

Moving Target Indicators

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Single Delay Line Cancelers

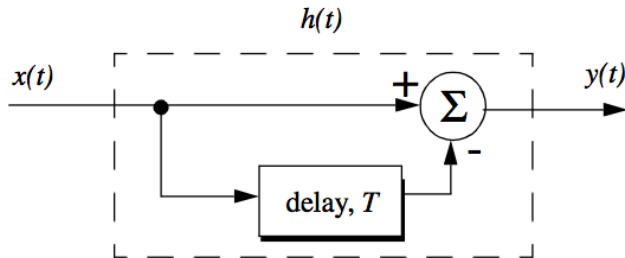


Figure: Single delay line canceler

Source: Bassem R. Mahafza. *Radar Systems Analysis and Design Using MATLAB[®]*. Chapman & Hall/CRC, 2000.

Single Delay Line Cancelers

$$h(t) = \delta(t) - \delta(t - T)$$

$$H(\omega) = 1 - e^{-j\omega T}$$

$$\begin{aligned}|H(\omega)|^2 &= H(\omega)H^*(\omega) \\&= (1 - e^{-j\omega T})(1 - e^{j\omega T}) \\&= 2(1 - \cos\omega T) \\&= 4(\sin(\omega T/2))^2\end{aligned}$$

Source: Bassem R. Mahafza. *Radar Systems Analysis and Design Using MATLAB®*. Chapman & Hall/CRC, 2000.

Double Delay Line Cancelers

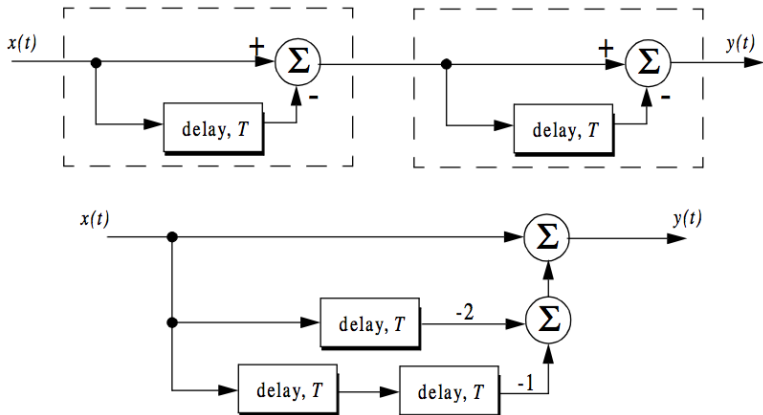


Figure: Two configurations for a double delay line canceler

Double Delay Line Cancelers

$$h(t) = \delta(t) - 2\delta(t - T) + \delta(t - 2T)$$

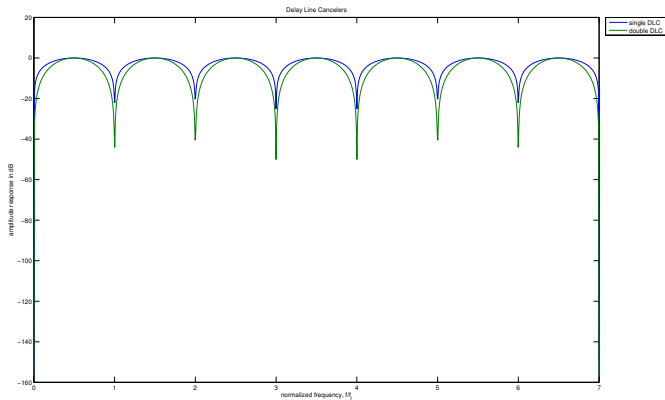
$$|H(\omega)|^2 = |H_1(\omega)|^2 |H_1(\omega)|^2$$

$$\text{where } |H_1(\omega)|^2 = 4(\sin(\omega T/2))^2$$

$$|H(\omega)|^2 = 16 \left(\sin \left(\omega \frac{T}{2} \right) \right)^4$$

Source: Bassem R. Mahafza. *Radar Systems Analysis and Design Using MATLAB®*. Chapman & Hall/CRC, 2000.

