Vase Rollout Photography Using Digital Reflex Cameras

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ABSTRACT

Peripheral or rollout photography is a nondestructive technique that can be applied to cylindrical vases or similar archaeological objects to obtain a full and continuous view of decorative motifs. Current digital single-lens reflex (DSLR) cameras make it possible to obtain high-quality rollout photographs with much less expensive materials than were required for standard film photography. This article explains the techniques that can be used to obtain high-quality rollout photographs.

Introduction

Peripheral or rollout photography aims to create a continuous flat representation of the surface details on the periphery of an object. By applying this technique to cylindrical vases, jars, or similar archaeological objects, a full and continuous view of the decorative motifs, with only moderate geometrical distortion, can be obtained.

Creating rollout photographs was very difficult using analog photography. Rollout photography requires that the artifact be rotated in a systematic manner so that a series of photographs can be taken. Some pioneer photographers such as Justin Kerr describe a few handmade cameras developed for this purpose. For example, the British Museum created a camera to roll out the Fenton Vase published in *The Blood of Kings* (Schele et al. 1986). Justin Kerr (2003) recorded more than 1,400 Mayan vases using medium- or large-format cameras. These cameras are expensive, and the price of materials makes the use of medium- and large-format cameras unaffordable for most museums. The techniques were difficult, and only with the arrival of digital cameras has rollout photography become more widely feasible. Historical information can be accessed in Davidhazy (1986) and Kerr (2007).

Material

Below is the list of materials recommended and used in this work. Added, as an example, are the models of the specific equipment that were used, but these are optional:

- DSLR camera (Nikon D7000)
- Zoom lens (Nikon 18–70 mm f/3.5–4.5)
- Tripod to prevent camera movement
- Manual or motorized turntable to rotate the vase
- Soft lighting (compact fluorescent light bulbs, 4600 K)
- Polarizing filter (Kenko circular PL)
- Polarizing sheets for lights (linear polarizer PF006 from Polarization.com, <http://www.polarization.com>)
- Color template (Color Confidence BST13)
- Software for remote camera control (NKRemote from Breeze Systems)

Some nonphotographic material is also needed: a table or platform to support the objects, and a black, white, or gray background.

Methodology

Figure 1 shows the basic arrangement for the rollout-photography procedure. The most relevant stages of the process are listed below:

1. The axis of the camera must be perfectly horizontal (use a level), perpendicular, and centered over the vase.
2. Using short focal distances (e.g., 18 mm) is not recommended. A focal distance of 80 mm or more minimizes the geometrical distortion, facilitating image processing.
3. The vase should be carefully centered over the turntable to avoid rotational displacements.
4. Use an appropriate distance and focus to exploit the full sensor size and get the best resolution.

5. Two compact fluorescent lamps at 4600 K (near daylight) are ideal. Some additional issues involving lighting with polarized sheets will be discussed below.

6. To ensure a sufficient and stable depth of field, use an aperture priority with a small value (i.e., 16).

7. The images must be taken in RAW file format because this makes it easier to adjust the color temperature. (This will be described below.)

Once this installation is complete, the procedure is simple: photographs are taken by turning the vase in increments of 10°, 15°, or 20° to complete the 360° rotation with 36, 24, or 18 shots, respectively. The increment value is a function of the vase radius: a small radius requires small increments and more shots to ensure only minor distortion where the central areas of the picture overlap, the latter which is required to assemble the pictures. The shooting can be controlled with remote-control camera software (tethered shooting), but this is optional. Manual shooting can be used, but the use of a remote cable is strongly recommended to prevent camera movement. The last image is taken with a color template or gray card included to allow for color correction (Figure 2).

Figure 1. The basic arrangement for the rollout photography. This replica of Greek Corinthian pottery is on a motorized turntable to shoot a control photograph with a color template card. The light on the right has a linear polarized sheet covering it. (Photo by author, 2011.)

Figure 2. Color correction using a color chart. The left image is the original, without correction. The right image has been corrected using the color chart as a reference for white, gray, and black levels. (Photo by author, 2011.)

Basic Digital Workflow

The digital-image workflow includes three stages. First, the color bias is corrected in the process of transforming the image from the RAW format to the 16-bit TIFF format. Using Adobe Camera RAW or similar software, the pure gray color in the color-card image is marked and the color correction noted as the color temperature. All of the images should be corrected with the same value, assuring a "perfect" gray without color bias. The images are saved in the 16-bit TIFF format to retain the full color variety.

The second step is to crop the corrected TIFF, retaining only the central vase zone (Figure 3). This can be performed with any image-processing software, such as GIMP (free, GNU license) or Adobe Photoshop (commercial). The objective is to retain the central zone, ensuring an overlapping zone with the neighboring images.

In the third step, all of the images are fused with software such as PTGui or Panorama Factory (commercial), or Hugin (free, GPL license). This software automatically searches for tie points, aligns and merges images, corrects distortions, equilibrates lighting, and creates a unique image as the output (Figure 4).

