Time Domain Calculation of MTI Power Gain

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1 Average MTI gain

As discussed in section 5.2.5 of [1], the MTI metric of improvement factor I can be factored as

$$I = G \cdot CA \tag{1}$$

where CA is the clutter power attenuation due to the MTI filter and G is the average power gain of that filter. If the filter impulse response is $h[m]$ and its corresponding frequency response in units of Hertz is $H(F)$, then the gain is defined by Eq. 5.45 of [1]:

$$\begin{aligned} G &= \frac{1}{PRF} \int_{-PRF/2}^{PRF/2} \left| H(F) \right|^2 dF \\ &= \frac{1}{2\pi} \int_{-\pi}^{\pi} \left| H(\omega) \right|^2 d\omega \end{aligned} \tag{2}$$

The restatement in terms of normalized frequency ω in the second line follows readily from the unit conversion $F \rightarrow \Omega/PRF \rightarrow \omega \cdot PRF/2\pi$ (which also implies $dF \rightarrow (PRF/2\pi)d\omega$).

Applying Parseval's theorem [2] to the last version of G in Eq. 2 immediately leads to an alternate equation for computing G based on the impulse response coefficients:

$$G = \sum_{m=-\infty}^{+\infty} \left| h[m] \right|^2 \tag{3}$$

This result may be easier to use in some cases, especially when $h[m]$ is a finite impulse response (FIR) filter.

2 References

[1] M. A. Richards, *Fundamentals of Radar Signal Processing*. McGraw-Hill, New York, 2005.

[2] A. V. Oppenheim, R. W. Schafer, and J. R. Buck, *Discrete-Time Signal Processing*, 2nd edition. Prentice-Hall, New York, 1999.