Profiling Digital Projectors

This is the first of a series of articles addressing the preparation of equipment for digital competition. The articles will also recommend steps competitors should take to assure optimum color with electronically projected images. This whole topic of "Color Management" is difficult but critical to image quality. It is intended that a further benefit of the articles will be a better understanding of the topic for members of the Photographic Society of America (PSA).

Fred Drury

These articles are intended to be "interactive," i.e. send comments and ask about issues, which have either been overlooked or not presented in a sufficiently clear manner. Please send questions, suggestions or recommendations to Fred Drury at: fred@marklandimaging.com.

As photography's digital age has taken hold, those involved with competition at every level have witnessed big changes. Slide entries have substantially declined while the number of maker-made print entries has been going through the roof. Concurrently there has been increasing interest in digital competitions. Naturally this has led to concerns that systems are in place to assure that digital projection delivers accurate and consistent colors.

These concerns are warranted. There is a lot of misinformation out there. At one end of the scale, a technical support person of a major digital projector manufacturer recently told an associate that their projectors did not require calibration or profiling. At the other end of the scale, it was recently suggested that before a digital competition begins, a standard print should be compared to its projected output, and that judges have the right to request re-profiling of the projector should they be dissatisfied with the match. A little perspective is in order: competitions go on all the time in which we have less-than-perfect control over equipment and environment. So let's recognize at the outset that what's practical it not always perfect, and oftentimes what's perfect is not practical. Good judgment is critical!

First some fundamentals. Devices "see" color differently. Out of the box, different monitors will display color differently (if you have any doubt, visit a local electronics store and take a look at the on-floor TVs with all of the units displaying the same program). We call this *"device dependent color"*; the color is dependent on the specifics (design, construction, age, etc.) of the device. If we're dealing with monitors of different age, the problem is more severe; so too if we're comparing LCD monitors with their CRT cousins. The situation becomes progressively more complicated as we add different types of devices such as projectors, cameras, scanners, and printers to the mix. Each device sees its own unique "device dependent color" and in the absence of any standard it's simply good luck when any two devices agree on the color they see.

Communicating color accurately is fundamental to any digital competition. Makers prepare the image on their monitor and pass the file along to the competition either electronically or using a portable hardware device such as a flash drive (aka thumb drive) or a CD. In competition, images are projected from a laptop to a digital projector. Clearly we all want the same projected color as the maker saw on their monitor. Device dependent color with each device delivering its own unique color is unacceptable.

If we want to communicate color in an accurate and consistent way, we want "**device independent color"**; and this means we need a device independent standard. This standard becomes a reference used by each device to correct its color, and the protocol used to adjust the color is called a **profile**. And yes, that means that every one of these devices must have its **own profile**.

Calibration is the essential first step in any profiling process. All of the devices we're dealing with have their own controls; for example monitors generally have individual controls for brightness, contrast, etc. Projectors have all sorts of brightness, contrast and color controls. Calibration refers to a known standard setup of the device. If, for example, we change the brightness setting on a projector, the resultant display will change, regardless of the profile.

Profiling is all about adjusting the colors to conform to the device independent standard. The process is relatively simple; the profiling software projects a sequence of "known" standard colors. An instrument (which comes with the system) "measures" the resultant colors on the screen (either monitor or projector). The software then compares the "known" with "measured" colors and builds an "error adjustment" curve that will subsequently enable the system to adjust the displayed colors to correct values. The profile is the answer to converting a device from "*device dependent"* to "*device independent*" color.

Calibration assures a consistent "starting point." Accurate and consistent color then depends on both criteria: the device setup (its calibration) and its profile.

But there's more to this story. In any competition, what the judges and viewers see is the result; this result is a consequence of the interaction amongst all of the components in the system. In a digital competition the components that are most significant are, in descending order of importance: the projector, the laptop computer, the screen, and the ambient light in the room.

- The projector is just that—it is not a computer—it simply receives a signal from a computer and passes it through a lens and on to the screen. What ends up on the screen is a function of the light output of the projector and the signal modifying properties of the lens.
- The laptop is the source of the signal going to the projector. More specifically, the video card in the laptop sends the same signal to both the projector and to the laptop screen. One important consequence of the single-output-video-card is that one can choose the profile for the laptop, **or** a profile for the projector (in combination with the laptop), **but not both**. Therefore, when we select the projector/laptop profile the projected image will be color-accurate but what you see on the laptop screen will not be—it's an either/or choice.
- The screen is significant to the result—most screens are either beaded or matte. Beaded screens have been the choice for traditional slides and the function of the beading is to amplify the limited light coming from the carousel (or equivalent) projector. Digital projectors put a lot more light on the screen and so the matte screen, which does not amplify the light, is preferred.
- The ambient light in the room also contributes to the result.

