Standards Update

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As we look at the standards landscape, so often issues that arise from different initiatives are inter-related in surprising ways.

Late last year I began looking at the various issues that need to be addressed as we consider the revision of two ISO standards within the graphic arts and photographic communities. These are ISO 3664:2000, *Viewing conditions—Graphic technology and photography,* and 13655:1996, *Graphic technology—Spectral measurement and colorimetric computation for graphic arts images.*

Early this year, in an ICC meeting, the issue of proof-to-print matching was raised and I took on the task of preparing a white paper on the topic. My earlier concerns of viewing and metrology obviously bears directly on this issue.

In this issue of the Reporter I will first summarize the observations about proof-to-print matching and then describe how the current discussions around viewing and colorimetric measurement probably will exacerbate the proof-to-print matching issues.

Predicting Proof-to-Print Match

One of the most frequent production decisions made in the printing industry is to answer to the question "do the print and proof match?" Wherever it is made – in prepress, in the press room, by the purchaser of a proofing system, by a trade association certifying proofing systems, etc – it is a decision that today is based on a visual comparison.

Many, particularly those trying to certify proofing systems, would like to be able to use measurement data to predict the quality of a match between a proof and a print. The ultimate goal is to remove the human element, the visual comparison, with all its uncertainty and individual bias.

The problem can be approached from two different, but related, perspectives. The first is "Can we use colorimetric measurements to predict whether human observers will be judged that a specific proof will match a specific press sheet?" The second, and larger question is "What is involved in predicting that a given proofing system will produce proofs that will consistently be judged to be a satisfactory match for sheets printed in accordance with a specific set of aims?"

A Simple Visual Match

Predicting a visual match between two images based on metrology, is simply a comparison of our ability to make colorimetric measurements (two) and the colorimetric criteria that must be met for the two images (proof and press sheet) to be considered close enough in appearance for the proof to be a valid predictor of the press sheet.

Unfortunately, there is no definitive data that allows us to predict the accuracy of colorimetric measurements. Even more of a concern is the fact that we simply do not have any criteria that allows us to use colorimetric data to predict the probability of a match.

Some groups have suggested that if we use an IT8.7/3 target and have an average deltaE of 2 and a max of 5 or 6 that is good enough. From the photographic industry we know that color differences in the paper, or D-min area, of as little as 0.5 deltaE can be objectionable.

We desperately need both psychophysical testing and input from the groups attempting to qualify proofing systems (SWOP, GRACoL, etc.)

A Proofing System Qualification

When we look at the issue of predicting the ability of a proofing system to consistently produce proofs that will match a reference printing condition, things get much more complicated. Before we try to analyze the variables involved, we need to put some boundaries on the problem.

Let's assume that we are starting with a set of CMYK digital data that has been prepared using CGATS TR 001 as a reference. The goal is to proof the images represented by this data and also print the same data on press and compare the results to each other and to the reference data set.

In our proofing workflow we will assume that the native behavior of the proofing system does not match the TR 001 characterization and the image data must be modified, using color management, to provide the input data required by the proofer. The intent is that the combination of the modified data and the proofing system's calibrated response will simulate the relationship between the file data and printed color defined by TR 001.

Some of the variables that must be accounted for include:

1. Uncertainty in the colorimetric measurement of the printed reference target used to characterize the proofer.
2. The modeling errors in the proofer profile building process.
3. The modeling errors in the TR001 profile building process (we assume that the TR 001 data has no variability).
4. The computational errors in the color management system when it applies the profiles to the data.
5. The variability of the proofer (changes in proofing system performance between the time the characterization data was printed and the proof is made).
6. Uncertainty in the colorimetric measurement of the target printed on the proofing device along with the image data.

As in the simple comparison, we do not know how good our match must be, nor do we have an estimate of the accuracy of our color measurement data. In addition we have added uncertainties in profile building, CMM performance, and proofer consistency to the mix. We not only do not have estimates of these uncertainties but we have no standardized test procedures to provide such data on a consistent basis.

What's next?

Is it hopeless – not at all. We think we know what has to be determined. We know some of the groups that are in the best position to find the answers. We just have to find a way to all pull in the same direction and share the necessary knowledge.

One possible way to proceed is to call a meeting that involves all of the potential players, share knowledge, and propose some cooperative efforts.