Image fusion is the key step in the workflow, but it is an easy and automatic procedure. Failures are rare, but they may occur for two reasons: a limited number of photos lacking sufficient overlapping zones, or a very irregular piece that cannot be unrolled without serious geometric deformations.
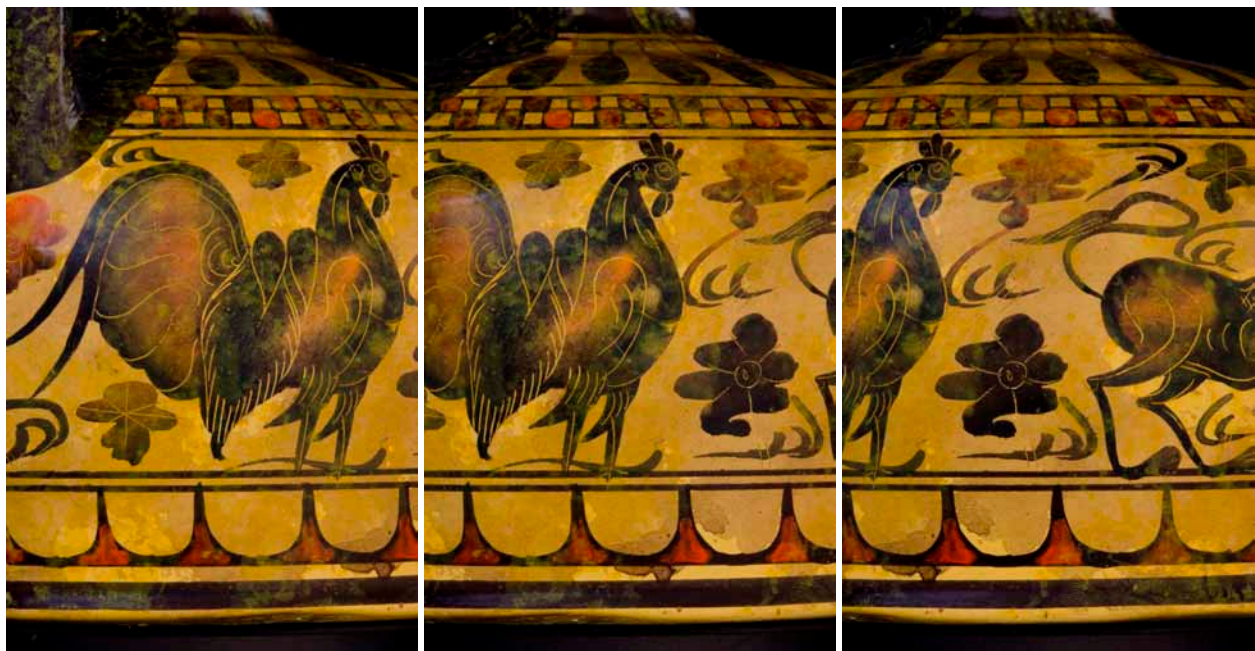

Figure 3. Three cropped images that retain the central part of the original images. (Photo by author, 2011.)

Figure 4. Rollout photograph resulting from the fusion of 18 images. (Photo by author, 2011.)

Lighting Improvements

Glare is the most common problem in the photography of varnished or vitrified vases. Here a technique called cross-polarization was used to avoid this problem. The technique involves placing a linear polarizer sheet in front of the spotlights and a linear or circular polarizer filter in the camera lenses. By rotating this filter, the glare can be significantly reduced and consequently a photograph obtained that is much more balanced in brightness and contrast. Figure 5 shows an example of this technique.

Geometric Distortion

The rollout procedure guarantees the absence of distortion for cylindrical vessels only. The same process using noncylindrical objects means that the projection of the object is distorted proportionally to its deviation from a cylindrical shape. In the case illustrated here, the bottom half of the vessel is roughly cylindrical. The maximum radius in this zone is 72 mm (Figure 2), and the distortion in the rollout image is very small. The upper half of the vase is narrower,

but each part is "stretched" to the same dimensions in the rollout image.

This procedure generates a distortion that increases proportionally to the ratio between the maximum radius and the local radius. For example, the maximum radius (72 mm) implies a circumference of 452 mm. If the local radius is 55 mm, the real circumference in this zone is 345 mm, and the distortion in the rollout image is $452/345 = 1.31$. Thus, the decrease of the real circumference is 31%. This issue makes it difficult to add horizontal scales to the rollout photographs because they are not applicable to the entire image, with the exception of cylindrical shapes.

Conclusions

Rollout photography can be performed with standard photographic equipment and simple procedures. The workflow can be improved using a motorized turntable and an automatic and coordinated shooting sequence, but the manual procedure is simple and suitable. The current DSLR cameras greatly simplify the process, which was,

Figure 5. Diffuse lighting generates glare over varnished or vitrified vases (left); cross-polarized lighting (right) reduces the glare. (Photo by author, 2011.)

until recently, too expensive and thus available only to specialists. The use of appropriate photographic techniques, such as color scales and cross-polarized lighting contributes to a high-quality product. The price of the materials used here was less than $2,000, and the time required for the work was approximately three hours.

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