

$$s(n) = s(n-1) + i(n)$$

$$s(n) = (s(n) + i(n))Z^{-1}$$

$$s(n) - s(n)Z^{-1} = i(n)Z^{-1}$$

$$s(n)(1 - Z^{-1}) = i(n)Z^{-1}$$

$$\frac{s(n)}{i(n)} = \frac{Z^{-1}}{(1 - Z^{-1})}$$

$$Z^{-1} = e^{-j\omega}$$

$$\frac{s(n)}{i(n)} = \frac{e^{-j\omega}}{(1 - e^{-j\omega})} = H$$

Frequency response

$$G = |H|$$

$$\sqrt{\frac{e^{-j\omega}}{(1 - e^{-j\omega})} * \frac{e^{j\omega}}{(1 - e^{j\omega})}}$$

$$\frac{e^{-j\omega}}{(1 - e^{-j\omega})} * \frac{e^{j\omega}}{(1 - e^{j\omega})} = \frac{e^{-j\omega} e^{j\omega}}{(1 - e^{j\omega} - e^{-j\omega} + e^{-j\omega} e^{j\omega})}$$

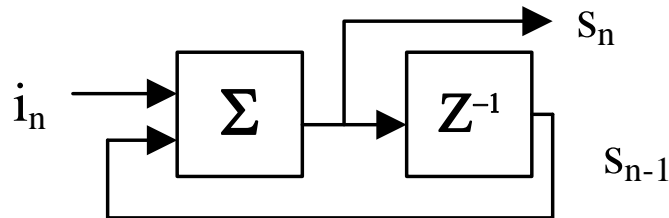
$$= \frac{1}{(1 - e^{j\omega} - e^{-j\omega} + 1)}$$

$$= \frac{1}{(2 - (e^{j\omega} + e^{-j\omega}))}$$

$$e^{j\omega} + e^{-j\omega} = 2\cos \omega$$

$$\Rightarrow \frac{1}{2(1 - \cos w)}$$

$$\sqrt{\frac{1}{2(1 - \cos w)}}$$



$$s(n) = s(n - 1) + i(n)$$

$$s(n) = s(n)Z^{-1} + i(n)$$

$$s(n) - s(n)Z^{-1} = i(n)$$

$$s(n)(1 - Z^{-1}) = i(n)$$

$$\frac{s(n)}{i(n)} = \frac{1}{(1 - Z^{-1})}$$

$$Z^{-1} = e^{-jw}$$

$$\frac{s(n)}{i(n)} = \frac{1}{(1 - e^{-jw})} = H$$

Frequency response

$$G = |H|$$

$$\sqrt{\frac{1}{(1 - e^{-jw})} * \frac{1}{(1 - e^{jw})}}$$

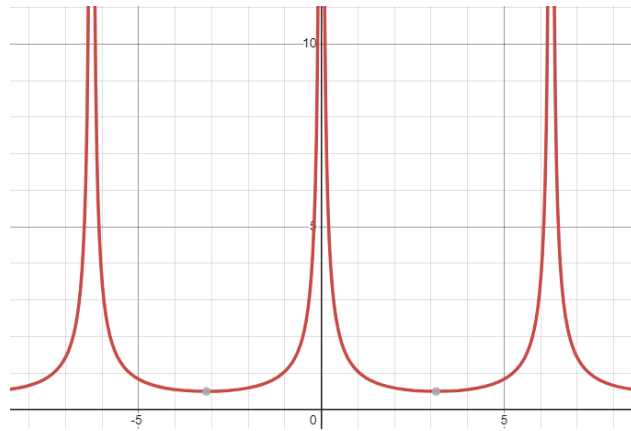
$$\begin{aligned} \frac{1}{(1 - e^{-jw})} * \frac{1}{(1 - e^{jw})} &= \frac{1}{(1 - e^{jw} - e^{-jw} + e^{-jw}e^{jw})} \\ &= \frac{1}{(1 - e^{jw} - e^{-jw} + 1)} \end{aligned}$$

$$= \frac{1}{2 - (e^{jw} + e^{-jw})}$$

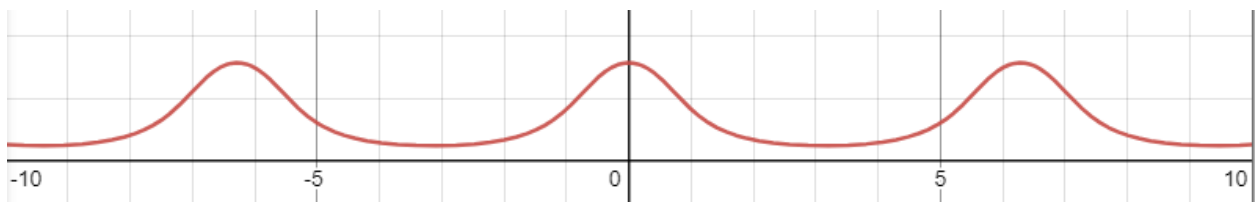
$$e^{jw} + e^{-jw} = 2\cos w$$

$$\Rightarrow \frac{1}{2(1 - \cos w)}$$

$$\sqrt{\frac{1}{2(1 - \cos w)}}$$



$$\tan^{-1}\left(\frac{1}{2(1 - \cos w)}\right)$$



Non-linear