Frequency Transformation in Analog domain

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Low pass to Low pass filter:

- Given a normalized low pass filter, it is desirable to have a low pass filter with a different cut off frequency Ω_c. This can be accomplished by the transformation, $s = s/\Omega_c$

Low pass to High pass filter:

- Given a normalized low pass filter, it is desirable to have a high pass filter with a off frequency Ω_c. This can be accomplished by the transformation, $s = \Omega_c/s$.

Low pass to Band pass filter:

- Given a normalized low pass filter, it is desirable to have a band pass filter with a different cut off frequencies Ω_l, Ω_u. This can be accomplished by the transformation,

$$s \rightarrow \frac{s^2 + \Omega_l \Omega_u}{s(\Omega_u - \Omega_l)}$$

and

$$\Omega_r = \min\left\{ \left| \frac{-\Omega_1^2 + \Omega_l \Omega_u}{\Omega_1(\Omega_u - \Omega_l)} \right|, \left| \frac{\Omega_2^2 - \Omega_l \Omega_u}{\Omega_2(\Omega_u - \Omega_l)} \right| \right\}$$

Low pass to Band stop filter:

- Given a normalized low pass filter, it is desirable to have a band stop filter with a different cut off frequencies Ω_l, Ω_u. This can be accomplished by the transformation,

$$s \rightarrow \frac{s(\Omega_u - \Omega_l)}{s^2 + \Omega_l \Omega_u}$$

and

$$\Omega_r = \min\left\{ \left| \frac{\Omega_1(\Omega_u - \Omega_l)}{-\Omega_1^2 + \Omega_l \Omega_u} \right|, \left| \frac{\Omega_2(\Omega_u - \Omega_l)}{\Omega_2^2 - \Omega_l \Omega_u} \right| \right\}$$