Technical note series:
An introduction to Filters – Article 4

Digital Filters or Analog Filters (Electronic Active Filters)

First of all some definitions:

Digital Filter:

A digital filter uses a digital processor to perform numerical calculations on sampled values of a signal.

Analog filter (Electronic Active Filter)

An electronic filter uses analog electronics to apply a filter directly to the continuous analog signal in real time.

Which should I use?

As with most situations each option has its strengths and weaknesses, we will review some of these and summarise where each could be used effectively.

For

Digital Filters:	**Electronic Active Filters:**
• Low cost – mathematical process carried out digitally on sampled signal data. • Complex filters can be constructed easily in the digital environment • No environmental effects • No long term aging performance change • Can provide linear phase	• Higher dynamic range • Higher frequency range, limited only by the amplifier chips used (500MHz+) • Real time filtering, no signal delays for results • Faster response time, no latency • Low power consumption • Low noise • No sampling errors • No signal loss due to load • Real time signal can be amplified

Against

Digital Filters:	**Electronic Filters:**
• Processing time can be long, depends on number of digital samples, particularly at low frequency time can be significant. • Signal requires analog to digital conversion before filter can be applied • Lower dynamic range • Limited frequency range due to aliasing • Can require high processing power and power consumption • Software host may require regular updates	• More expensive due to electronics and physical unit • Non-linear phase • Analog electronics can be affected by environmental conditions that change filter characteristics

Summary:

In real terms many software engineers will advocate for a digital filter being a ‘more accurate’ option and in many ways this is true.

However this will rely entirely on an application whereby the user has effectively unlimited time to post-process a digitised set of data. As any data engineer will recognise when acquiring digitised data at lower frequencies it can take minutes to take one average to ensure no data is missed. Digital filters are well suited to research or software based data analysis.

If the application for the filter is a real world, real time requirement, such as machine health monitoring or similar whereby the outcome of the filtered signal is being used to determine a pass/fail criteria or go/no go for a piece of equipment, then an electronic active filter will be required to ensure there are zero time delays in being able to apply the filtered signal.

Such real time analysis is also critical in many acoustic and sonar applications where the output of the filtered signal must be available immediately and where low frequency signals are commonplace.

Whilst not an exhaustive analysis this should provide an overview of where these different filter types can be used effectively, there are many more layers to determining suitability but this is a top level overview.

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