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Transitioning to International Imaging Standards at the Metropolitan Museum of Art's Photograph Studio: A Case Study

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Introduction

When reading this case study it is important to note that the evolution and adoption of standards does not occur in a vacuum. In many ways, the concept of standardization is at odds with the rapid pace of technology. Traditionally the process of standardization takes many years while it is not uncommon for technology to move on a six-month cycle. Some may argue that standardization in the digital arena is futile and standards for imaging are best maintained by industry. A stronger case can be made that the industry has done a poor job in the "best practices" department. If there is one valuable lesson to be learned from the work of The Photograph Studio at the Metropolitan Museum of Art, it is that there are ways to implement standards by taking an active role in the process as opposed to waiting on the sidelines. In short, standards bodies, researchers, and industry consortiums cannot be effective without the valuable experiences gained in the field.

The adoption of international imaging standards by the studio at the Metropolitan Museum of Art has been a gradual process that began years ago with the early adoption of ICC color management. Prior to ICC color management, digital imaging programs were held hostage by the display of a local computer or a particular output device. During this phase digital imaging was often performed "by the numbers", but those numbers were often dictated by a particular workflow or camera system. By the summer of 2001 the completion of a formal internal evaluation of imaging practices set the foundation for the workflow of the MMA studio. This testing revealed without a doubt that carefully calibrated digital cameras and scanners encoded to a 16 bit ProPhotoRGB color space TIFF yielded a "master" image file that could serve as the source for subsequent media-specific renditions of an image asset. Based on this testing and subsequent evaluations, MMA studio staff have avoided the temptation to subjectively edit calibrated digital captures up front to any particular output as experience has shown that in almost all cases, digital output is in constant flux. If editing to CMYK what CMYK? If editing for RGB Inkjet are we editing to Matte or Glossy media? If editing to a display are we editing for web typically 6500K or D50? To a great extent the modern imaging workflow relies on the ICC color management model. If edits are necessary this editing is performed on derivatives for a specific use. While there are limitations with the ICC model it has proven time after time to provide a solid foundation.

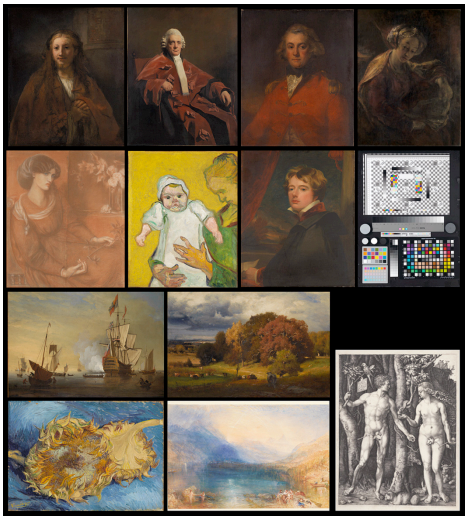
During the time frame from1999 to around 2007, the Metropolitan Museum's Photograph Studio enjoyed a period of very consistent output, as color management practices became the norm worldwide and cameras, scanners, displays and printers offered consistent support for the color-managed workflow. Around 2007 the imaging industry experienced a series of unrelated but unfortunate events that began to impact museum and library imaging programs worldwide.

The advent of the DSLR and explosion of proprietary Raw file formats and Raw processing software coupled with a major consolidation in the color management industry led to a rapid decline in the use of ICC color management-especially for digital capture. Almost overnight, software tools that once supported custom ICC profiling moved towards increasingly subjective slider controls for color, tone, and all sorts of tools designed to make visual editing easy and attractive. The idea of capture by the numbers and objective process control was being replaced by proprietary consumer level controls. By 2007 it became painfully clear that the increase in subjectivity was having a negative impact on even the highest end camera systems. During this time period it became very difficult to maintain a capture workflow, as it seems that with each upgrade to camera software, the ability to create and utilize proper ICC profiles and meaningful numeric readouts became chaotic at best. Managing imaging quality for many became an exercise in frustration.

The efforts to explore the solution to this problem are well documented in my previous IS&T papers. This paper focuses on the efforts to apply emerging standardized imaging practices across a very large imaging operation employing eleven full time photographers and three assistant photographers.

