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To: Mark 5 Development Group

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Subject: Windowing and PFB spectral efficiency

A good digital filter has low sidelobes and minimal loss due to aliasing. However sidelobes and aliasing are not the only form of loss. For example, if the input signal is multiplied by a windowing function the input samples are unequally weighted. This results in a loss of signal to noise ratio. If we define the signal to noise loss 'L" as the ratio between the output signal to noise (SNR) and the input SNR then for spectrometer or correlator formed by taking a windowed FFT is

$$L = \sum w_k^4 \Big/ \Big[\sum w_k^2\Big]^2$$

where w_k is the window function. The SNR loss can be reduced by overlapping the data spans and adding the resultant spectra or correlations.

For some common window functions

Window	Peak sidelobe	SNR loss factor No overlap	SNR loss With 50% overlap
Uniform	-13 dB	1.0	1.0
Hanning	-32 dB	0.72	0.97
Hamming	-43 dB	0.74	0.98
Blackman	-58	0.65	0.91

Using a polyphase filter (PFB) also reduces the SNR loss. In fact the loss factors for a PFB with only 2 taps per subfilter has SNR loss factor of 0.93 and 4 taps per subfilter has a loss factor of 0.98.