After demodulation and range gating, the receiver signal $\mathbf{S}$ at one particular range gate forms a discrete complex time series for $k = 0, \ldots, N_{ci} \cdot N_p \cdot N_s - 1$ (The length of the time series is written as a product of three integers for later convenience, $i = \sqrt{-1}$):

$$S[k] = S_I[k] + iS_Q[k].$$

The sampling time ΔT depends on the inter-pulse period.

1 Coherent integration

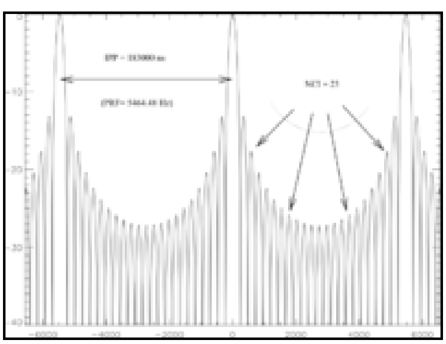
RWP's often apply a simple preprocessing method called coherent integration:

$$S^{ci}[m] = \frac{1}{N_{ci}} \sum_{n=0}^{N_{ci}-1} S[m \cdot N_{ci} + n].$$

This is a digital filter with decimation (Farley (1985)), whereby the sampling interval is increased to $N_{ci}\Delta T$. Its frequency response is referred to as comb-filtering (Schmidt et.al. (1979)), with an amplitude transfer function depending on frequency as

$$|H(f)| = \frac{\sin(N_{ci}\pi f \Delta T)}{N_{ci}\sin(\pi f \Delta T)} = \mathcal{D}_{N_{ci}}(f\Delta T),$$

where $\mathcal{D}_{N_{ci}}$ is the Dirichlet kernel. A plot of this function around baseband is shown below. Note that the function is periodic and only plotted over a finite interval. The time increment of the coherently integrated series is changed to $N_{ci} \cdot \Delta T$. This method poses no problems if the number of coherent samples N_{ci} is chosen not to large.



H(f)

The motivation for coherent integration is a reduction of the data rate and it has mainly historical roots. For sufficiently capable hardware it is possible to set this method aside, which has some advantages, see Wilfong et.al. (1999), Hocking (1997a) and Hocking (1997b).

2 Filtering of nonstationary clutter

Any non-stationary character of clutter signals, as for example caused by bird or airplane echoes, make a sole spectral representation of the signal inadequate for an efficient and suitable description of the clutter component.

Methods of non-stationary signal analysis therefore need to be used to find a decent (hopefully sparse) representation for such signals, which may then allow efficient filtering strategies with the purpose of either fully removing the intermittent clutter component or for setting appropriate quality flags.

Examples are wavelet filtering methods as suggested by Jordan et.al. (1997) or Boisse et.al. (1999) and Gabor frame based methods, see Lehmann and Teschke (2008), Lehmann (2012).

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