The Strategy

After having participated in previous rounds of successful evaluations of the Metamorfoze Digital Preservation Imaging Guidelines with other institutions worldwide, the decision was made to formally evaluate the process internally using a cross-section of artworks from the Met's collections. Tests were performed during the summer of 2009 using the museum's existing Hasselblad, Leaf and Sinar Cameras.



Difficult to reproduce artworks were intentionally incorporated

Metamorfoze or FADGI?

For the initial testing we focused on the most critical aspects of the Metamorfoze protocols related to tone and color reproduction. People may ask why not evaluate the FADGI imaging guidelines? At the time of this initial work, the FADGI guidelines were not formally published (formally published in August 2010). The good news is that the FADGI guidelines and Metamorfoze point to the same ISO standards and are interchangeable in many ways. Metamorfoze protocols were mature enough at the time (already being used in Europe) AND offered published tolerance tables for all common working color spaces. To date, the FADGI guidelines only offer tolerance tables for Adobe®RGB1998. While Adobe®RGB1998 is a popular RGB space it is NOT an ISO standard. The existing ProPhotoRGB (ROMM RGB) is an ISO standard and the eciRGBv2 L* based color space recommended by the Metamorfoze is near finalization as an ISO technical specification. It is important to draw a line between commercially popular proprietary environments and international standards. Years ago IBM dominated computing and Microsoft dominated operating systems. Imagine if each company had their own branded image encoding. Would you feel comfortable archiving cultural heritage images in IBM®RGB, Microsoft®RGB or even Google®RGB? If not, you will understand the desire to use an internationally standardized environment. Adobe®RGB1998 is a corporate branded, trademarked environment with a legal disclaimer regarding its use that is posted on the Adobe® corporate web site.

When you look carefully at the Metamorfoze and FADGI documentation you will find that both protocols strive to offer users practical objective methods to configure and maintain an imaging workflow. Where they differ is that the efforts have spawned two new technical targets and analysis software tools: the UTT Universal Test Target cooperatively designed by Image Engineering in Germany and the Dutch KB, and the Golden Thread system developed by Image Science Associates in the US in conjunction with the FADGI effort. Efforts are underway to bring these two very similar protocols, including targets and software, towards one universal protocol but this will take time. The most important development is that the current trend towards objective capture methodology is a welcome sign of a maturing industry. The MMA studio is currently evaluating both protocols and targets. In the end, pixels, math and physics are universal and should have no geographic boundaries.

Test Phase

The capture tests were structured to be as realistic as possible, meaning we set out to test with existing cameras, existing lighting and readily available color targets. If the protocols did not work with the tools the museum already owned they would be of little value. We were not evaluating the entire range of imaging performance metrics (limited to tone and color) at this stage.

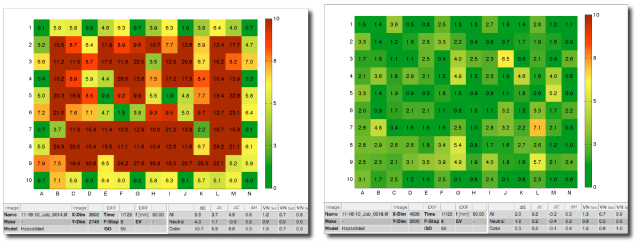
Regardless of camera make and model there are several steps that are followed to dial in a camera system:

1. Set up a lighting configuration typical for copy light. In the case of the MMA studio, this involved two electronic flash light sources and bounce umbrellas. Color temperature of the sources should be checked if possible to be within an acceptable tolerance of 100 degrees Kelvin.
2. If the camera system supports “flat fielding” (or custom scene reference generation) this may help achieve more precise results. *It is important to note that in practice utilizing custom scene references could complicate workflow or even reduce quality if not applied properly. Unlike an ICC profile, scene references are specific to camera height, lens aperture etc.*
3. Create a custom ICC camera profile. Each brand of camera system and capture software offer varying degrees of support for creating custom ICC input profiles. During our testing we decided to evaluate several popular profiling tools. We used the X-Rite® DCSG color chart for all testing.
4. After generating an ICC profile and selecting it as the source space in the capture application the next step is usually to select the desired output color space and to verify that the destination tonal values are within the published tolerances. Depending on the camera system and profiling software used results will vary. On some systems we found that after profiling, tonal values were within tolerance requiring no further adjustments.
5. In cases where tone curves need to be adjusted to meet the published tolerances we begin with a linear curve, expose to white and make adjustments working down to black. The Camera profile and tone curve become a working pair for the particular lighting scenario.

