Moving Target Indicators

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Single Delay Line Cancelers

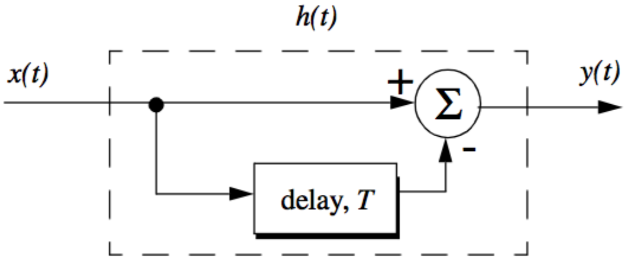


Figure : Single delay line canceler

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

Single Delay Line Cancelers

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

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

Double Delay Line Cancelers

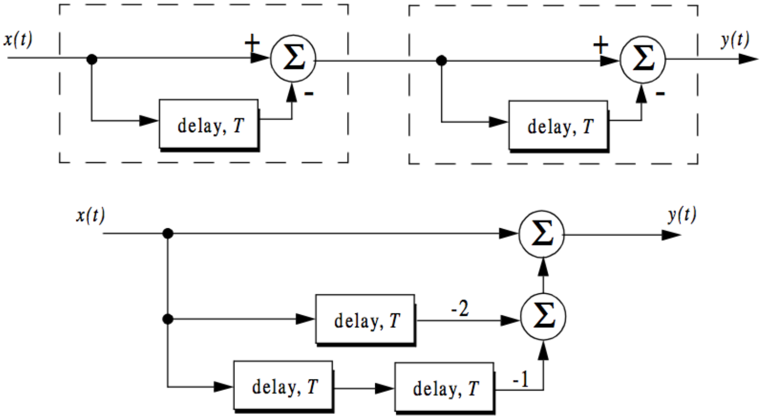


Figure : Two configurations for a double delay line canceler

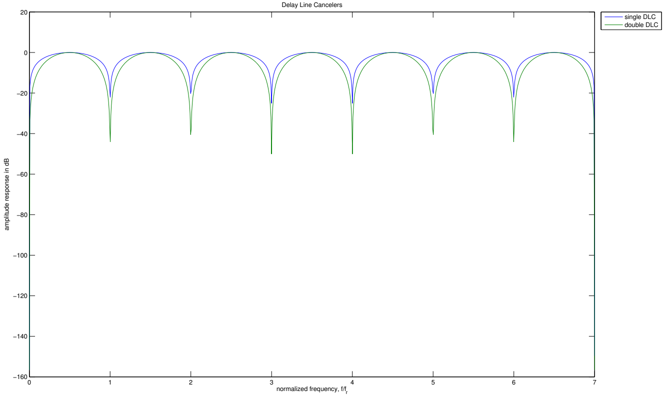
Source: Bassem R. Mahafza. *Radar Systems Analysis and Design Using MATLAB®*. Chapman & Hall/CRC, 2000.

Double Delay Line Cancelers

$$h(t) = \delta(t) - 2\delta(t-T) + \delta(t-2T)$$
$$|H(\omega)|^2 = |H_1(\omega)|^2 |H_1(\omega)|^2$$
$$where\ |H_1(\omega)|^2 = 4(sin(\omega T/2))^2$$
$$|H(\omega)|^2 = 16\left(sin\left(\omega\frac{T}{2}\right)\right)^4$$

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

Delay Line Cancelers



Delay Lines with Feedback

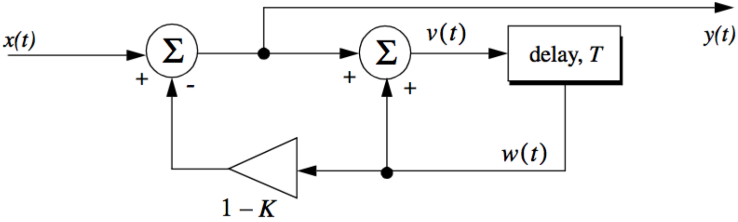


Figure : MTI recursive filter

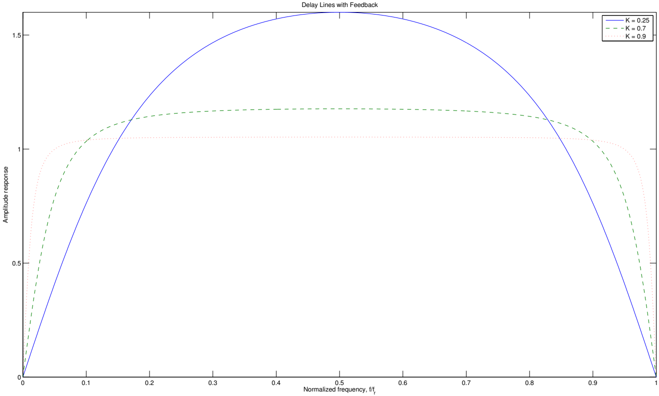
Source: Bassem R. Mahafza. *Radar Systems Analysis and Design Using MATLAB®*. Chapman & Hall/CRC, 2000.

