内容截取自：https://community.sw.siemens.com/s/article/introduction-to-filters-fir-versus-iir

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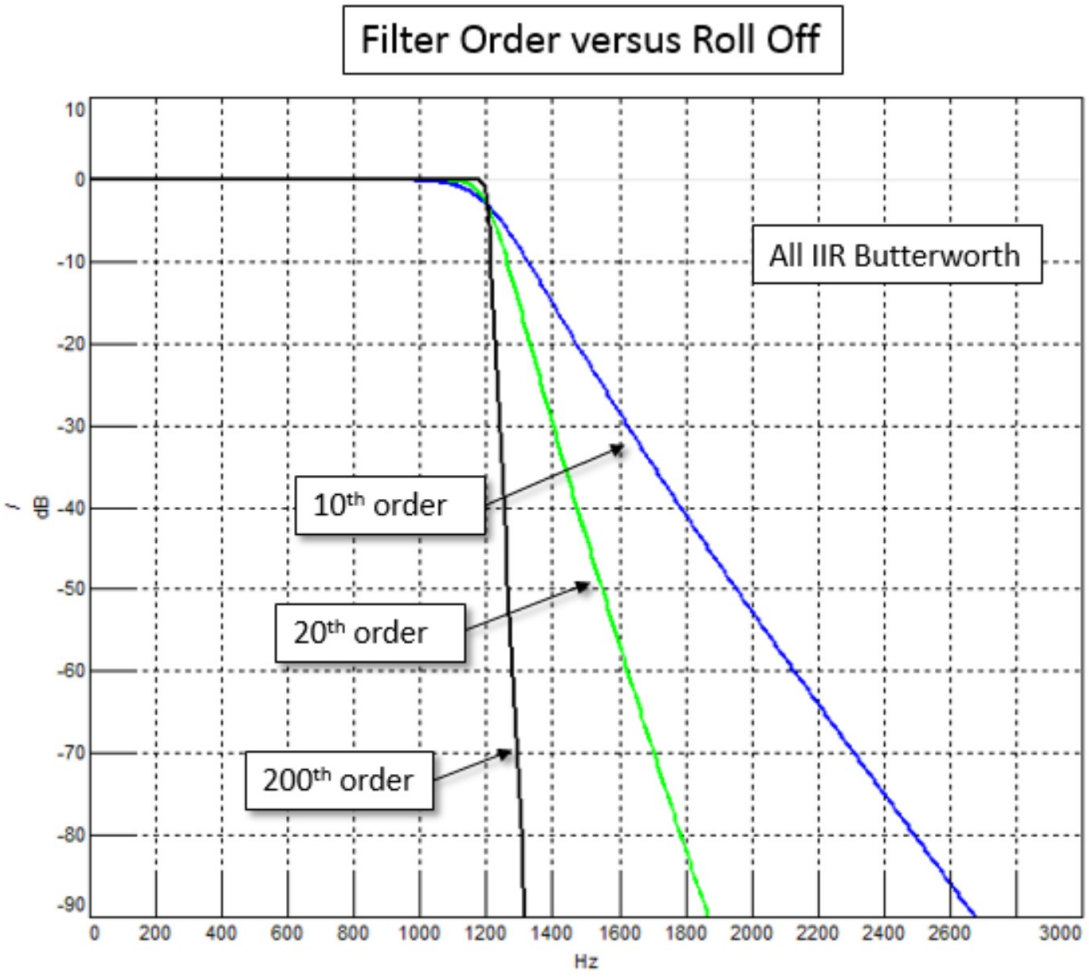
FIR Filter Equation: $y(n) = \sum_{k=0}^{N} a(k)x(n-k)$