Delay Line Cancelers



Delay Lines with Feedback

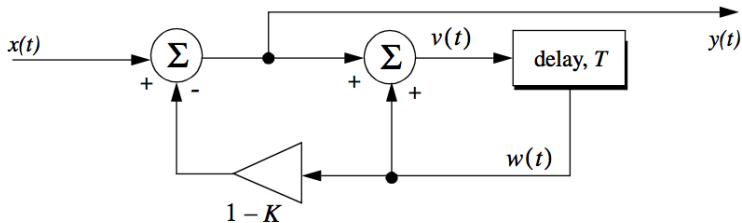


Figure: MTI recursive filter

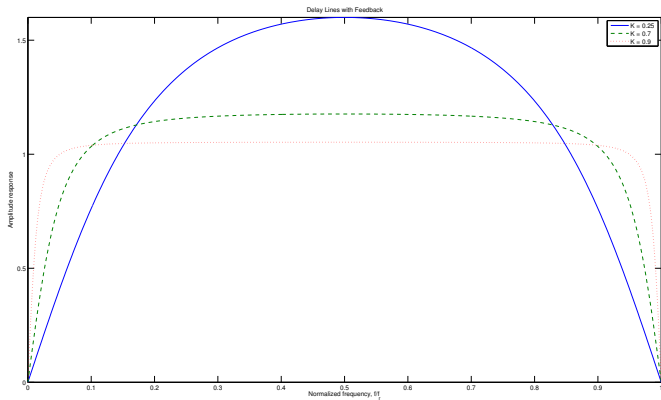
Source: Bassem R. Mahafza. *Radar Systems Analysis and Design Using MATLAB[®]*. Chapman & Hall/CRC, 2000.

Delay Lines with Feedback

$$\begin{aligned} H(z) &= \frac{1 - z^{-1}}{1 - Kz^{-1}} \\ |H(z)|^2 &= \frac{(1 - z^{-1})(1 - z)}{(1 - Kz^{-1})(1 - Kz)} \\ &= \frac{2 - (z + z^{-1})}{(1 + K^2) - K(z + z^{-1})} \\ |H(e^{j\omega T})|^2 &= \frac{2(1 - \cos\omega T)}{(1 + K^2) - 2K\cos(\omega T)} \end{aligned}$$

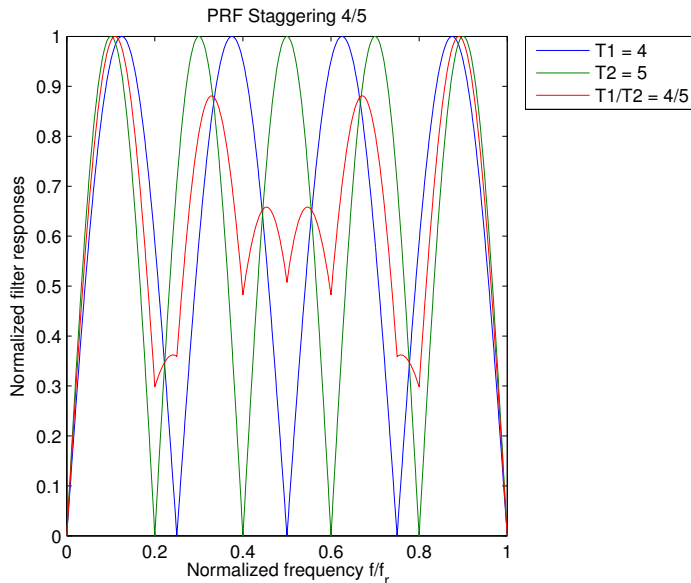
Source: Bassem R. Mahafza. *Radar Systems Analysis and Design Using MATLAB®*. Chapman & Hall/CRC, 2000.