Validation

Simply comparing RGB file values to the Metamorfoze tolerance tables) can be quite effective for checking the tonal response, as the tonal values are either in or out of tolerance. Checking colors can be more tedious, so we utilized several tools to check color accuracy: The Image Engineering IQ Color module and the Image Science Associates Color Gauge software are reasonably priced solutions that exist today and are extremely useful tools. The Image Engineering software works on the Mac platform as well as Windows and supports the proper analysis of images encoded in eciRGBv2. The Image Science Associates software is less costly, but only runs on Windows and supports the L* based eciRGBv2 only by approximation (this may have been updated since this paper was written). Most importantly, when validating to the X-Rite DCSG chart both tools agree in terms of results as they point to the same standards. Metamorfoze tolerance tables incorporate support for the Image Science Associates test targets.

For evaluation of color, the Image Engineering IQ Color Module was used to evaluate color and tonal response. Color and tone either agree or disagree with the published tolerances. In the case of the Metamorfoze, this is <=4 average Delta-E (cie1976) and <=10 Delta-E for a specific color. At the time of testing this was a pass/fail scenario. Our primary camera systems resulted in a consistent 1.6 average Delta-E result-well within the tolerances. Older cameras often ended up between 2-and 3 Delta-E’s. It is important to note that DSLR’s using Adobe® Lightroom™ in most cases hover just on the edge of the protocols usually 3-5 Average Delta-E’s and 10-15 Maximum Delta-E’s.



This set of reports from IQ Color Module contains valuable information about imaging performance: Report 1 is a capture of an X-Rite® DCSG color chart using a manufacturer default configuration. The second report is a capture from the exact same camera that meets the Metamorfoze tolerances for color and tone (custom ICC profile & validated tone curve). The report clearly indicates that the illumination is uneven (notice Delta-E value differences between patch 1N and 10A). A simple illumination adjustment would improve accuracy.

Lightroom tests were performed using the common X-Rite® Passport Color chart. We are strongly encouraging X-Rite® to support the DCSG chart in the Passport software for Adobe® Lightroom™ as many museums and libraries enjoy Lightroom™ for rapid capture projects. Adding support for the more precise DCSG color chart would immediately elevate the quality of these systems. There is limited value in validating to a 24patch chart for advanced museum imaging as it is simply not precise enough, but make no mistake, it is clearly better than no profiling. We have relayed the findings and other museum-specific feature requests to Adobe®.

Initial Capture Tests

After initial testing and software validation of test charts, a series of artworks were imaged. While the initial results were technically accurate, there was considerable concern amongst the photographers about the perceived need to light paintings under perfectly even "copy light" illumination geometry when strictly following the capture protocols as if they were works on paper. The argument here is that paintings have various levels of impasto and surface treatment that often require complex lighting to bring the artwork to life. Additional tests were run and we found that changes to the lighting geometry had little impact on the overall color and tonal reproduction as long as careful attention was given to the initial exposure values. More on this later.

"ISO Film"

The idea that there may be flexibility in terms of lighting geometry is counter-intuitive to the imaging scientists that created the protocols, as an uneven pool of illumination would clearly fail if a UTT or GoldenThread chart were placed in an asymmetrically illuminated scene. However there is a hidden value in the use of objective capture protocols. I like to present these protocols to photographers as "ISO Film". By carefully following the protocols to configure the camera response under idealized conditions, the resulting tonal response curve and other technical aspects are clearly defined and normalized across any camera brand and any site worldwide. When a photographer captures using these protocols, the tonal response and color response is predictable and provides a solid foundation. Imagine "ISO Film" as a film optimized for 1:1 reproduction, a film that is not too flat or contrasty, just an accurate universal starting point. If lighting decisions are to be made, or certain objects and lighting scenarios require modifications, the changes can be documented and repeated as a protocol for the entire staff to follow across any camera brand. To document lighting geometry it is a good idea to place a smooth black ball-bearing in the scene, as this surface will document the exact position and size of the scene illumination. This approach is borrowed from the RTI imaging techniques that are being discussed within the conservation community.

