

Lecture 11 Discrete-Time IIR Filters (Part 2)

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start out $n \geq 0$;

EE 313 Linear Systems and Signals

The University of Texas at Austin

initial conditions

$$y[0] = a_1 y[-1] + a_2 y[-2] + b_0 x[0] + b_1 x[-1] + b_2 x[-2]$$

slide 11-9

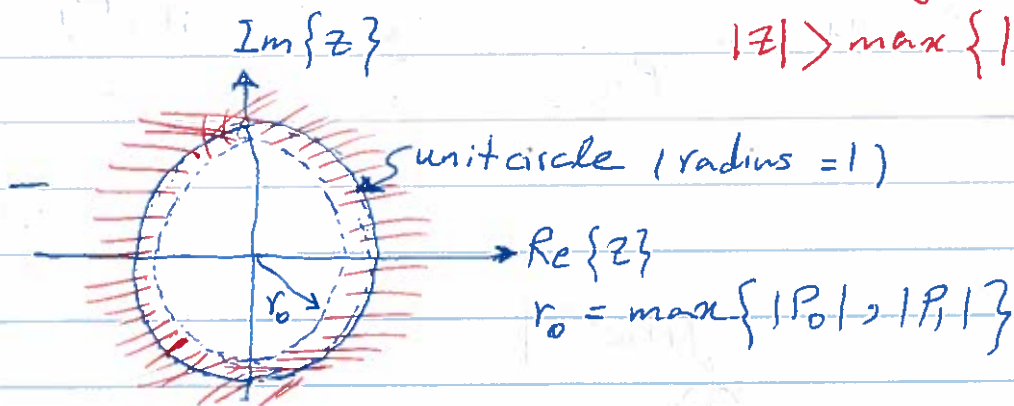
$$H(z) = \frac{b_0 + b_1 z^{-1} + b_2 z^{-2}}{1 - a_1 z^{-1} - a_2 z^{-2}} \cdot \frac{z^2}{z^2} = \frac{b_0 z^2 + b_1 z + b_2}{z^2 - a_1 z - a_2}$$

$$= b_0 \frac{z^2 + (\frac{b_1}{b_0})z + (\frac{b_2}{b_0})}{z^2 - a_1 z - a_2} = b_0 \frac{(z - z_0)(z - z_1)}{(z - p_0)(z - p_1)}$$

$$|z| > |p_0| \quad |z| > |p_1|$$

Region of convergence $|z| > |p_0|$ and $|z| > |p_1|$

$$|z| > \max\{|p_0|, |p_1|\}$$



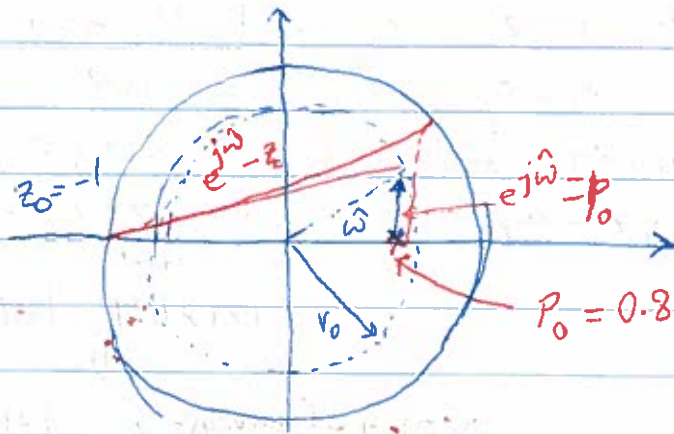
$$H(z) = b_0 \frac{(z - z_0)(z - z_1)}{(z - p_0)(z - p_1)} = b_0 \frac{z^2 - (z_0 + z_1)z + z_0 z_1}{z^2 - (p_0 + p_1)z + p_0 p_1} \cdot \frac{z^{-2}}{z^{-2}}$$

$$= \frac{1 - (z_0 + z_1)z^{-1} + z_0 z_1 z^{-2}}{1 - (p_0 + p_1)z^{-1} + p_0 p_1 z^{-2}} \cdot b_0$$

$$|ab| = |a| |b| \quad , \quad \angle ab = \angle a + \angle b$$

$$a = r_a e^{j\theta_a} \quad , \quad b = r_b e^{j\theta_b}$$

$$ab = (r_a r_b) e^{j(\theta_a + \theta_b)} \quad , \quad |e^{j\theta}| = 1 = \sqrt{\cos^2 \theta + \sin^2 \theta}$$



$H(z) = \frac{z - z_0}{P - P_0}$:	$\hat{\omega}$	$H(e^{j\hat{\omega}})$
		0	$\frac{2}{0.2} = 10$
		π	0
		$\frac{\pi}{2}$	$\frac{\sqrt{2}}{1.28} = 1.1$

