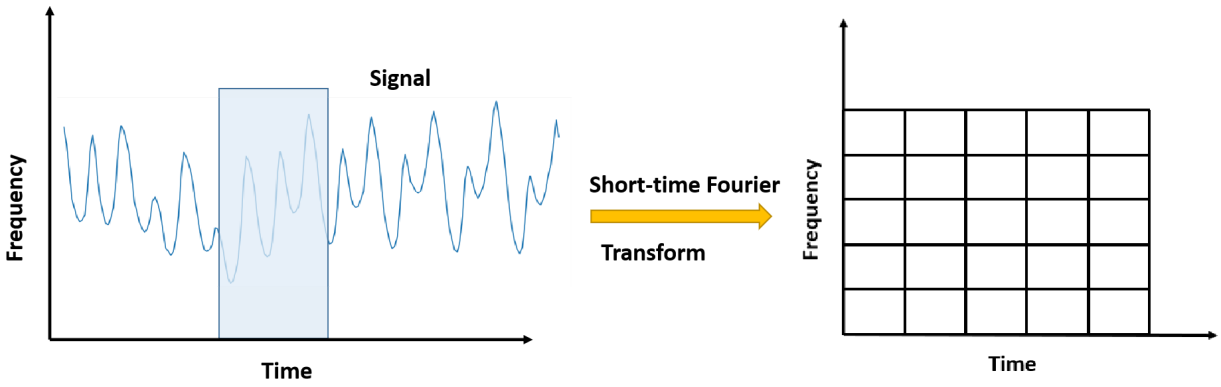


- The big disadvantage is that it has only frequency resolution and no time resolution.
- We are able to determine all the frequencies present in a signal, but we do not know when they are present.
- It works well on continous, stationary and smooth data, while
- It doesn't work well on discontinuous, nonstationary, and "bursty" data

2. Short-time Fourier Transform (STFT)

$$F(\tau, \omega) = \int_{-\infty}^{\infty} f(t) w(t - \tau) e^{i\omega t} dt$$

- It cut the signal of interest into several parts and then analyze the parts separately



- It is able to get more information about when and where of different frequency components

- But the fundamental problem is: how to cut the signal?
- The STFT was known to have poor localization in both time and frequency