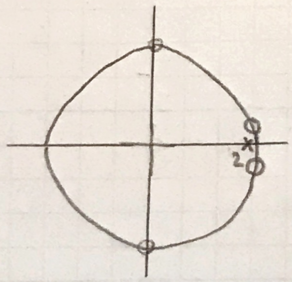
CoffeeTrackerPro | Filter Design | Trevor Trouchon



Limited to single pole, single zero to preserve μC resources.

$$H(z) = \frac{b_0\left(z-e^{-jw_1}\right)\left(z-e^{jw_1}\right)}{(z-0.99)^2}$$

$$H(z) = \frac{b_0\left(z^2 - z e^{jw_1} - z e^{-jw_1} + 1\right)}{(z-0.99)^2}$$

$$H(z) = \frac{b_0\left(z^2 - z\left(\underbrace{e^{jw_1} + e^{-jw_1}}_{2\cos(w_1)}\right) + 1\right)}{(z-0.99)^2}$$

$$H(z) = \frac{b_0\left(z^2 - 2z\cos(w_1) + 1\right)}{z^2 - 1.98z + 0.9801}$$

$$\frac{Y(z)}{X(z)} = \frac{b_0\left(1 - 2z^{-1}\cos(w_1) + z^{-2}\right)}{1 - 1.98z^{-1} + 0.9801z^{-2}}$$

$$Y(z)\left(1 - 1.98z^{-1} + 0.9801z^{-2}\right) = X(z)\,b_0\left(1 - 2z^{-1}\cos(w_1) + z^{-2}\right)$$

$$Y(z) = b_0X(z) - 2b_0\cos(w_1)z^{-1}X(z) + b_0z^{-2}X(z) + 1.98z^{-1}Y(z) - 0.9801z^{-2}Y(z)$$

$$\underline{y(n) = b_0x(n) - 2b_0\cos(w_1)x(n-1) + b_0x(n-2) + 1.98y(n-1) - 0.9801y(n-2)}$$

Let $w_1 = 2.5625°$ $(.014\pi)$, Shoot for gain of 10 at DC (4000 Hz aliases to DC)

$$H(z=1) = 10 = \frac{b_0\left(1 - 2(1)\cos(.014\pi) + 1\right)}{1 - 1.98(1) + 0.9801(1)}$$

$$10 = \frac{b_0(0.002)}{.0001} \qquad \underline{b_0 = 0.5}$$

Given $w_1 = 2.5625°$, Freqs between 0 and 28.47 Hz $\left(\frac{2.5625}{180} \cdot 2000 \leftarrow \text{Max Hz}\right)$ exist ~~to~~ in "passband"

$$\underline{y(n) = 0.5x(n) - 0.999x(n-1) + 0.5x(n-2) + 1.98y(n-1) - 0.9801y(n-2)}$$