Calibration and profiling should take as many of these factors into consideration as possible and significant changes to any one of these system components would be reason to re-calibrate and re-profile. The projector, laptop and screen are fundamental to the system and should be calibrated and profiled as a unit —if any of these are changed; a new calibration and profile are necessary. Furthermore, it is preferable that calibration and profiling be carried out in the room where the competition is going to take place and under similar ambient light conditions as are expected for the competition. This is not much of a problem, since, with a little experience, the calibration and profiling process takes less than a half hour.

There are two systems widely available for profiling digital projectors; both come in multiple models, the least expensive for profiling only monitors, the most expensive more fully

ColorVision has just released upgraded versions of their Spyder system … the Spyder 3 Elite provides software and hardware components for creating both projector and monitor profiles. There is another version, Spyder 3 Studio which includes the additional hardware and software required for printer profiles.

featured including the ability to create and edit printer profiles. One system is the Spyder Pro™ manufactured by ColorVision®. The Elite version of the ColorVision system is priced at $279 and can be used to calibrate and profile both monitors and projectors. It includes an adapter used to mount the measuring instrument on a tripod, which is centered 12" in front of the screen. This will be the preferred choice for most camera clubs and users. The other alternative is the GretagMacbeth™ system now available from X-rite®. The Gretag system is somewhat easier to setup; it includes a device called the Beamer®, which can be placed next to the projector and pointed at the screen. However, the i1-Photo version of the Gretag system, including the Beamer mount, retails at just under $1400. The version includes a spectrophotometer and the capability to build printer profiles as well; it is an appropriate choice but only if you can justify the additional functionality.

Next month's article will show, step-by-step, how to use these systems to calibrate a laptop and projector for digital competition.

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The Gretag-Macbeth i1Photo system at $1400 (including the Beamer which is used to hold the instrument) is too pricy for most camera clubs. However, this package includes the hardware and software needed to build printer profiles.

Profiling Digital Projectors

PART 2

This is the second in a series of articles addressing the preparation of equipment for digital competition. In this article I'll walk you through the procedure for calibrating and profiling your system in preparation for a competition. I'm going to focus primarily on how to use the ***Spyder3Elite*** *system (Datacolor). As I mentioned last month, this is the least expensive of the two systems available for this work. Along the way, I'll point out what I think are the significant differences from the much more expensive* ***i1-Beamer*** *system (X-rite).*

Fred Drury

I'd like your comments on these articles! Especially regarding issues you think have either been overlooked or not presented in a sufficiently clear manner. Please send questions, suggestions or recommendations to me at: fred@marklandimaging.com.

One of the points we made in the last article was that we must take a "systems approach" in preparing for a digital competition. What the judges and audience see is affected not just by the digital projector alone, but rather it is a consequence of the combination of the projector, laptop, screen, and the ambient light in the room. Therefore, we strongly recommend that the calibration and profiling process be done with the equipment and in the room that will be used for the competition—ideally under ambient light conditions similar to those that will prevail at the time of the competition.

Once the system is set up, the projector and laptop should be turned on and allowed to warm up for about 30 minutes. During this time, review the projector controls and reset them to the factory defaults if necessary.

The first step in the process is to calibrate the system luminance. Digital projectors generally put out a lot more light that transparency projectors (this is the reason matte screens are preferred for digital competition). The system luminance is affected by the light output of the projector and how it is reflected by the screen. PSA has established a good standard:

1. Project a 1024x768 pixel white image.
2. Using a light meter that measures reflected light, and standing at the judges location, measure the light being reflected from the screen:
    a. Adjust the projector brightness for a light meter reading of as close as possible to 9 EV. A reading between 8.5 and 11 EV is acceptable.
3. If a light meter is not available an in-camera meter can be used. On the camera, set the ISO to 200, meter to spot, exposure mode to shutter priority, and shutter speed to 1/30th second.
    a. Adjust the projector brightness for an in-camera aperture reading of as close as possible to f5.6. A reading between f4.8 and f11 is acceptable.
4. Whichever method is used (light meter or in-camera meter), it's a good idea to keep a record of the reading—it's part of the system calibration and the same setting should be used in the future.

Figure 1

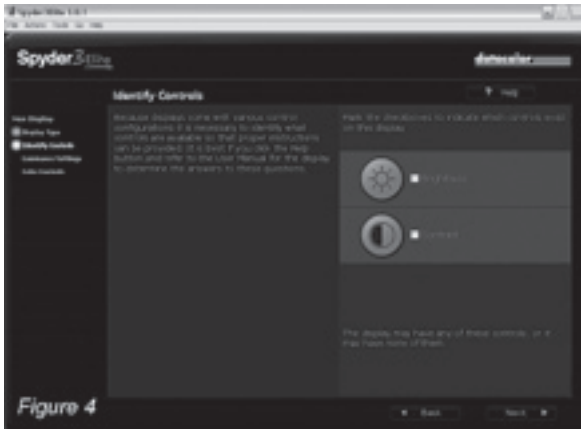
The next step is to connect the **Spyder3** instrument to one of the laptops' USB ports and then open the **Spyder3** software. The first time you use the software; you'll be asked for your name and product serial number and then asked to register the product. The first "working" screen is titled "New Monitor"—click "Next" at the bottom right corner which takes you to

the “Display Type” screen (*Figure 1*). Select the correct device, proceed to step 4 below.