Dark Paintings, Light Paintings

Certain artworks selected for capture tests were intended to represent known technical challenges, as this is the true test of any imaging system. Very dark paintings and very light artworks were included. The imaging of dark paintings has been an area of ongoing debate as many museum photographers will increase exposure at the time of capture in an effort to get more shadow information. You will often encounter the "Art is not Charts" argument, and there is some validity to this if the goal was a single fixed output such as CMYK printing where it is difficult to reproduce shadows. In this approach, the photographer will subjectively gauge exposure often making judgments on a calibrated display as a guide breaking away from the chart as a reference. In a way, this approach does satisfy the immediate desire for a "pleasing rendition" but as the photographer is making these subjective decisions, the ability to repeat the process over time or across multiple photographers is diminished. In a large studio with over eleven photographers these subjective decisions can potentially become difficult to manage over time. For example: it is quite common for a painting to be fully documented prior to conservation. If a photographer captures an image using subjective methods and six months later the same painting (now stripped of varnish) requires photography you begin to see where the subjective model breaks down. Is it the same photographer? If it is the same photographer, how will he/she base the exposure? How can we know the net effect of the cleaning treatment? The fact is that only an objective capture method can deliver the repeatability and precision required for this scenario.

After extensive testing of the various subjective and objective capture and exposure methods we have found that there is no loss of quality when capturing dark or light using today's cameras in conjunction with measured objective capture methods. In fact, we consistently find an improvement in accuracy compared to subjective methods based on actual spectral surface measurement of the artworks. Why the improvement? When calculating Delta-E values, one third of the formula is related to lightness (L*). When photographers make subjective adjustments to exposure and tone curve during capture, the L* values shift dramatically often distorting the A* B* values as well. The bottom line is that, accurate exposure minimizes Delta-E differences not just from chart to image file, but from actual artwork spectral measurements to the file values. Smaller Delta-E values translate to better image quality. Results are dramatically improved in the very dark and very light regions as important tonal relationships are maintained. Depending on the ultimate use of the content there is a place for subjective editing to create "pleasing renditions" for limited gamut media such as CMYK publications, but making subjective assumptions regarding output at the time of capture does not necessarily help as the decisions are difficult to manage and are not easily reversed.

Standards and Raw files

It is clear that the entire industry is slowly moving towards Raw file formats and more advanced dynamic encoding methods for both input and output. Unfortunately, until the industry matures and truly standardizes both Raw file formats AND Raw processing tools, we need to make the best use of current technology.

One other caveat of current Raw processor and digital camera capture software applications is that many assume sRGB or Adobe®RGB1998 working space internally with no ability for users to change these "under the hood" parameters. When users think they are working with the full Raw information from a camera sensor encoding, this is not always the case. An example can be found in the current versions of Adobe® Camera Raw™ and Adobe® Lightroom™. Adobe® Camera Raw™ users are able to select Adobe®RGB1998, ProPhotoRGB, and for some strange reason ColormatchRGB working color spaces with accurate readouts while there is no option to select eciRGBv2 or any other legitimate ICC encodings. In Adobe® Lightroom™ users have no choice of working color space at all, and RGB readouts are completely undocumented. Clearly Raw file processing needs to be standardized to enable any meaningful objective imaging practices. Adobe® product managers have described Raw processing as "a black hole" and this is a perfect analogy. It is important to note that the DNG file format itself is not the problem and most experts agree that the format is quite advanced and may be appropriate for archiving. The problem lies in DNG (Raw) editing software tools and an almost complete disregard for standardization.

Output Evaluations

The images created at the Metropolitan Museum of Art are used across every conceivable media and therefore the assets created must be robust and flexible. It is not an option to create collection images based upon any single form of output. The goal of the operation is to achieve maximum quality both technically and aesthetically. The primary interest in evaluating these standardized practices is driven by the desire to continually improve quality and productivity.