Delay Lines with Feedback

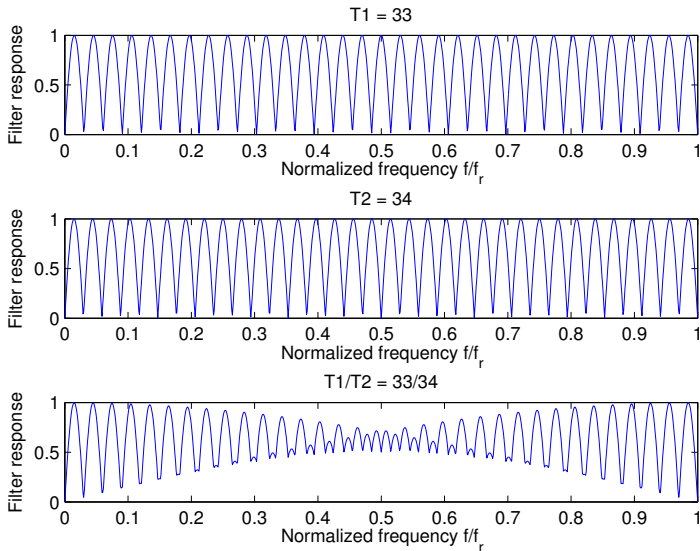


Source: Bassem R. Mahafza. *Radar Systems Analysis and Design Using MATLAB®*. Chapman & Hall/CRC, 2000.

