Fourier Transform Review

You have likely studied the Continous-Time Fourier Transform before.

$$x(t) \longleftrightarrow X(j\omega)$$

$$X(j\omega) = \int_{-\infty}^{\infty} x(t)\, e^{-j\omega t}\, dt \qquad \left(\begin{array}{c}\text{forward}\\ \text{transform}\end{array}\right)$$

$$x(t) = \frac{1}{2\pi} \int_{-\infty}^{\infty} X(j\omega)\, e^{j\omega t}\, d\omega \qquad \left(\begin{array}{c}\text{inverse}\\ \text{transform}\end{array}\right)$$

The meaning of a transform comes from the inverse transform. Notice it is an integral (or continuous summation) over all <u>frequencies</u> ω.

For any choice of ω

$$\frac{1}{2\pi} X(j\omega)\, d\omega$$

may be thought of as the <u>complex coefficient</u> of the complex sinusoid $e^{j\omega t}$.

Thus the Fourier Transform is a sum of complex sinusoids model of the signal $x(t)$.

The Discrete-Time Fourier Transform

$$x[n] \longleftrightarrow X(e^{j\omega})$$

$$X(e^{j\omega}) = \sum_{n=-\infty}^{\infty} x[n]\, e^{-j\omega}$$

$$x[n] = \frac{1}{2\pi} \int_{-\pi}^{\pi} X(e^{j\omega})\, e^{j\omega n}\, d\omega$$

sum of sinusoids model