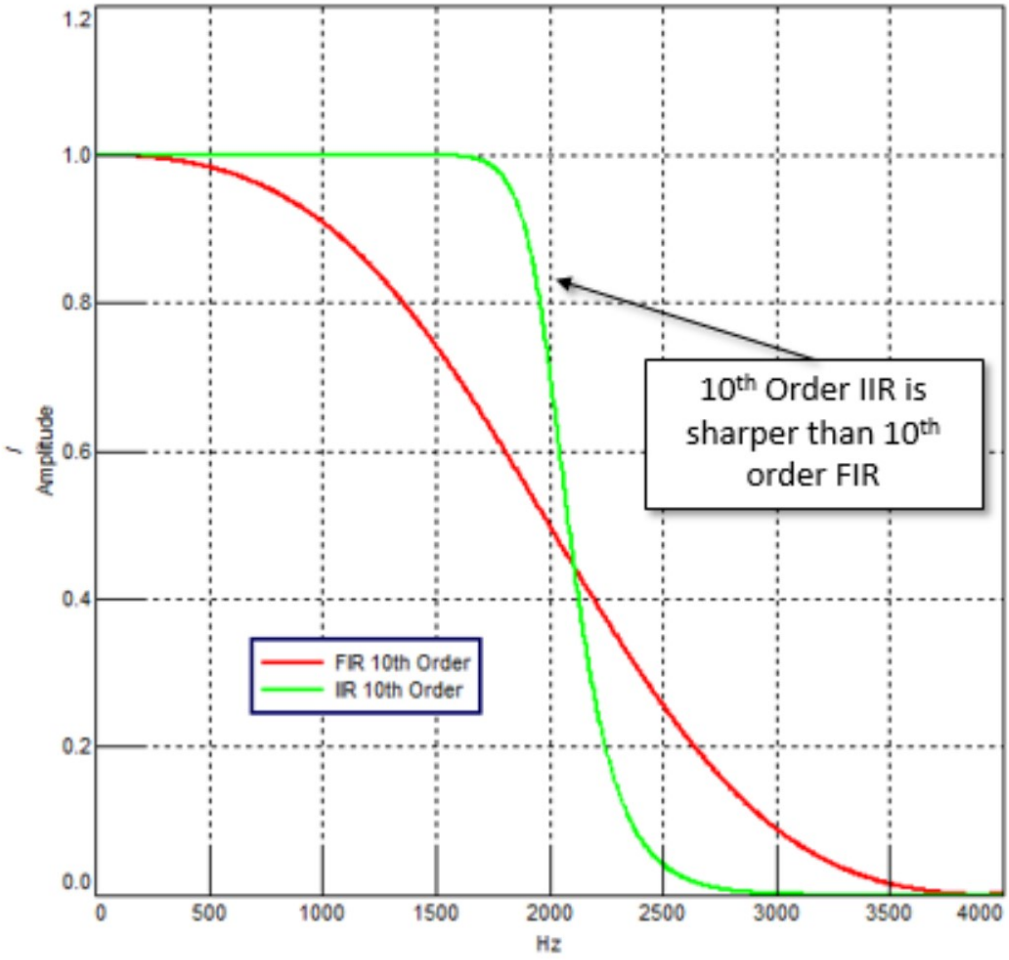
IIR Filter Equation: $y(n) = \sum_{k=0}^{N} a(k)x(n-k) + \sum_{j=0}^{P} b(j)\underbrace{y(n-j)}$