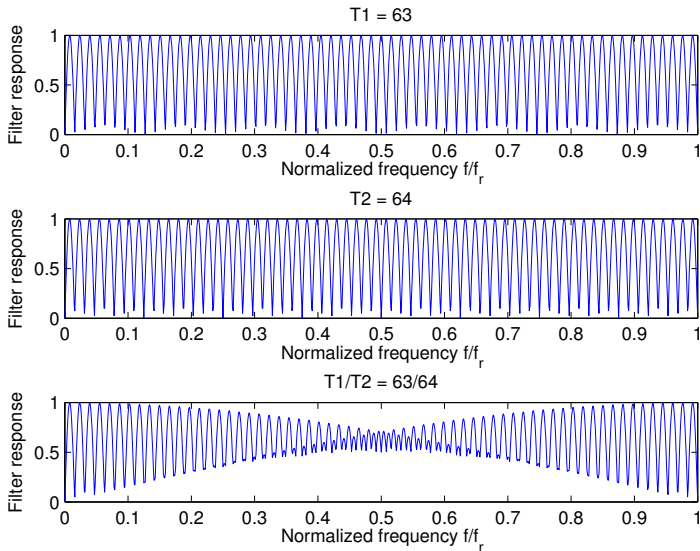
PRF Staggering 4/5



PRF Staggering 33/34



PRF Staggering 63/64

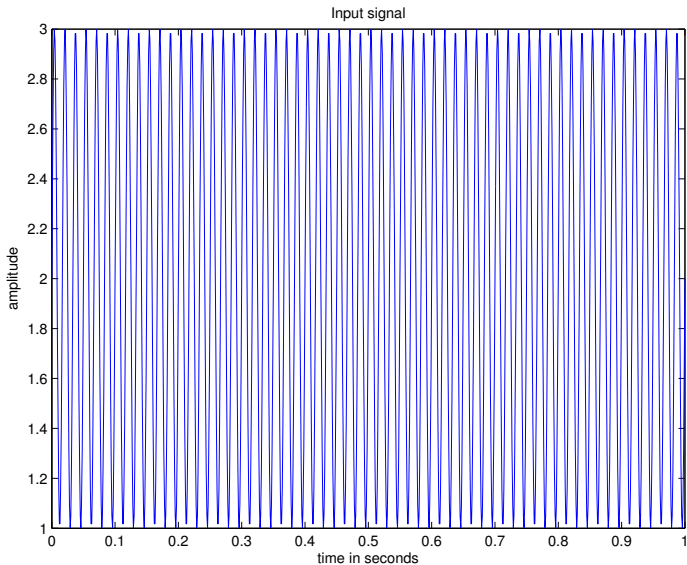


First staggered blind speed

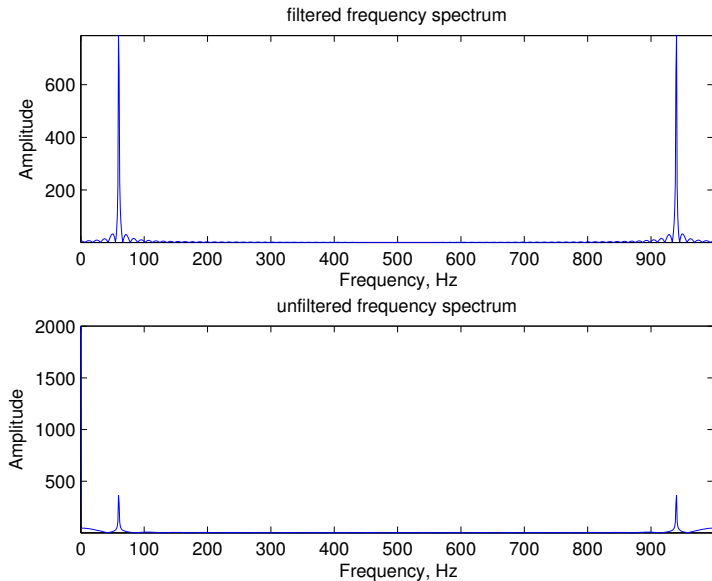
$$\frac{n_1}{T_1} = \frac{n_2}{T_2} = \dots = \frac{n_N}{T_N}$$
$$v_{blind} = \frac{n_1 + n_2 + \dots + n_N}{N} v_{blind1}$$

Source: Bassem R. Mahafza. *Radar Systems Analysis and Design Using MATLAB[®]*. Chapman & Hall/CRC, 2000.

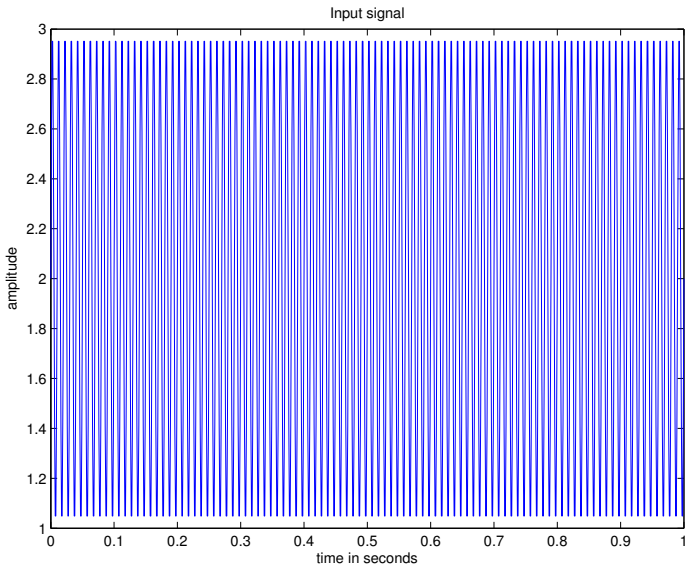
60Hz input



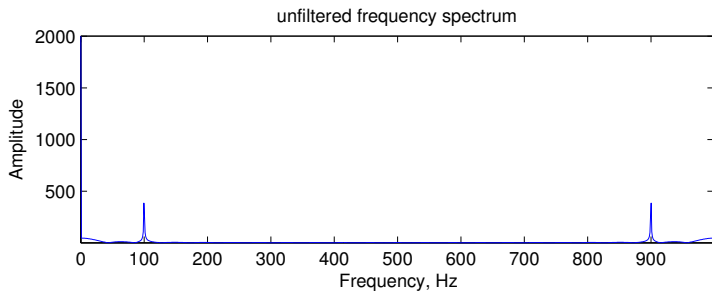
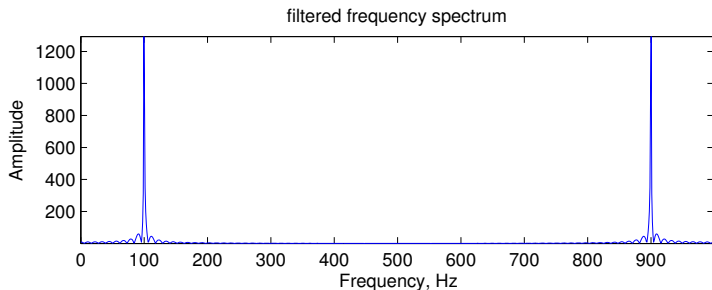
Filtered spectrum of 60Hz input



