CMT Chapter One - Manual Equation~System Build

1 EM Theory - The Basics

1.1 What is a Complex Amplitude?

From http://musicweb.ucsd.edu/~trsmyth/compExpAndSpecRep/Complex_Amplitude_or.htmlWhen two complex numbers are multiplied, their magnitudes multiply and their angles add:

$L_{101} : r_1 \cdot e^{i\phi_1} \times r_2 \cdot e^{i\phi_2} \;=\; r_1 r_2 e^{i(\theta_1+\theta_2)}$

The complex number $X = Ae^{i\phi}$ is referred to as the complex amplitude, a polar representation of the amplitude and the initial phase of the complex exponential signal.The complex amplitude is also called a phasor as it can be represented graphically as a vector in the complex plane.

If the complex number $X = Ae^{j\phi}$ is multiplied by the complex exponential signal $e^{j\omega}\_^{0t}$, we obtain

$x(t) = Xe^{i\omega_0 t} = Ae^{i\phi}e^{i\omega t} = Ae^{i(\omega_0 t+\phi)}$

1.2 What is a Phase Constant?

The Phase Constant (Phase Coefficient) is actually frequency-dependent. It is the ratio of the mode amplitude at the source to the mode amplitude at some distance x from the source.The mode amplitude is a complex amplitude

$\gamma = \alpha + i\beta \;,\; \gamma = e^{ix} \;=\; cos(x) + isin(x)$

Attenuation Coefficient: $\alpha = cos(x)$
Phase Coefficient: $\beta = i * sin(x)$

$E(x, y, z, t) = E(x, y)e^{i(\omega t-kz)}$
$H(x, y, z, t) = H(x, y)e^{i(\omega t-kz)}$