Output used recursively

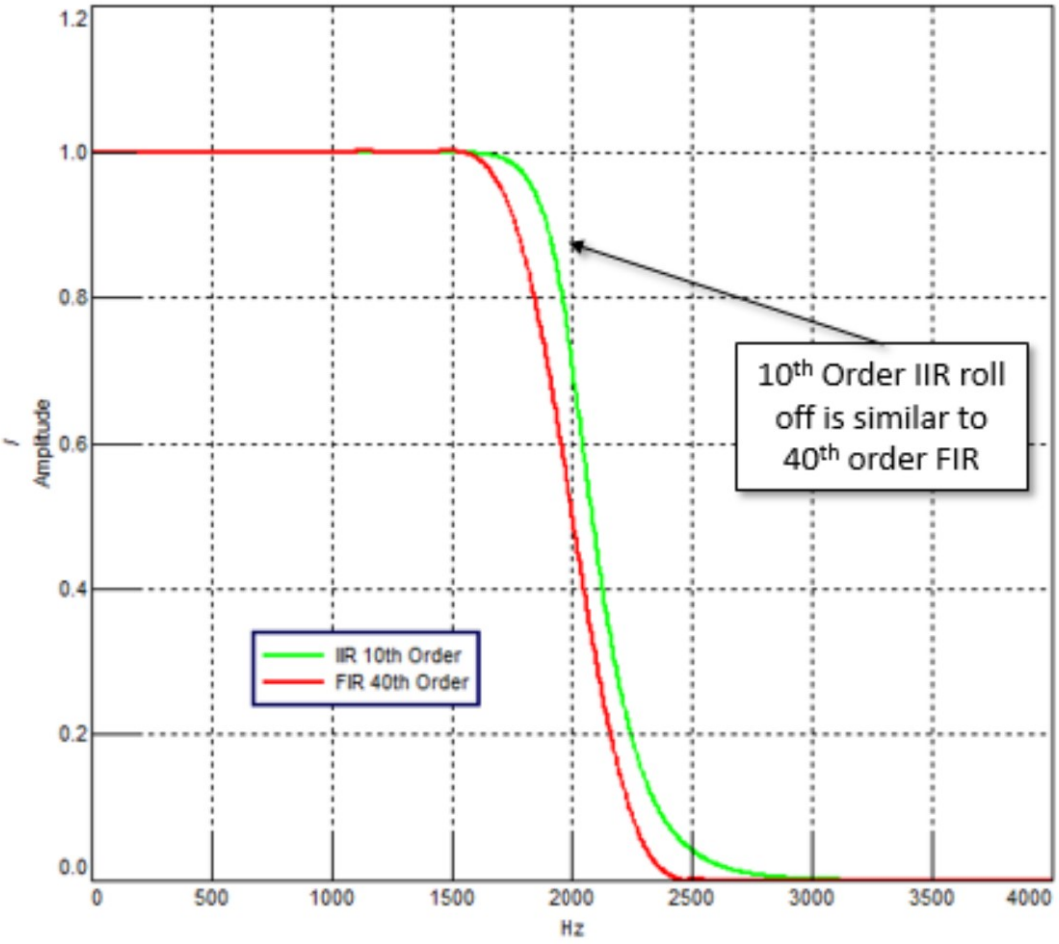


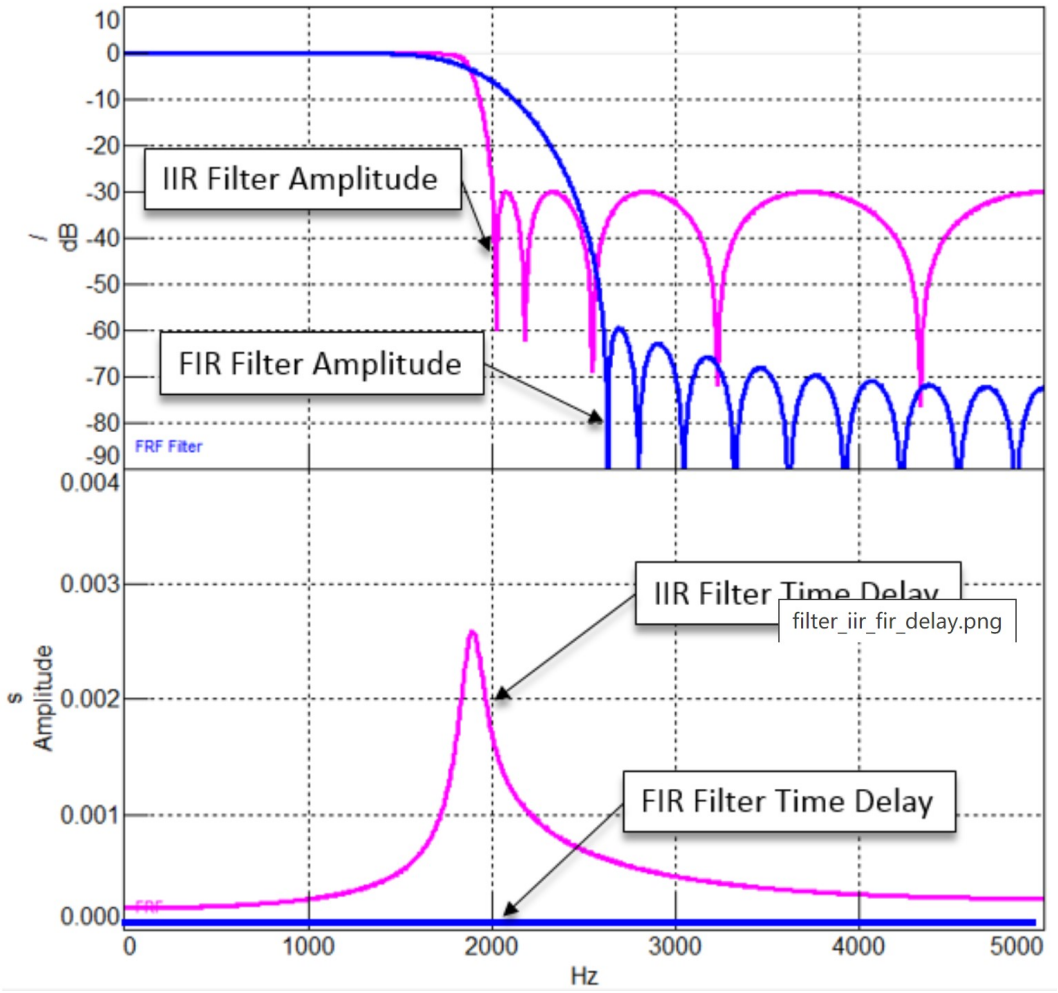
IIR Versus FIR Filters

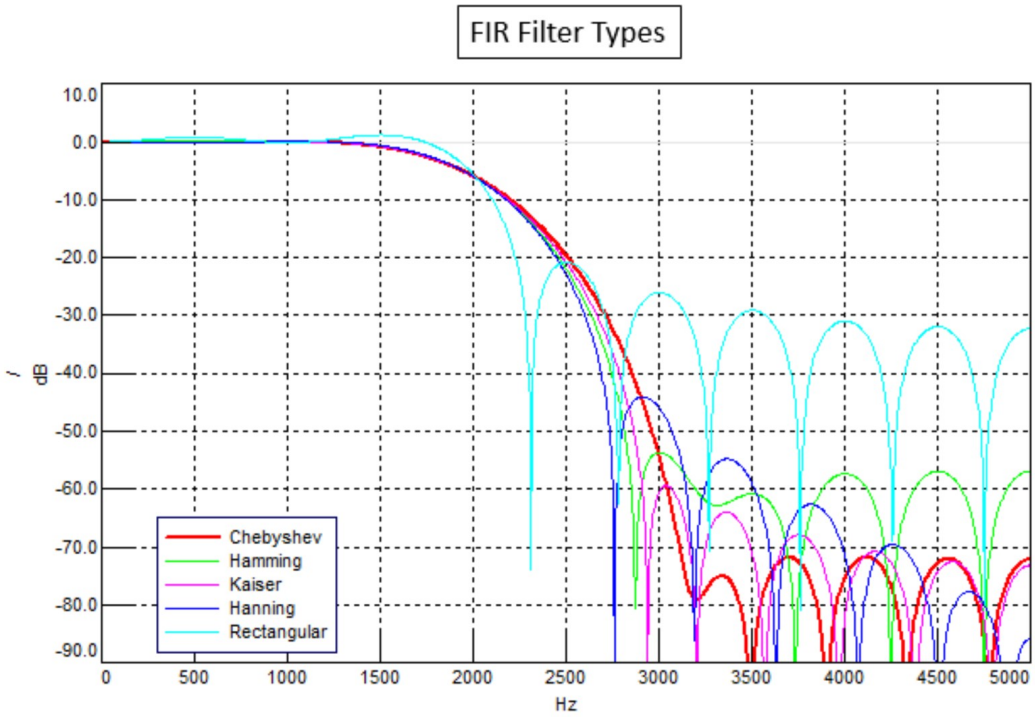
Comparison with same order



IIR Versus FIR Filters
Comparison with different order







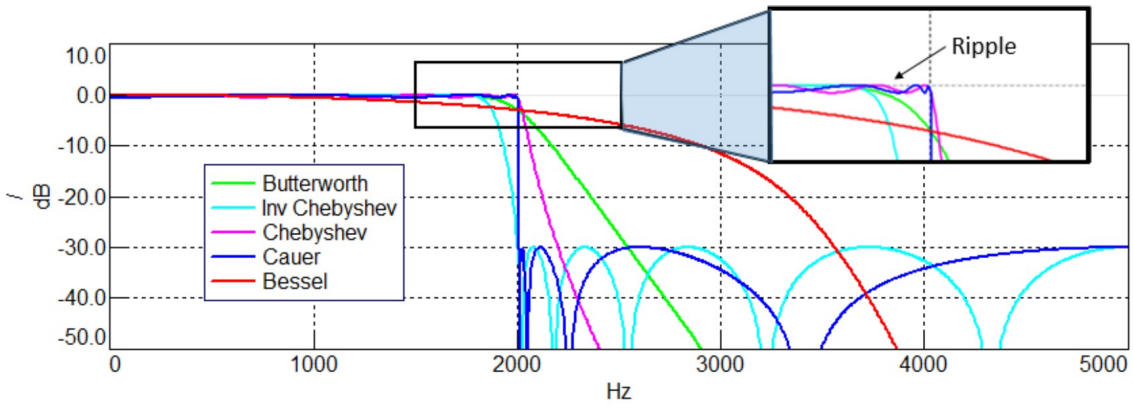
The FIR methods use different spectral windows when transforming from the frequency to time domain. Some of the window methods include:

- Chebyshev – Has the lowest amount of ripple in stop band, but widest transition band.
- Hamming – Narrow transition zone, smaller ripple than Hanning. Developed by Richard Hamming, who was a member of the Manhattan Project.

