Smithsonian
Museum Conservation Institute

Imaging Studio Technical Note: Flexible Solutions for Reflectance Transformation Imaging (RTI)

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After two years of using Reflectance Transformation Imaging (RTI) on a range of objects and materials at the Smithsonian Museum Conservation Institute (MCI), we have found that the image acquisition for this process is definitely an adventure of trial and error. The technique has been chosen to image a variety of objects, materials, and sizes including bone, fossils, paintings, paper objects, a daguerreotype, door panels, jewelry, jade sculptures, and a writing slate ranging from macro scale to a 7′ panel painting. RTI has proven itself as a useful tool and resource for condition reports, enhancing legibility and surface characteristics, and creating an accessible, digital surrogate for many objects that in some cases may be difficult to image using other techniques.

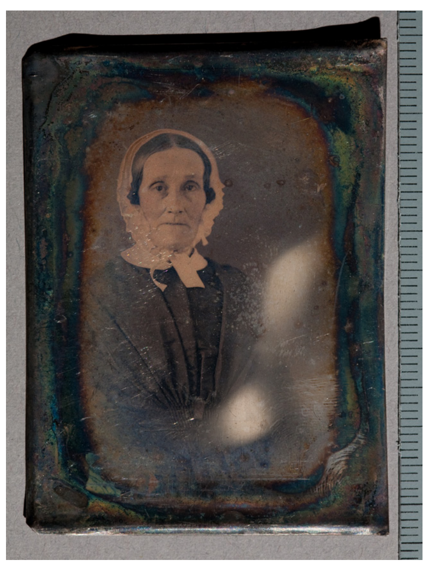
We have adopted a creative process of trial and error to our RTI workflow that can incorporate crafting homemade devices and using available materials to remedy unexpected hurdles and produce high quality RTI files for research and conservation purposes. The following notes include a few examples of projects and solutions we have used in the Imaging Studio at MCI.

Recording Results and Project Sheets

The best way to make this trial and error process and creative problem solving useful is to record the progression and results in a way that can act as a resource for future imaging. Within the Imaging Studio at MCI, we have created project sheets specifically for RTI that record equipment and settings, setup, problems/issues and additional notes. These documents are scanned and used to create a searchable PDF that can be referenced when similar objects are imaged, familiar issues surface or for writing papers similar to this one. An example of a Project Sheet is found at the end of this technical note.

Handmade Snoot

An early "homemade" solution came about when a daguerreotype was received by MCI from the Eastman House. We took advantage of having an unusual object to try out with RTI. A daguerreotype is one of the earliest photographic processes; an image is formed on a silver coated copper plate. The highly reflective and relatively flat surface proved to



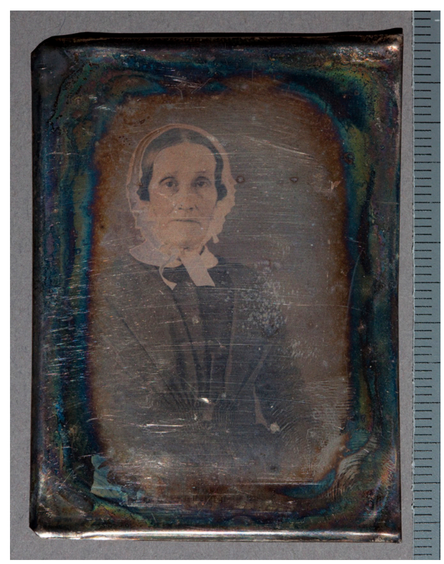


Figure 1 (left) The flare from the flash shows up towards the bottom right fogging some of the detail. Figure 2 (right)The snoot eliminates the stray light from the flash.

be an ideal candidate for the RTI process, the final RTI file revealing detailed information of polish marks and scratches on the metal surface and allowed for very close examination due to the high resolution.

When initially imaging the daguerreotype, we ran into issues with flare on the highly reflective surface (*see* Figure 1). The images were processed resulting in an RTI file that included the flare in some light positions, but disappeared in others. The flare needed to go, so that continuous information of the surface could be gathered without the interruption of stray light and resulting fogged details. We crafted a homemade snoot from cardstock, black velvet and Velcro bands, which quickly solved the problem and generated a beautiful final RTI file. The snoot was able to limit and direct the light eliminating the reflection of any stray light (*see* Figure 2). The addition of the snoot to the image acquisition required that the photographer be very aware of the direction of the light during each exposure and ensure that the entire surface of the object stay evenly lit.

Stray Light in the Studio

The size of an object directly dictates the setup for the RTI image acquisition. Our studio, approximately 17'x34' is quite roomy for Washington, DC and Smithsonian standards, but with larger objects and RTI we can find ourselves a bit limited. While smaller objects can be imaged using a copy stand on a tabletop, some larger canvas and panel paintings necessitate doing a wall-hung setup. A canvas painting that we imaged early in our RTI career, approximately 30"x40", was hung on the wall for image acquisition. By using a wall-hung setup in a studio with 12' ceilings, we compromise some of the lighting positions, specifically the 15° angles coming from the top and bottom of the painting. This compromise of lighting positions is best seen in the composite images of the reference sphere. (A nearly ideal example of highlights can be seen in Figure 3, while Figure 4 shows the limitations of a wall-hung setup.) Aside from this compromise, we also ran into stray light issues (*see* Figure 5). While our walls are painted a nice neutral gray, our floor is made up of reflective, white tiles and the ceiling, while less reflective, is also white. The use of strobes within close proximity to the floor and ceiling created additional highlights on the reference spheres, compromising the results of the final RTI files. To reduce this stray light by limiting the strobe's light, we tested a set of grids (10°, 20°, 30°, 40°) finding that the extraneous reflection disappeared with the 30° and 40° grids. These two grids also had less light fall off than the 10° and 20°, even though there was about a 20-30% loss of light. As with using a snoot, the grids required an awareness of the photographer for the direction of the light, which directly influences the evenness of the light on the object's surface.

