Calibrating the Chroma 5

By Darrell Bird – July 1, 2010

I've really enjoyed my time working in the calibration labs at SpectraCal. It's been a great chance to put my physics degree to work, and I've been proud of helping build a state-of-the art facility and process.

The work we do isn't conceptually complex. We use a very accurate spectroradiometer (in most cases a $40,000 Konica Minolta CS-2000) to measure a display. Then we measure the same display with a tristimulus colorimeter (such as a Chroma 5). The difference between what the CS-2000 sees and what the Chroma 5 sees is error in the Chroma 5. Using some math that I won't go into, we create a correction table and write it into the Chroma 5's flash memory. Then when you use the Chroma 5, it corrects its readings using this table.

This method of correcting a colorimeter is the recognized industry standard. It was devised at the National Institute of Standards and Technology (NIST) and has been published in several peer-reviewed scientific journals. (The classic article is: Yoshi Ohno and Steven W. Brown, "Four-Color Matrix Method for Correction of Tristimulus Colorimeters," Proceedings of the IS&T Sixth Color Imaging Conference, 1998).

What we do at SpectraCal is that same process that a manufacturer (such as X-rite, who makes the Chroma 5) does at the factory. And it's essentially the same process that you would do yourself when you profile your Chroma 5 against a spectroradiometer such as an EyeOne Pro on a specific panel.

The hardest part of the process isn't optical or mathematical, though; it's mechanical. The steps we take in our lab to ensure that neither meter moves, that they're held in *exactly* the same positions between readings, *exactly* the same angle, border on the fanatical. Obsessive attention to detail, and fantastic rigor, is necessary to insure replicable and reliable readings.

Chris and I also double-check each other on every meter we calibrate. One of us calibrates the meter, and the other checks it on separate equipment. We know that no matter how careful we are, a mistake is always possible. And if I was the one who made the mistake, I'm the least likely person to notice it, so we always have an independent check of each calibration. (If you've ever examined the NIST certificate you get with your meter from SpectraCal, you'll see that it has two signatures on each page.)

In addition to calibrating the meters people buy directly from us, we're now doing calibration for some of the largest companies in America, who have their meters drop-shipped from the factory directly to our lab before taking receipt of them and using them.

We're in the process of building our fourth calibration lab now, since our move from Ballard to the Wallingford neighborhood in Seattle. If you're ever in Seattle, I invite you to drop in and tour it. We've incorporated everything we learned from the previous labs, and we've spent thousands of dollars on setup in our quest for ever more accuracy. I know that perfection is unattainable, but we're driven to be as accurate as we possibly can, even if the result of weeks of work is only one digit different four digits to the right of the decimal point.

While we're in the process of designing the new lab, we brought in a consultant who spent his whole career working at NIST. He had some great advice for new designs. When we took his proposals – none of which were cheap – to SpectraCal management, in every case they said, "If it makes the lab better, let's do it."

So it does irk me when I see people out on the forums occasionally disparage our meters. These postings usually take the form "I bought a Chroma 5 from SpectraCal, and I just did a calibration with it, and I don't like the calibration, so the Chroma 5 must be bad."

I've seen Chris and the other support people, sometime up to and including the company president, spend hours and days with users getting to the root of their problems. But people don't very often take the time to come back to the forum and post, "It turns out that my Chroma 5 wasn't the problem."

Now the noise level is worse, because a former reseller has picked up some new guy selling Chroma 5s that he says are better than ours. The problem with this is that he isn't even really calibrating. Instead of the internationally recognized Four Color Correction Matrix method, all he's doing is a simple x,y correction. He takes two measurements, figures out the difference in the x and the y, and he subtracts.

When L.A. said this last week to the consultant who spent his whole career at NIST, first I thought the guy was going to choke on his coffee. Then his whole face wrinkled up like crumpled paper, until he burst out laughing. The only way he could parse the story was as a hilarious joke. When L.A. said, "No, it's serious, the guy's actually charging people money," the consultant alternated for about ten minutes between complete disbelief and total outrage. "But . . . but . . . but at every point except the point at which you measure, the results will be completely *wrong*." We all nodded. "Are you sure? He can't possibly . . . How could anyone believe . . . I mean, x,y *isn't even a linear space*!"

We made up a Top Ten List of reasons why you would *never* depend on an x,y correction. Then we all agreed that since we like to think people are basically decent, the guy probably isn't calibrating wrongly on purpose, he just doesn't know the very first thing about meter correction.

So today is another day that I'll spend all day in a completely blacked out climate and humidity controlled room, where we're working hard to establish ourselves as The Best Colorimeter

Calibration Lab in America. I have to focus very intently on what I'm doing, so I can't afford to be distracted about some forum. I have to focus on what I'm doing.

I'll correct the meter I'm working on to an amazing degree of precision, maybe four decimal degrees of precision. And then I'll put it on a shelf for Chris to check shortly after and I'll grab the next meter.

I believe that consistent good work will eventually be recognized. But even if it never is, I'm going to continue doing it, because it's the right thing to do.