Delay Lines with Feedback

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

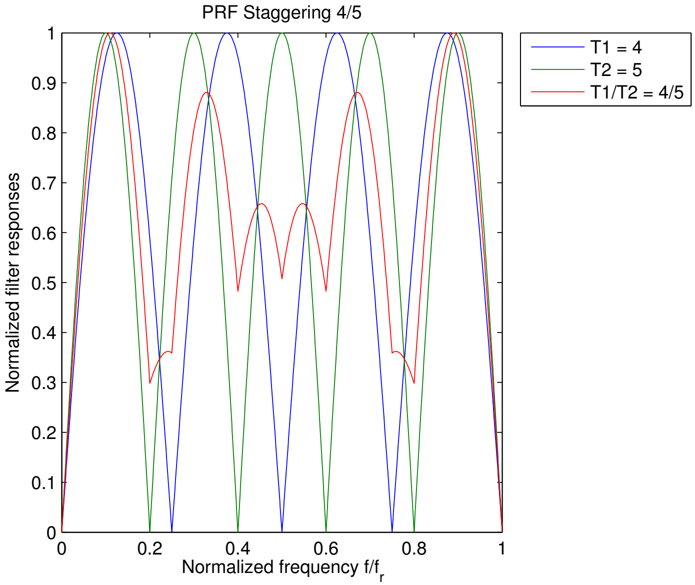
Source: Bassem R. Mahafza. *Radar Systems Analysis and Design Using MATLAB®*. Chapman & Hall/CRC, 2000.

Delay Lines with Feedback



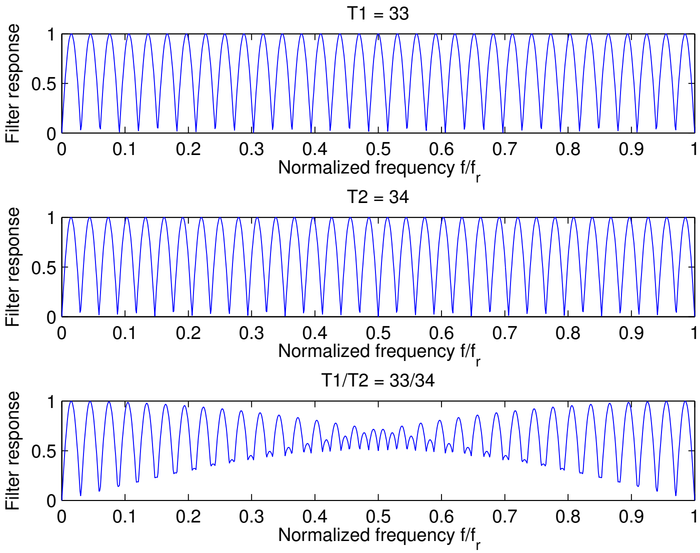
Source: Bassem R. Mahafza. *Radar Systems Analysis and Design Using MATLAB®*. Chapman & Hall/CRC, 2000.

PRF Staggering 4/5



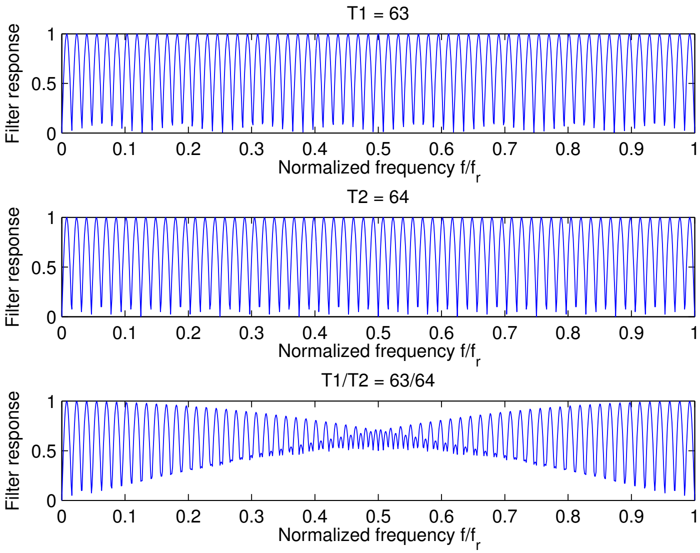
Source: Bassem R. Mahafza. *Radar Systems Analysis and Design Using MATLAB®*. Chapman & Hall/CRC, 2000.