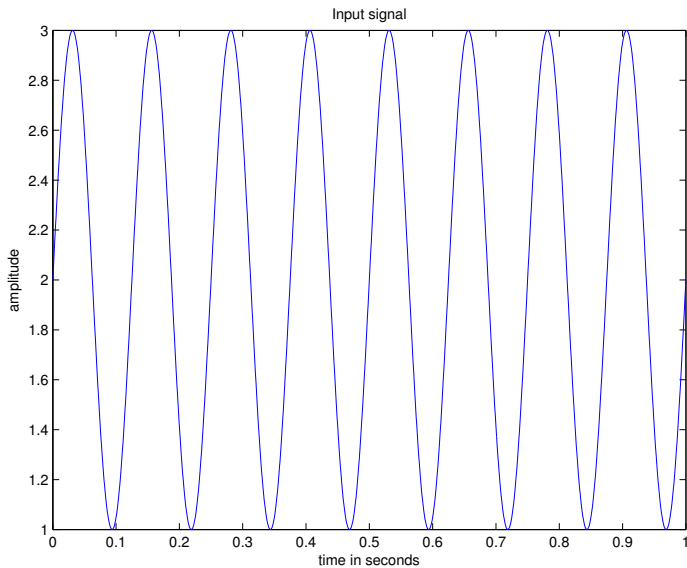
100Hz input



Filtered spectrum of 100Hz input

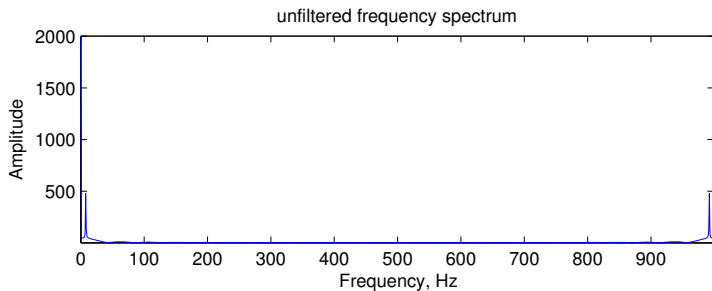
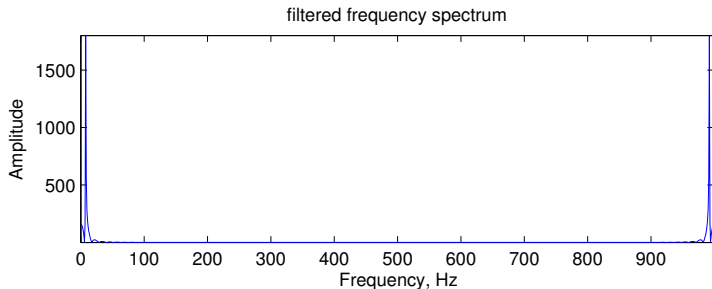


1008Hz input



Aliased because sampling rate is just 1000Hz.

Filtered spectrum of 1008Hz input



References

- ▶ Merrill I. Skolnik. *Introduction to Radar Systems*. McGraw-Hill, 2001.
- ▶ Bassem R. Mahafza. *Radar Systems Analysis and Design Using MATLAB®*. Chapman & Hall/CRC, 2000.

Thanks