The initial rounds of tests were evaluated against existing captures onscreen, and via ink jet output as well as informal CMYK proofing tests. The immediate impact of the Metamorfoze verified captures was a noticeable improvement in shadow and highlight accuracy, and consistently smaller Delta-E differences between file and actual artwork samples. Tests across paintings drawings and photographs indicate that on average, the charts agree with actual artwork samples. The tests specifically involve measuring the artwork using a handheld spectrophotometer and then measuring the actual digital file values for comparison as well as visual comparison of L*A*B* samples on display and print. The results of Delta-E value comparisons are encouraging, as we have seen similar results at other museums using the protocols.

Creating accurate digital captures that measure near 1:1 with actual object colors does not necessarily guarantee that viewers of digital output will find the result "pleasing". What we do find is that in terms of viewing on calibrated displays, the visual matching is very successful across a wide range of artworks from dark paintings to light works on paper. When the same artworks are output on ink jet or CMYK devices (with no further editing) you begin to see the limitations of current output technology. Because these devices are often smaller gamut, dark images are often perceived as too dark. It is critical to separate capture from output issues. It is obvious that an accurate digital capture may be manipulated via post-production or automated methods, but an inaccurate capture compromises any form of output and compromises preservation goals.

Publication Tests

The next step was to begin to utilize the Metamorfoze captures as part of ongoing projects. Images encoded in both ProPhotoRGB and eciRGBv2 color spaces were pushed through various live initiatives for print, web, signage and all other possible outputs for comparison. This real-world testing is critically important. It is difficult to be very scientific when evaluating images as part of normal production cycles as it is not the traditional role of a photograph studio to perform pure research.

RIT Study

By pure coincidence the Metropolitan Museum of Art was invited to participate in Franziska Frey and Susan Farnand's Mellon study: *Current Practices in Fine Art Reproduction*. As we had already started to migrate to the Metamorfoze protocols the timing could not have been more perfect. In December 2009 the package of charts and artworks arrived from RIT. We captured the RIT materials using the Metamorfoze tolerances referenced earlier in this document and verified to the DCSG chart using the Image Engineering IQ Color analyzer software. Images were exported directly from the camera software in eciRGBv2, Adobe®RGB1998, and ProPhotoRGB as we wanted to see how these three encodings performed through this very formal study.

During the testing one of the paintings had a deep impasto and once more the photographers were concerned that the copy style lighting used for charts was not representative of how they would normally light an artwork. So we decided to deliver two versions: "by the book", and the photographer's own lighting. We believe based on the results of the test thus far, that the aesthetic lighting skills of a photographer can fully co-exist with even the most precise technical protocols.

The RIT test set included a couple works on paper that had a distinct warm tone. In our particular test, the resulting images were best described as "hyper-neutral". While density was spot on, the near-neutral colors of the artwork were de-saturated. As with other images delivered to the study, we refrained from performing any post-production, as we wanted to see raw results right off the camera using the capture protocols under evaluation. We know that we can edit files to rectify any problems, but the real value of a study like this is identifying problems and getting to the source. We learned much later that the particular version of capture software used during the testing had a bug (sometimes called a "feature") that de-saturated near-neutral tones. It is interesting to note that the DCSG chart results for this session still passed the Metamorfoze tolerances. This brings up and interesting topic: How precise can we expect to be? Some people worry that the tolerances of the Metamorfoze and FADGI protocols are unrealistically tight. This experience indicates that the protocols could possibly be too wide or it may simply mean that we could use a different type of color chart with more near-neutral patches for this type of material. Given that the overall results are improved by using these methods,

the real answer may simply be that objective capture methods help to identify and resolve problems. In the case of the de-saturated neutrals, a simple software update took care of the problem.

The RIT study was an incredibly important and informative effort for the Metropolitan's evolving workflow.

Going Live

With such positive test results, the decision was made to migrate the MMA studio's entire workflow to the Metamorfoze protocols (Tone and Color) as part of a planned rollout of camera system updates.

One notable project was the recent publication *Stieglitz, Steichen, Strand: Masterworks from The Metropolitan Museum of Art.* This important collection of photographs was to be photographed for the publication. The files for this publication went directly from the camera to the museums separator. The publication has been extremely successful. One of the most striking things about this exhibition is that these iconic photographs are incredibly subtle. Many film-based and early digital images of these photographs suffered from subjective interpretation and are almost always overly saturated and exhibit too much contrast. The new images faithfully convey the surface qualities of the original photographs. It is very fortunate that we were able to use these methods for this important collection.