Another option for removing reflection from the stray light was to use non-reflective, diffuse material like dark moving blankets over the tiled floor or scraps of black velvet to cover metal equipment.

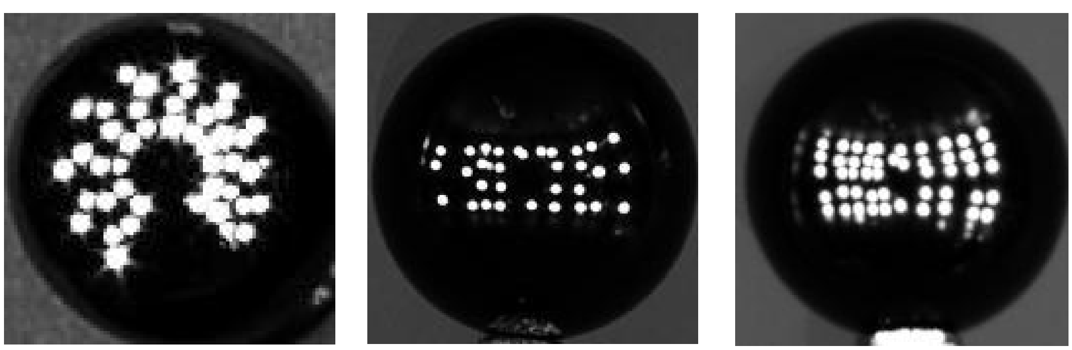


Figure 3 (left) The highlights on this reference sphere illustrate a near ideal setup with even coverage and an almost complete hemisphere of light with the exception of where the studio stand is located. Figure 4 (middle) The reference sphere for a wall-hung painting shows the restrictions of the studio size and ceiling height. The reflections create more of a bow tie pattern as compared to Figure 3. Figure 5 (right) The reference sphere for a wall-hung object with reflections from the walls, ceiling and floor (the less defined reflections).

Ring Light and Human Skull

A final example of our adventures with image acquisition includes a human skull and a ring flash. We were losing information to shadows in the roof of the mouth of a skull while imaging the gold filings in the teeth (*see* Figure 6). To resolve this loss of information we used a (stationary) ring flash during the image acquisition in addition to the standard repositioned light source breaking the rule of using one light source (*see* Figure 7). Before processing the files in RTI Builder, we batch-edited the images removing the ring flash highlight (*see* Figure 8) on the reference spheres, which produced a successful final RTI file.

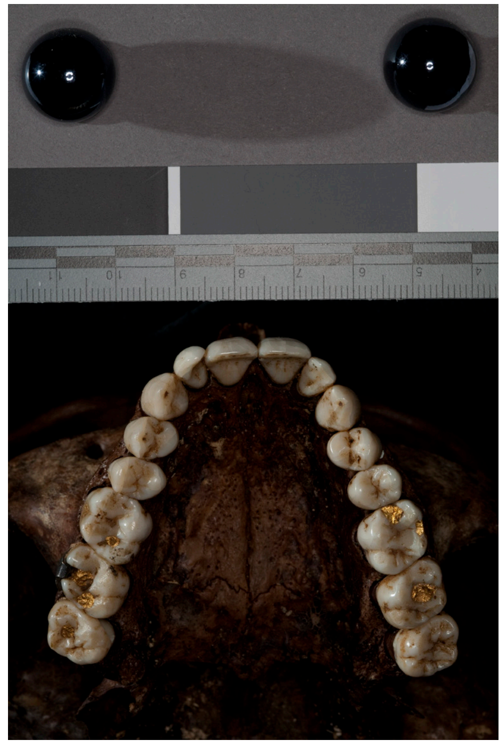


Figure 6 (left) A lower angle raking light image not using a ring light. Detail is lost because of the shadow. Figure 7 (right) A similar lower angle raking light image similar to the left, but using a ring light. The detail is not lost in the shadow.

Figure 8 The reference sphere for the human skull RTI with the reflection of the ring light falling in the center. Before processing the image files, this center reflection from the ring light is removed.

Reflectance Transformation Imaging (RTI)
Project Sheet

Date:
Name:

Set-Up (ie: hanging, on the floor, etc):

Title:
Medium:
Dimensions:

Distance from light to object:

MCI #:
RTI File Name:

Camera System:			Lighting System:
Camera Settings			**Lighting Settings**
ISO	APERTURE	SHUTTER SPEED	
1.			1.
2.			2.
3.			3.
4.			4.
5.			5.
6.			6.
FINAL:			FINAL:

PROBLEMS/ISSUES:

ADDITIONAL NOTES: