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Technical Guidelines for Digitizing Cultural Heritage Materials

Creation of Raster Image Files

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Technical Guidelines for Digitizing Cultural Heritage Materials: Creation of Raster Image Master Files *http://www.digitizationguidelines.gov/guidelines/FADGI_Still_Image-Tech_Guidelines_2010-08-24.pdf*	Don Williams and Michael Stelmach
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Technical Guidelines for Digitizing Archival Records for Electronic Access: Creation of Production Master Files – Raster Images *http://www.archives.gov/preservation/technical/guidelines.pdf*	Steven Puglia, Jeffrey Reed, and Erin Rhodes U.S. National Archives and Records Administration
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Digitization Equipment

It is beyond the scope of this document to provide recommendations on specific digitization equipment, and such advice would quickly become obsolete if we did. However, it is within the scope to discuss classes of digitization equipment and their application to cultural heritage digitization.

Camera

Digital cameras have become first line digitization tools in the cultural heritage community in the past few years. It is common to have digital cameras with 50 to 80 MP sensors coupled with very high quality lenses that together provide a fast and high quality digitization system. However, digital cameras have limitations.

The principal limitation is the imaging sensor. The sensors generally used in digital cameras cannot "see" color. To solve this problem micro color filters are coated on each pixel site of the sensors in what is known as the Bayer filter pattern. Each block of four pixels is arrayed to resolve one color, using one red, two green, and one blue filter. Inevitably this leads to reduced resolution and imperfect color. Very sophisticated algorithms translate the information and interpolate full color data for each of the four pixels. In essence, the true resolution is far less than the stated resolution, and the color is interpolated from the data from four pixels.

However, the results are compelling and the cultural heritage community has embraced professional digital cameras. Given the complexity of these imaging systems, it is essential to test the entire imaging system for performance.

A few digital cameras use monochrome sensors, without the Bayer filter. These specialty cameras may be appropriate when imaging monochrome materials, and may be incorporated into digitization systems that use multi-exposure processes to achieve color, hyper-spectral and multi-spectral images.

Scanner

Digital scanners use several different technologies to capture images. The oldest of these is the photomultiplier tube (PMT) used primarily in drum scanners. To this day, drum scanners provide the highest image quality of all imaging devices, but due to the risk of damage to originals and inherently slow speed, they are inappropriate for most cultural heritage digitization.

The predominate technology used in scanners today is the linear, or tri-linear array. This is a one pixel line of sensors the length of the device, sensing only one color through a solid filter, or gray without a color filter. Linear scanners can image both reflective and transmissive, depending on the design of the scanner. These scanners rely on very precise movement of either the original or sensor in relation to the original, capturing data one line at a time as the system "scans" across the object. In a tri-color configuration, there is a distance gap between the three rows of sensors, which is compensated for as the image is constructed in software.

Planetary Scanner

This class of scanner uses one of two methods to capture an image. Either the sensor moves in the camera head capturing the image one line at a time or the sensor remains stationary and the object moves under the camera, again capturing the image one line at a time. Beyond this difference, there is great similarity to a digital camera on a copy stand. Planetary scanners have the advantage of being able to capture images in very high resolution, due to the very long high resolution linear sensors available, and the unlimited ability to add rows of scans in one dimension if the system moves the original under the camera. However, they take time to capture an image and are only efficient for original materials that can be held flat during the long exposure cycle.

Flatbed Scanner

The flatbed scanner has found a home in almost every digitization facility in the world. They can be fast, very high resolution, easy to use and versatile, scanning everything from film to documents. Few of this

breed, though, have a place in a cultural heritage digitization effort. Perhaps the best policy to adopt in considering flatbed scanners is you get what you pay for. Beware of fantastic claims of resolution or dynamic range. Rely on DICE testing to verify the results. For almost every application where a flatbed scanner might be used, there is a better solution using other tools. However, FADGI recognizes that flatbed scanners have their place and may be appropriate for some applications.

Lens

High quality optics are critically important in cultural heritage imaging. All lenses are designed and optimized for specific applications, and there may be significant variability in the performance of two identical lenses. DICE testing will validate performance specifications of the lens as integrated in the total imaging system. Generally, apochromatic and macro lenses outperform other lenses for cultural heritage close focusing applications, and lenses designed specifically for digital flat field imaging are best. It is important to assure that the image circle of the lens is appropriate for the imaging sensor used and that the lens is designed to be used at the working magnifications needed.

As digital sensors become available in ever higher pixel counts, the quality of the lens becomes a critical factor in actual system resolution. It has reached the point where the resolution of digital cameras and scanners may be limited by the performance of the lens, and in some cases a theoretically perfect lens cannot match the resolution capability of available digital sensors. More pixels on the sensor may not relate to increased resolution in the digital file.

Film Scanner

Film scanners are perhaps the least understood class of digitization equipment. Under the hood they are really either a planetary scanner or digital camera, with the exception of true drum scanners, which are single point acquisition devices. What makes film scanners unique is the software designed to interpret the film image and convert the digital data into an image file that resembles the final original image, which is a generation away from the film itself in the case of either a color or black and white negative. This is an especially difficult task for negatives since they lack a visual reference, and rely on an operator interpretation of the digitized negative.

Drum Scanner

Drum scanners function by securing either reflection or transmission originals to the surface of a “drum,” generally with tape. The drum then spins at high speed and individual pixels are acquired through a focused lens one at a time as the drum spins. Very high quality scans can be produced from high quality drum scanners, but there is risk to the original as it spins attached to the drum. These systems are also quite slow. Given the risk to the original and the method of attachment, these scanners have very limited application in cultural heritage imaging.

Selection of Digitization Equipment

Proper selection of digitization equipment is an essential element of a successful digitization program. Factors to consider are:

- Type of materials to be digitized
- Size of the originals
- Quantity of each type of original
- Condition of the materials and how they can be handled during scanning
- Staff digitization experience and quantity
- Budget
- Physical space available
- Duration of the project