- Kaiser – Developed by James Kaiser at Bell Laboratories, the Kaiser window has small amplitude ripple in stop zone, only the wide transition width Chebyshev has lower amplitude ripple.
- Hanning – Narrowest transition band, but large ripple in stop band.
- Rectangular – Largest amount of ripple/lobes, even affects pass band.

Comparison of IIR Filters

Method	Pass Band	Transition Width	Stop Band
Butterworth	Flat	Wide	Monotonic
Inv. Chebyshev	Flat	Narrow	Ripple
Chebyshev	Ripple	Narrow	Monotonic
Cauer	Ripple	Narrowest	Ripple
Bessel	Sloping	Very Wide	Sloping



Attributes of the different IIR filter methods:

- Butterworth – Flat response in both the pass and stop band, but has a wide transition zone. First described by British physicist Stephen Butterworth in 1930.
- Inverse Chebyshev – Flat in the pass band, with a narrower transition width than the Butterworth filter, but has ripple in the stop band. If ripple in the stop band is not a problem, might be preferred for a given application over the Butterworth filter.
- Chebyshev – Can have ripple in pass band, but has steeper rolloff than Inverse Chebyshev.
- Cauer – Narrowest transition zone. Ripple in both stop and pass bands. Sometimes called an Elliptic filter.
- Bessel – Sloping amplitude in both the pass and stop band, with a very wide transition zone. The delay versus frequency in the filter is the flattest in this list. The Bessel filter was named for Freidrich Bessel (1784-1846), a German mathematician.