PRF Staggering 33/34



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

PRF Staggering 63/64



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

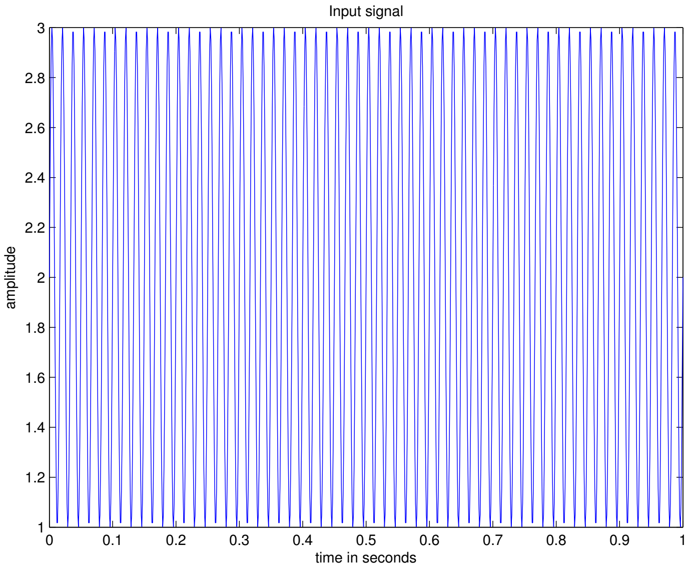
First staggered blind speed

$$\frac{n_1}{T_1} = \frac{n_2}{T_2} = ... = \frac{n_N}{T_N}$$

$$v_{blind} = \frac{n_1 + n_2 + ... + n_N}{N} v_{blind1}$$

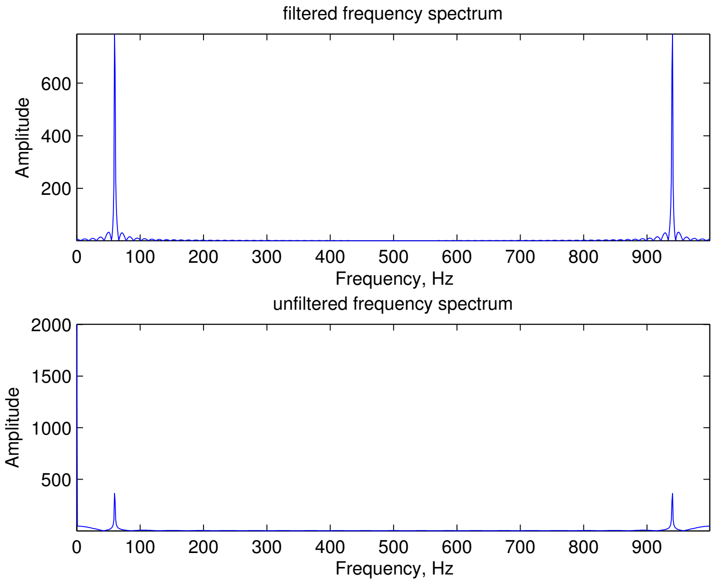
Source: Bassem R. Mahafza. *Radar Systems Analysis and Design Using MATLAB®*. Chapman & Hall/CRC, 2000.

60Hz input

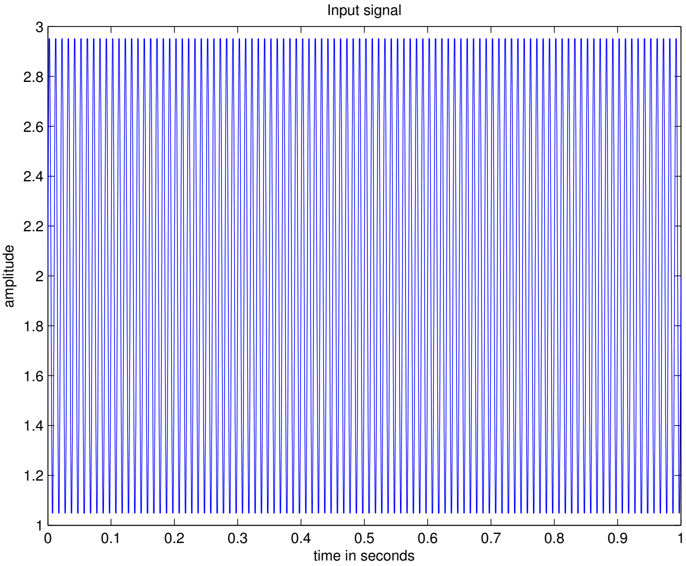


Input signal
amplitude
time in seconds
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

