Should I Stay Or Should I Go?

Should we keep our original signal intact or convert them, especially in regards to analog to digital ▪ By C.R. Caillouet

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These 4x expanded 1080i images illustrate several points. Both images were recorded using DVCProHD before the test, so neither is uncompressed, and you can see compression artifacts. The subsampling also limits the test. 1) Quality differences can be subtle; one may "feel" softer than the other. 2) If you can see a sharpness difference, it's because one of the images was captured as HD SDI directly from the camera and the other came from the camera's analog component output, through 50 meters of GEPCO low-loss miniature coax and an external A/D. 3) If you can see some contouring on the lizard's back, that's probably caused by quantizing errors in the compression; 10-bit capture might help a little.

Myth: It's always better to keep signals in the original format rather than convert them.

In past columns, I've discussed image-format conversion, color-space conversion, video-compression conversion and analog-to-digital conversion. You might get the impression that I hate conversions and that all signals should be retained in the original format, or some ultimate force in the universe will frown on your production. Well, as usual, it's not that simple.

Carefully choosing the material, the converter and the formats can reduce the visible losses in conversion processes. Converters are getting better and some conversions are less destructive than others. One special case is that of analog-to-digital conversion. In my first "Misinformation" column, I talked about the process of digitization and described sampling

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and quantization as the dual functions that allow us to convert an electrical analog representation of a physical quantity into a string of "digits," which we then can analyze, process, modify, record, transmit and, ultimately, convert back to a visual, aural or physical form for human interface. Our world consists of things that we can see, feel, hear, smell and touch, so at some point, our digital world has to include conversion back to one of these modes, or we have a lot of trouble dealing with it.

So why not just keep signals in an analog form unless we need to do complicated processing on them? One answer is that analog signals require great care to reproduce at the quality of the original. For some signals, we're quite capable of keeping the quality level high enough to satisfy most humans. But as the quality requirements increase, the resources required to maintain that quality through a system also increase. In addition, analog systems must be designed for the specific types of signals that will be carried, often dictating multiple devices for similar analog signals.

Then there's the issue of degradation over time and distance. Analog systems take more TLC (tender loving care) to keep them tuned for the type of signals carried. A friend is fond of reminding me that all the signals we handle are ultimately analog ones, even those that we call digital. At the lowest circuit level, electrical signals are modified to carry digital information. For that reason, there are limits to the distances that we can carry digital signals, but until those limits are reached, the signals will be almost identical to the original digital version, making the reproduction consistent and reliable, if the underlying system is reliable. A comparable analog system is much less consistent and ultimately less reliable over time.

So, if you can digitize at a high enough level, and if you can afford the cost of conversion at both ends, then a mature digital system usually will provide a more reliable path than a comparable analog one. Over the past decade, digital conversion and processing has matured to the point where it's now practical to digitize even high-definition signals for moderate transmission applications and to avoid the degradation inherent in analog video cabling. You can buy portable analog-to-digital (A/D) and digital-to-analog (D/A) converters and send HD signals over 500 feet of good-quality video coax with very little degradation, and much farther over a fiber-optic cable. Why not "no degradation?" Because even digitization may involve compromises, albeit small ones.

For example, converting a full-resolution RGB signal from a camera into a color-difference signal involves reducing the resolution of the color signals, so if your digitization process includes that color conversion, the resulting digital signal will be lower quality than the original analog one. That may not matter in most applications and probably will result in better quality than one would get from a long RGB cable, but it might not satisfy a high-end compositing requirement. That's not the fault of the digitization process, but of the color conversion that's implicit in the converter. A higher-quality conversion is an option, but it might double your cabling requirements and/or the cost of the converters on both ends.

Be alert for things that look like other things. I guess that we could call that "functional aliasing." One of the problems with modern integrated electronic boxes is that it's difficult to figure out what really goes on inside them. Discrete component systems of days gone by may have been hard to understand, but most of the functions could be analyzed by studying a diagram of a circuit or looking at the input and output signals. Modern systems are much more complicated and functions are often hidden inside sophisticated integrated circuits, making it hard to figure out what the box does under different conditions.

Herein lies one of the conundrums of modern technology. While our devices make it easier for us to perform functions, it's often harder to predict specific performance under varying conditions. That means that it's still important to test and practice your craft under as many conditions as you can, so that you'll be proficient when a new situation arises.

I guess some things haven't changed so much. HDVP