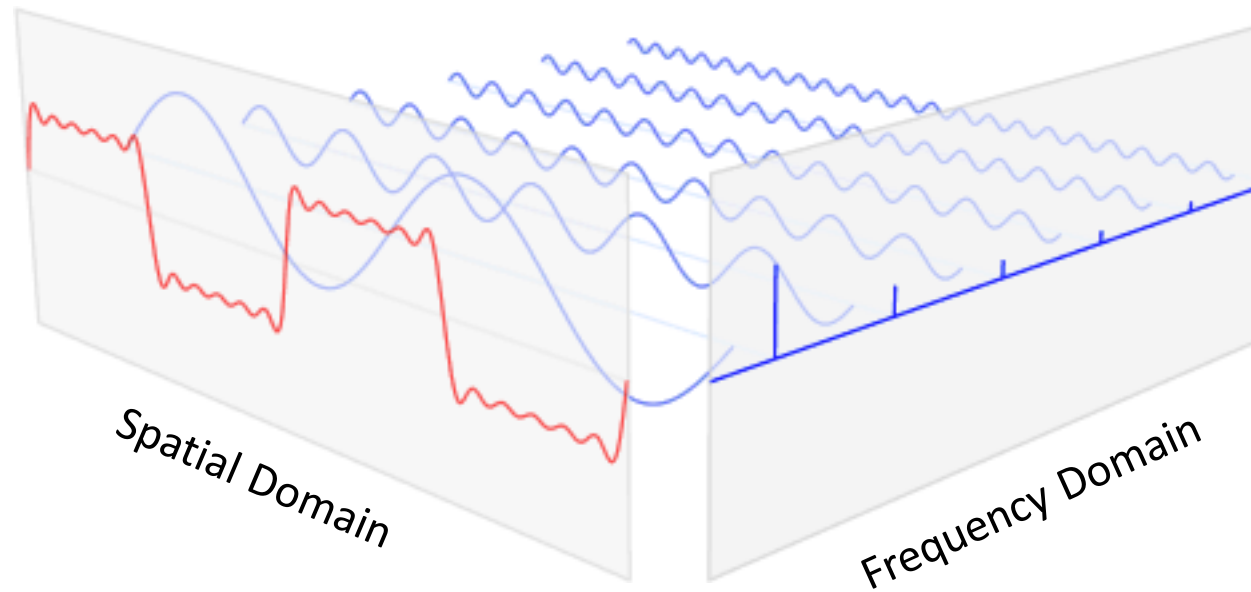


Audio: Spatial to Frequency Representation



Discrete Fourier Transform

$$X_k = \sum_{n=0}^{N-1} x_n e^{-2\pi i k n / N}$$

Where:

- N = number of samples
- n = current sample
- x_n = value of the signal at time n
- k = current frequency (0 Hz to $N-1$ Hz)
- X_k = Result of the DFT (amplitude and phase)

$$\sqrt{\text{Re}(X_k)^2 + \text{Im}(X_k)^2} / N$$
$$\text{atan2}(\text{Im}(X_k), \text{Re}(X_k))$$

Discrete Fourier Transform Implementation

```
import numpy as np

def DFT(x):
    """
    Compute the discrete Fourier Transform of the 1D array x
    :param x: (array)
    """

    N = x.size
    n = np.arange(N)
    k = n.reshape((N, 1))
    e = np.exp(-2j * np.pi * k * n / N)
    return np.dot(e, x)
```