In the future (after the first use), here the procedure:

1. When you open the software, the first working screen will be *Figure 2*, the “Check Cal” screen.

2. If you want to work on a projector, go to the command line and select <Go><Edit Display Information>, which will take you to the ‘Select Display To Edit’ screen (*Figure 3*).
3. Click “Next” and that will bring you back to *Figure 1*, the “Display Type” screen where you choose the projector icon.



4. Then “Next” takes you to the “Identify Controls” screen (*Figure 4*)—you have already adjusted the system Brightness, so best choice is to leave these controls unchecked.

5. Again click “Next” to *Figure 5*, the “Identify Color Controls” screen. The best choice is to leave these controls unchecked and click “Next.”
6. The “Method of Attachment” screen applies only to monitor calibration, so click “Next” to the “Current Settings” screen.

7. Your settings in the lower section of this screen should be identical to *Figure 6*, with the exception of the “Display” setting. Now turn the “Continue with these settings” radial button “ON,” and click ‘Next.” These, along with the Brightness adjustment made earlier to the projector, constitute the ‘calibration’ process. The next steps setup the sensor to build the profile.

8. *Figure 7* shows how the sensor fits into

the adapter. I use a spare lens plate (Kirk Enterprises or Really Right Stuff) to securely connect the sensor assembly to my ball head (there's a properly sized threaded hole in the bottom of the adapter). Click "Next."

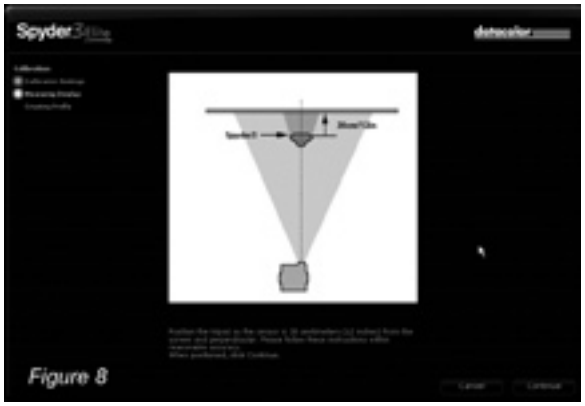


Figure 8

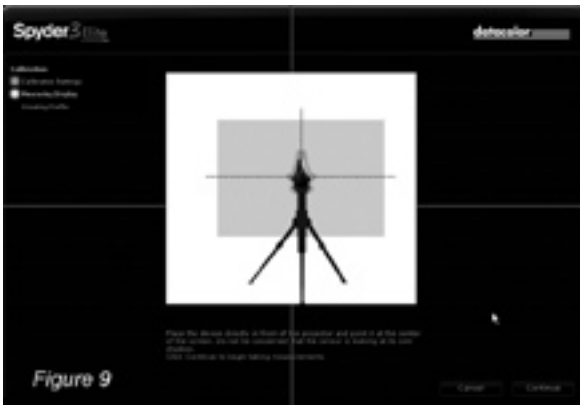


Figure 9

9. The next two screens (*Figures 8 & 9*) show how the sensor should be positioned so it can 'read' the patches that are going to be projected onto the screen. It should be 12" in front of the center of the screen, with the sensor axis perpendicular to the screen. The instructions include the caveat: "Please follow these instructions within reasonable accuracy." With some setups, such as very large screens, it may be impossible to raise the instrument high enough to have it perpendicular to and directly in front of the screen. The objective should be to get as close as practically possible to the desired configuration. (*Note*: the **X-rite i1 Beamer** is different; the sensor is attached to the Beamer, and is pointed at the screen. An interactive system helps you position the sensor—you want it looking (more or less) at the center of the screen. With this system I normally set the Beamer on top of the projector.)

Figure 10

10. At this point, the software takes over and the process is automatic. A series of color patches are projected and are "read" by the sensor. The software uses these values to create the projector system (projector- laptop-screen-ambient light) profile.
11. The final step is to name the system profile. In *Figure 10*, the 'system' name includes the projector, laptop and location.

Clearly there are quite a few steps in this process. Like most such processes, the procedure must be carefully followed in order to get the best results. However, once you've had a little experience, the procedure is quite simple, and will become a matter or routine, taking no more than 10-15 minutes.

***Remember*: if you have questions, suggestions or recommendations concerning these articles, please sent me an E-mail at: fred@marklandimaging.com. The next column in this series will be dedicated to your feedback and questions.**

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