Filtered spectrum of 60Hz input

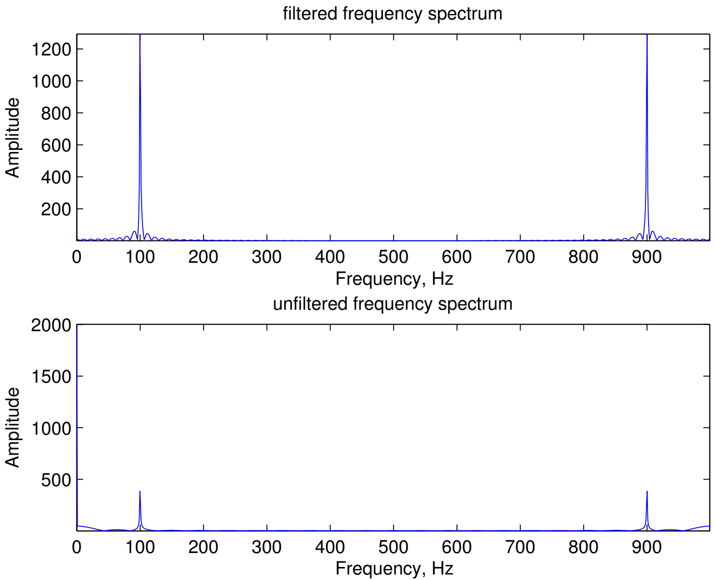


100Hz input

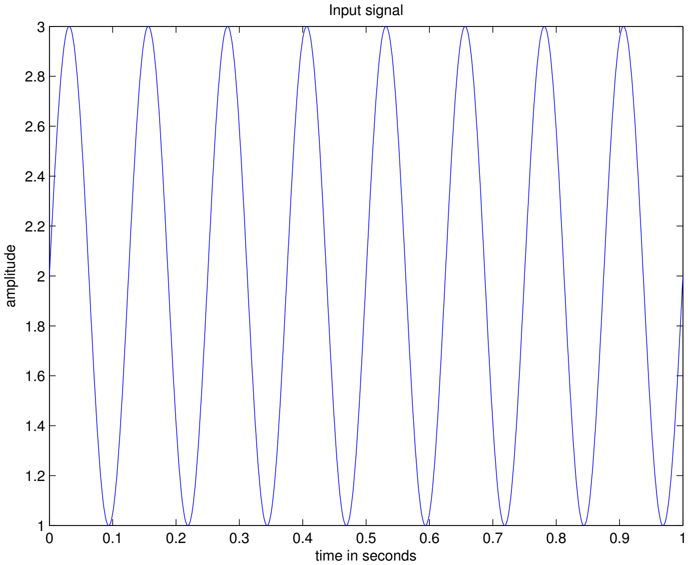


Input signal
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
amplitude
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
time in seconds

Filtered spectrum of 100Hz input

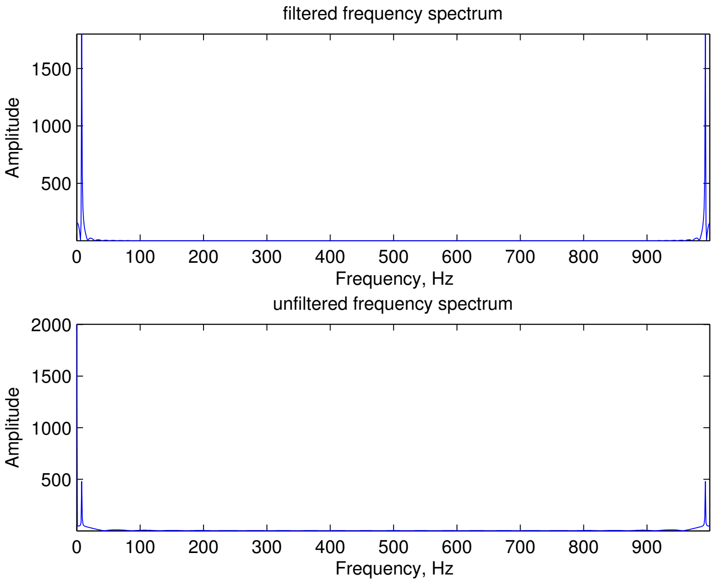


1008Hz input



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