Window Characteristics[a]

Window (length N)	Main Lobe Width	Side-lobe Level (dB)	Transition Bandwidth	Passband Ripple (dB)	Stopband Attenuation (dB)
rectangular	$4\pi/N$	-13.5	$1.8\pi/N$	0.75	21
Bartlett	$8\pi/N$	-27	$6.1\pi/N$	0.45	25
von Hann	$8\pi/N$	-32	$6.2\pi/N$	0.055	44
Hamming	$8\pi/N$	-43	$6.6\pi/N$	0.019	53
Blackman	$12\pi/N$	-57	$11\pi/N$	0.0017	74

[a]Other window names: rectangular=boxcar, Bartlett=triangular, von Hann=Hann=Hanning. NA: the von Sump window is a figment of my imagination and yet to be invented.

Common z-Transforms

$x[n]$	$X^z(z)$	ROC
$\delta[n]$	1	All z
$u[n]$	$\dfrac{1}{1-z^{-1}}$	$\lvert z\rvert > 1$
$a^n u[n]$	$\dfrac{1}{1-az^{-1}}$	$\lvert z\rvert > \lvert a\rvert$
$na^n u[n]$	$\dfrac{az^{-1}}{(1-az^{-1})^2}$	$\lvert z\rvert > \lvert a\rvert$
$-a^n u[-n-1]$	$\dfrac{1}{1-az^{-1}}$	$\lvert z\rvert < \lvert a\rvert$
$-na^n u[-n-1]$	$\dfrac{az^{-1}}{(1-az^{-1})^2}$	$\lvert z\rvert < \lvert a\rvert$
$\cos(\theta_0 n)\,u[n]$	$\dfrac{1-z^{-1}\cos(\theta_0)}{1-2z^{-1}\cos(\theta_0)+z^{-2}}$	$\lvert z\rvert > 1$
$\sin(\theta_0 n)\,u[n]$	$\dfrac{z^{-1}\sin(\theta_0)}{1-2z^{-1}\cos(\theta_0)+z^{-2}}$	$\lvert z\rvert > 1$
$a^n\cos(\theta_0 n)\,u[n]$	$\dfrac{1-az^{-1}\cos(\theta_0)}{1-2az^{-1}\cos(\theta_0)+a^2z^{-2}}$	$\lvert z\rvert > \lvert a\rvert$
$a^n\sin(\theta_0 n)\,u[n]$	$\dfrac{az^{-1}\sin(\theta_0)}{1-2az^{-1}\cos(\theta_0)+a^2z^{-2}}$	$\lvert z\rvert > \lvert a\rvert$

$$X(z)=\sum_{n=-\infty}^{\infty} x[n]z^{-n}$$

$$w'=\frac{2}{T}\tan\left(\frac{\theta}{2}\right)$$

$$\theta=2\tan^{-1}\left(\frac{T}{2}\cdot w'\right)$$

$$s=\frac{2}{T}\left(\frac{1-z^{-1}}{1+z^{-1}}\right)$$

$$z=-\left(\frac{s+\frac{2}{T}}{s-\frac{2}{T}}\right)$$

From Porat, "A Course in DSP", Wiley and Sons, 1997

Type	I	II	III	IV
Order (length)	even (odd)	odd (even)	even (odd)	odd (even)
Symmetry of $h[n]$	symmetric	symmetric	anti-symmetric	anti-symmetric
Symmetry of $A(\theta)$	symmetric	symmetric	anti-symmetric	anti-symmetric
Period of $A(\theta)$	2π	4π	2π	4π
ϕ_0	0	0	0.5π	0.5π
$F(\theta)$ in (9.23)	1	$\cos(0.5\theta)$	$\sin\theta$	$\sin(0.5\theta)$
K in (9.23)	$N/2$	$(N-1)/2$	$(N-2)/2$	$(N-1)/2$
$g[n]$ in (9.23)	see (9.5)	see (9.10)	see (9.16)	see (9.21)
$H^f(0)$	arbitrary	arbitrary	0	0
$H^f(\pi)$	arbitrary	0	0	arbitrary
Uses	LP, HP, BP, BS, Multiband filters	LP, BP	Differentiators, Hilbert transformers	

Table 9.1 Properties and parameters of the four FIR filter types.