Metamorfoze, FADGI and 3D Objects

The Metamorfoze and FADGI protocols are based on an ideal 1:1 reproduction (tone and color) of an evenly illuminated 2D object. Due to the complex nature of how light falls on 3D objects, using these settings for 3D objects will often result in lifeless "flat" images. It is important to note that these protocols do not directly apply to photographing 3D objects.

This image of the Liberty Bell is a perfect example. The image on the left is a color correct image in that the measured L*A*B* values of the actual Liberty Bell match the image data. While the settings are technically correct in every way, the resulting images can be perceptually unappealing. The version on the right has been adjusted to create a pleasing output rendition, but the color Delta-E color differences are unacceptable. You can literally see these differences when you drag measured color swatches from the bell over the adjusted image. Efforts to better define standards for photographing 3D objects are ongoing.

Most people prefer the enhanced image on the right, but the image on the left is measurably accurate to the actual Liberty Bell.

There are currently no formal protocols for 3D object photography, but extensive testing has revealed some findings:

1. The color profiles used for Metamorfoze 2D captures can be used for 3D captures and have been found to consistently improve color accuracy over manufacturer default profiles.
2. Many cameras offer a "Linear Curve" and possibly a "Film Curve". These curves are different for each camera brand and every image processing software program. Additionally, selecting a "Linear Curve" does not always apply a true linear relationship between input and output. The definition of a standardized tonal response curve and target method for 3D object capture is an area of great interest and should be explored in the future as a possible addendum to current capture guidelines.
3. Tone curve adjustment at capture has a direct impact on lighting technique. For example: if you photograph an object in a scene using a linear tone curve, you will need to use smaller, more directional light sources to increase scene contrast. If you begin with a high-contrast tone curve, highlights will become prematurely over-exposed requiring larger diffuse light sources to decrease scene contrast. Defining a more universal tone curve for 3D object photography would be desirable. Using a single tone curve over time is equivalent to using the same film emulsion. Photographers are able to learn to light to a more consistent foundation. Why is this important? Confusion over tone curve adjustments at capture leads to inconsistencies. These inconsistencies may lead to more post-production, and more post-production may lead to lost time and more inconsistencies. Digital cameras are inherently stable devices; adjusting tone curves at capture often leads to instability. *Note: This only applies to tethered studio photography under controlled studio lighting*.
4. Tests have proven that lighting adjustments made at the time of capture, as opposed to post-capture tone curve adjustments, result in higher quality images.

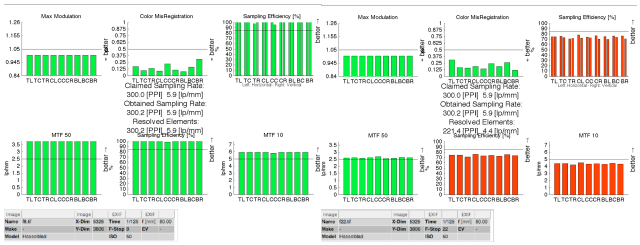
What about the UTT and Golden Thread?

Both the Metamorfoze and FADGI efforts were born within the library / preservation community rather than the museum photography community. Libraries, especially large national libraries, face massive digitization volume challenges and projects are often outsourced to mass-digitization vendors. The efforts to create protocols and unified charts were specifically designed to monitor digitization quality as a critical part of project management. In the ideal implementation scenario, a high volume digitization facility would capture and validate charts on a preset schedule to monitor the process and to identify problems. In many cases, the digitization is performed on a fixed copy stand, or a flatbed scanner. A large portion of the protocols and targets are related to geometric *distortion, resolution, homogeneity and other aspects of imaging that require a locked* down capture situation that is not as common at museums or even conservation labs.

The primary tools currently utilized at the Metropolitan Museum studio have been the X Rite® DCSG chart and verification software to monitor color and tonal response over time. This chart is also used for color calibration. The studio utilizes the Image Science Associates Object Level targets for 2D capture as the production of the Kodak® Q-14 Grayscale has

beenphased out. The UTT and Golden Thread Charts are used primarily when evaluating new camera systems, as well as for configuring and validating copy stand workstations used for reproducing works on paper.

