Macro Imaging with a Digital Camera: Examination of a .22 Revolver

Digital cameras are supplanting film cameras in many areas of science. Investigators are now using these cameras for crime and accident scene imaging. Digital cameras attached to microscopes are now found in practically every laboratory in the US. Even in macro imaging applications, which is the main focus of this paper, these cameras will likely replace film cameras.

In a recent article, Burnett and Blaauw (2003) explored the capabilities of digital cameras for macro imaging applications. They found that the high resolution (5.8 megapixel), Peltier cooled Pixera 600CL camera is capable of taking images with extraordinary depth of field. Indeed, the depth of field that the Pixera 600CL with a good macro zoom lens produces rivals or even exceeds that of the scanning electron microscope. And how is this possible? It is mainly is due to the camera's exceptionally sensitive charged coupled device (CCD). The sensitivity that can be achieved by the CCD in this camera is so great, that images can be taken with the attached macro zoom lens stopped down past f 44. Along with this extraordinarily high f-stop comes an extraordinarily high depth of field.

There are actually two purposes for this paper. First, and foremost, I wish to show the remarkable capabilities for achieving a high depth of field in a digital camera and second, to locate apparent gunshot residue (GSR) deposits on a revolver.

A Smith and Wesson (S&W) Model 18 .22 revolver (Fig. 1) was used to demonstrate the depth of field capabilities of the Pixera 600CL coupled with a Computar MLH-10X (f 5.6) or a Optem 18-108 (f 2.5) macro zoom lens. The Pixera 600CL sensitivity was set to ISO 200. Generally, for images to about 3X,

Figure 1

the Computar lens was used (Figs. 1, 2 and 3A). For magnifications greater than 3X or so, the Optem macro zoom lens was used (Figs. 4 through 7). Illumination of the subject was with a 60 Watt-equivalent fluorescent bulb (high intensity lighting should be avoided because such lighting produces image hot spots). Most images were taken at greater than f 44 with exposure times usually exceeding one second.

Figure 2

The image shown in Fig. 3A demonstrates the extraordinary depth of field that this camera system can achieve. Details on the muzzle, the rifling in the barrel and the firing pin of the .22 revolver can be seen. Figure 3B shows the distance that the Pixera 600CL/Computar MLH-10X macro zoom was from the .22 revolver when the image (Fig. 3A) was taken. Color loss or other distortion is not an issue with images taken at this high f-stop.

Apparent gunshot residue deposits were found at various locations on the breech face (Fig. 4, discoloration flanked by arrows) and the cylinder (Figs. 5, and 7). Probable remnants of gunpowder were found along the edge of the cylinder chambers that are closest to the breech face (Figs. 5 and 6: brown particles at arrows). In Fig. 6, the lighting was such that GSR debris shows as bright specks in the chamber. Figure 4 reveals that the rifling in this revolver does not extend to the breech face. Instead in this area of the bore there are file-like ridges that run perpendicular to the axis of the barrel. Gunshot residue is likely to deposit in these groves.