Such a meeting has been arranged as part of the TC130 WG3 meeting on Friday, May 13, 2005 at BSI in London. This meeting is being organized by Dr Fred Dolezalek (dolezalek.f@freenet.de) Chairman of TC130 and Craig Revie (craig.revie@ffei.co.uk) Chairman of the ICC. Contact them to be involved.

Viewing and Colorimetric Measurement Standards

Now for the second half of my concern and how it directly impacts the proof-to-print matching issue!

I am sure everyone would agree that the standards that define colorimetric measurements, viewing conditions, and

profile building must be consistent with each other. More importantly, they must be both consistent with current practice and technically sound.

However, as we begin the process of revising these standards we find that achieving that consistency it is easier said than done. In each of these areas, there seems to be a series of disconnects between what we do and what we say we should do. The real riddle is how do we reconcile them.

What are the Issues Here?

The two major issues are the backing to be used behind a reflection sample, and the spectral power distribution of the illuminant used to view the sample and compute colorimetry. The issue is compounded by the need to define the appropriate combination of both parameters for viewing, for colorimetric measurements for profile building, for colorimetric measurements for proof-to-print metrological comparison, and for density measurements. Should they all be the same?

Backing

The question of which backing to use when making spectral reflectance measurements to compute densitometry and colorimetry has many answers depending on the application and perspective of those using the data.

The densitometry standards all call for a black backing to minimize the impact of back-printing and to minimize variability due to translucency effects. On the other hand, the color management world finds more consistent results between visual comparisons of proof and print when using profiles based on colorimetric measurements made using white or self backing.

On top of that, everyone would prefer to be able to compute both density and colorimetry from the same set of spectral data and to not have to measure everything twice.

The existing viewing standard also specifies viewing over black to achieve consistency with the measuring standards and to minimize any effects of printing on the back side of the material being examined. However, a black backing is rarely used in practice.

Illumination

Another area that is beginning to receive attention is the spectral power distribution of the illumination used for both measurement and viewing. We usually identify illumination (and monitor white points) by its equivalent color temperature—D50, D65, etc. However, this only takes into account one characteristic of the illumination.

The spectral power distribution of the illumination specifies the amount of energy at each wavelength, including energy outside of the visible portion of the spectrum. Two illuminants with the same color temperature can have significantly different spectral power distributions. The dyes and pigments used in proofing systems often do not match the spectral reflectance of the printing inks. Therefore, differences in the spectral power distribution of viewing illumination (even when it meets the color temperature criteria) will change the match of proof and print.

Even more critical is the use of brightened papers and/or fluorescent inks. Their effect is directly proportional to the amount of UV light present, and can be dramatic.

The viewing standard defines the spectral power distribution of the reference D50 illuminant in both the visible and in the UV. Unfortunately, few systems match the UV criteria because it is difficult to produce illumination systems with the correct UV content.

The measurement standard says, "If the materials do not fluoresce, the spectral power distribution of the measurement source is not a concern and so no specification is given for the conformity of the spectral power distribution of the measurement source to the illuminant specified…" It goes on to say that if the materials do fluoresce then the spectral power distribution of the measurement source should match D50.

But papers and some inks do fluoresce! And many proofing substrates have a high level of brighteners.

The illumination source in most spectrophometers is designed for efficiency, long life, stability, etc.—not to match D50.

Since it is very difficult to properly match the specified UV content of a D50 illuminant in a spectrophotometer, some have suggested that all colorimetric measurements should be made without any UV present at all to get better agreement between instruments. If we did that, measurements would be more consistent but profiles would be based on colorimetric measurements that did not reflect the effect of brighteners or fluoresce.

That would also imply that if viewing and measurement are expected to match, we should also block all UV in the viewing booth.

If we block UV in viewing, the effect of paper brighteners goes away—but the client is paying for brightened paper and the customer (at least in some viewing environments) is seeing the effect of brightened paper. Why else would the client be paying a premium for it? If two prints match in the absence of UV will they also match when UV is present in typical (non booth) viewing environments?

The Puzzle

As you can see, the issues of measurement and viewing must be solved hand-in-hand with the whole issue of proof-to-print matching. They are all parts of the larger issue.

What is technically sound and consistent, is hard to implement in practical instruments and viewing booths. What is practical and relatively easy to accomplish, may not lead to consistency between viewing and measurement or between equipment from different manufacturers.

The photographic and printing portions of the imaging industry have some real problems to solve.

Your input and comments are welcomed.

For suggestions for (or input to) future updates, or standards questions in general, please contact the author at mcdowell@npes.org or mcdowell@ kodak.com