CMT Chapter One Manual Equation Set

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: $\beta = i * sin(x)$

1.3 Plane Wave Equations

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

(%o4) $$\overrightarrow{E}\left(\overrightarrow{r}\right) = \overrightarrow{E_0}\, e^{j\,\overrightarrow{k}\,z}$$

1.4 Separating Transverse and Longitudinal Components

Decompose the waves and Maxwell's equations into components that are parallel to the propagation (z) axis of the waveguide and others that are transverse (perpendicular) to the z axis.

1.4.1 Derive Phasor Amplitudes E(x,y) and H(x,y)

1.5 Testing Latex For Maxima

$$D_{P_z}\left(z\right) = \frac{\partial}{\partial z}\sum_{m=-\infty}^{\infty}\left|a_m^{(\nu)}\right|^2$$