Figures 3A and 3B

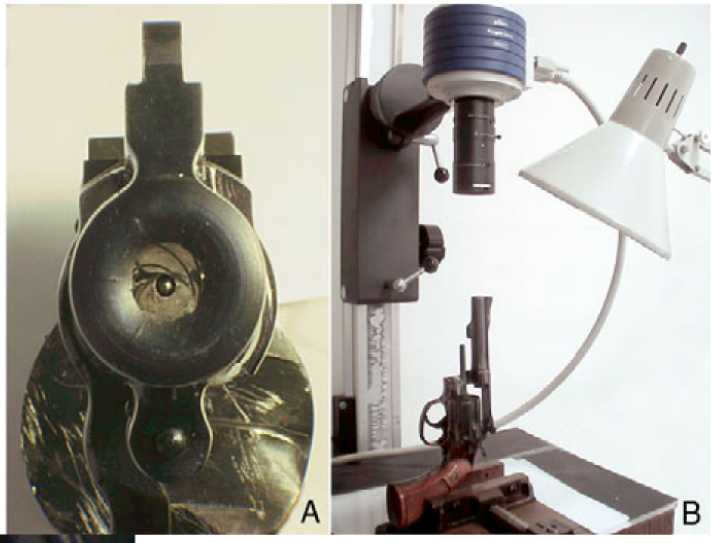

Figure 4

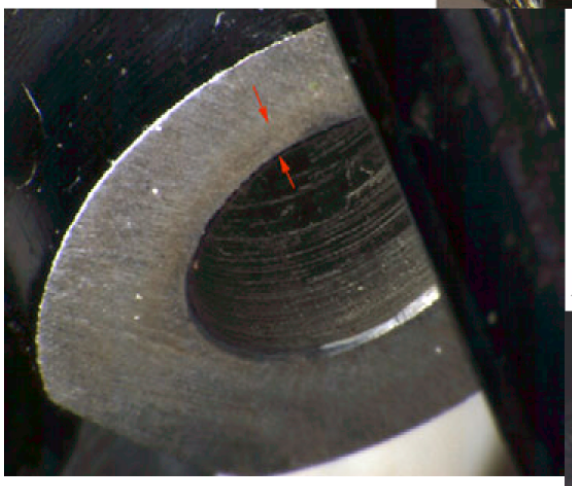

Figure 5

The nose of a Remington brass-coated bullet is seen in the right chamber in Fig. 7. Above this bullet relatively large GSR particles can be seen. The chamber on the left is empty and is backlit with a fiber optic light. There is a heavy ribbon-like deposit of apparent GSR on the wall of the chamber (Fig.7, arrow). This material was likely deposited following the departure of each bullet while it was within millimeters of the casing during the firing process.

The Pixera 600CL digital camera coupled with either the Computar or Optem macro zoom lens presents a broad range of low magnifications with large depth of field. This system essentially allows for much better documentation of small three dimensional evidence as well as the potential for providing a more precise record of collection areas on evidence. The stereo

microscope, as an intermediate optical system for documenting sampling of evidence, in many cases can now be eliminated - it just cannot match the documentation potential of the system described in this paper. Dr. Jozef Lebiedzik noted, upon reading an earlier version of this paper, that this Pixera camera/macro zoom lens system fills "the gap between macro photography/viewing and SEM."

Figure 6

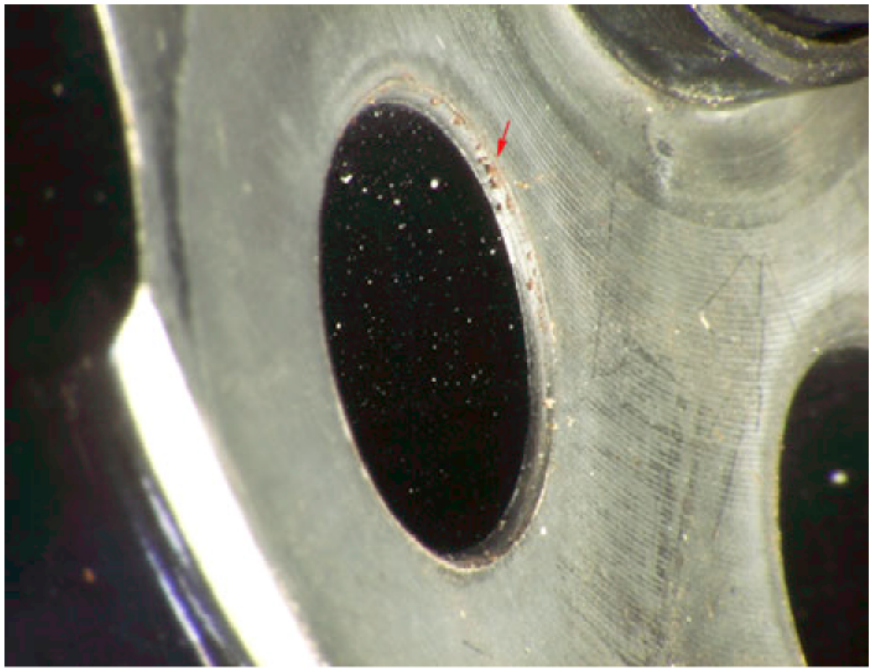

Figure 7

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Reference

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