Digital processing does not always rule (Or, what makes an analog engineer laugh?)

Q. *Why recommend analog signal processing when digital systems are so cheap and powerful?*

A. Because sometimes analog signal processing is even cheaper, and can do things that digital processing cannot. Sales of analog signal processing circuits support this.

The Science Museum in South Kensington, London, was founded in Queen Victoria's reign. Although it is imaginatively run and well worth a visit, it is scarcely renowned for its humor. On a recent visit to their computer science area, however, I laughed so much, and so loudly, that I barely escaped arrest for disorderly behavior. The cause of my uncontrolled mirth was a glass case labeled, "Obsolete Analog Computing Technology," containing, among other things, an AD534 analog multiplier. ADI has been making this device for more than 30 years, and it continues to generate substantial sales revenue.

In fact there are a number of operations where analog processing has clear advantages over digital. Digital multiplication is simple and cheap, but if the original data and the required output are both analog, the cost and complexity of analog-to-digital converters (ADCs) and digital-to-analog converters (DACs) to convert from analog to digital — and back again — often exceed those of an analog multiplier. Also, the digital propagation delay may be too great for a high-speed system.

In addition, it may be more efficient to process the analog signals before the ADC, even if digital data is required. An example is ac power measurement. If the signal to be measured is a simple 50 or 60 Hz sine wave and the load is resistive, then the measurement is simple. But if the signal is more complex, the load is reactive, or the frequency is higher, then it is necessary to over-sample both the voltage and the current in the load to determine the actual power, increasing the demands on converters and processor. An analog multiplier driven by the voltage and current in the load has an output proportional to instantaneous power, which may be integrated and sampled quite slowly.

Even if we are only interested in the root-mean-square (rms) voltage of a complex waveform, analog rms computation works at several gigahertz — 100 times faster than an over-sampled digital system.

And, of course, the dynamic range of the highest resolution ADC is 20 or 30 dB less than that of an analog logarithmic amplifier. So there are still a number of areas where analog signal processing offers substantial cost and performance advantages over digital.

To learn more about analog processing, Go to: http://rbi.ims.ca/4921-501