VE216 Lecture 17

> Discrete Time Frequency Representations

Complex Geometric Sequences

For the DT LTI $h[n]$ with input $x[n] = z^n$, we get

$$y[n] = (h * x)[n] = \sum_{k=-\infty}^{\infty} h[k] z^{n-k} = z^n \sum_{k=-\infty}^{\infty} h[k] z^{-k} = z^n H(z)$$

So $H(z) = \sum_{k=-\infty}^{\infty} h[k] z^{-k}$, this is for DT Transform.

Remember CT Transform $H(s) = \int_{-\infty}^{\infty} h(t) e^{-st} dt$

Rational System Functions

We can derive $\sum z^{-k} Y = \sum z^{-p} Z$, then we can derive the $H(z)X = Y$ here.

DT Vector Diagram

$H(z_0) = K \frac{\sum_{k=0}^{k_q} (z_0 - q_k)}{\sum_{r=0}^{r_p} (z_0 - p_r)}$, very similar to CT Vector diagrams.

$|H(z_0)| = |K| \frac{\sum_{k=0}^{k_q} |z_0 - q_k|}{\sum_{r=0}^{r_p} |z_0 - p_r|}$ and $\angle H(z_0) = \angle K + \sum_{k=0}^{k_q} \angle(z_0 - q_k) - \sum_{r=0}^{r_p} \angle(z_0 - p_r)$.