Two interesting applications of the UTT chart were evaluating the resolving power of lenses at different apertures, and comparing the real resolving power of various camera systems. In one such evaluation, we learned that the 39MP Leica® S2 digital camera performed on par with the 50MP Hasselblad® camera in terms of real resolving power. While one would think at first glance that more megapixels immediately translates into more resolving power, this test illustrated that there is still a value in precise optics.



This UTT test chart report is the performance of a camera system at f/8 and f/22. Photographers have known for years that stopping down a lens reduces resolving power. This report shows just how dramatic the losses can be. The horizontal bars represent Metamorfoze tolerances.

Ongoing Process Control

The ongoing monitoring of many digital cameras across this large operation is currently a work in progress. As cameras are in the process of being updated a full calibration/verification is created as each camera is installed. Originally a dozen X Rite® DCSG charts were ordered and distributed to photographers. As we went through the process of configuring cameras we found that cameras behaved with a certain predictability-for example: the Hasselblad® 50MP cameras all hover around 1.6 average Delta-E's which is quite good, but during one configuration session we encountered a situation where a camera was just not behaving correctly with a few patches with over 25 Maximum Delta-E values. For fun we used another DCSG chart and the results were fine. After this, we inspected the charts and to our surprise one of the DCSG charts was improperly manufactured with several patches in the wrong locations. After this experience, we now check that the charts we utilize agree with published values before configuring cameras.

Once again, the ability to resolve problems though verification proved to be very useful. Camera configurations are currently checked as photographers move from project to project, and especially after ANY software updates as we find that this is the single most fragile part of any digital imaging workflow. So far, the custom profiles have been very stable over time.

Curve Balls

Museum imaging is always challenging due to the wide range of materials and surfaces encountered. One challenge for objective capture is photographing illustrated manuscripts and documents that incorporate gold leaf. Using a typical copy lighting configuration the paper will be perfectly exposed and the color of the paper will be correct, but the gold surfaces will almost disappear. To highlight the gold work, a fill card may be positioned directly over the artwork to bounce light onto the surface. Measuring color charts with this bounced light is not possible due to flare, and of course the color accuracy and tone curve is lost to some extent. The Met photographers have come up with a lighting method that delivers consistent results, but object level charts will give false values in this scene. Once more, it is very helpful to think of a camera configured to the Metamorfoze tolerances as a camera loaded with "ISO Film". If you need to break away from rigid copy lighting, you are still free to apply traditional lighting techniques to solve problems. By building upon an objective foundation it is possible to document approaches to solve complex imaging problems in a manner than can be repeated over time.

Future Implementation Plans

As of summer 2011 the Photo Studio program at the Metropolitan will be fully migrated to the Metamorfoze protocols. We eagerly await the publication of the full RIT study as well as the ISO finalization of the eciRGBv2 specification and continued efforts to merge the US and European protocols. Planning is underway for a final comprehensive pre-press test that will be international in scope to begin to expand the process control from capture to output.

Summary

Following the adoption of standardized protocols has been an extremely rewarding experience as the work of the imaging scientists, library experts, museum photographers, standards organizations and researchers has built enough momentum to begin to influence camera manufacturers and ultimately Adobe, Apple, and the industry at large. It is encouraging that the work of a handful of people can have such a worldwide impact.

The work at the Metropolitan focusing on standards has moved the Museum's program forward in important ways. During the process, the studio has had contact with Hans van Dormolen, the author of the Metamorfoze guidelines, Michael Stelmach and Steve Puglia of the FADGI initiative, Don Williams of Image Science Associates, Robert Buckley of the CIE, Dietmar Wueller of Image Engineering, Franziska Frey and Susan Farnad as well as product managers from Adobe, Hasselblad, Leica, BasICColor X-Rite and Epson. In my opinion, it is critical for museums to take an active role in the process of the development of standards, sharing experiences encountered in the field with those professionals guiding the movement and developing the products on which the community depends. I would especially like to thank Marianne Peereboom of the Van Gogh Museum for having the vision to combine the latest in library standards and process control methods with the latest of museum imaging technology. Her decision to make this connection has helped museums worldwide.

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