



Utilizing Contrast Photography and Invert Filters

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EVAWI is proud to partner with SDFI®-TeleMedicine for the upcoming 2015 [*International Conference on Sexual Assault, Domestic Violence, and Campus Responses*](#). By partnering with EVAWI, SDFI is publicly and proactively committing to join our efforts to end violence against women – a powerful and compassionate statement. We hope this training bulletin provides forensic examiners, investigators and prosecutors with helpful information that can be used to improve forensic documentation.

About SDFI-TeleMedicine (SDFI)

[SDFI®-TeleMedicine](#) offers a Secure Digital Forensic Imaging system designed for investigations such as sexual assault, intimate partner violence, homicide, child abuse, human trafficking, and death investigations.



Photo Credit: SDFI - TeleMedicine

The SDFI System is a turn-key solution intended to serve the needs of crime victims, as well as the medical and legal communities. SDFI®-TeleMedicine is used at numerous hospitals, independent forensic service locations, child advocacy centers, police departments, medical examiner's offices, risk management departments and military hospitals throughout the nation and abroad.

Caution: Some of the photographs included in this bulletin are graphic in nature.

What are Contrast Filters?

In photography, you capture contrast; otherwise photographs would be blank. An example of a photograph without contrast would be an all-black photo void of anything except black (this happens when you leave the lens cap on, take a picture and then spend 10 minutes wondering just what the heck happened). That all-black picture you just took is still a photograph, except it's a photograph without contrast and therefore of little value.

Filters can be designed to do many things. Contrast filters, in general, help you see existing detail that is already there. They don't add or take anything away from the subject itself; they only "highlight" what is already there. Contrast filters make it easier to see detail in your picture, like removing the lens cap before taking a picture.

A great example of a common contrast filter would be a pair of sunglasses that you wear on a bright sunny day. Without them, everything looks "too" bright and when it's that bright, it's hard to see. When this happens, the iris in your eyes close and when your iris can't close anymore,



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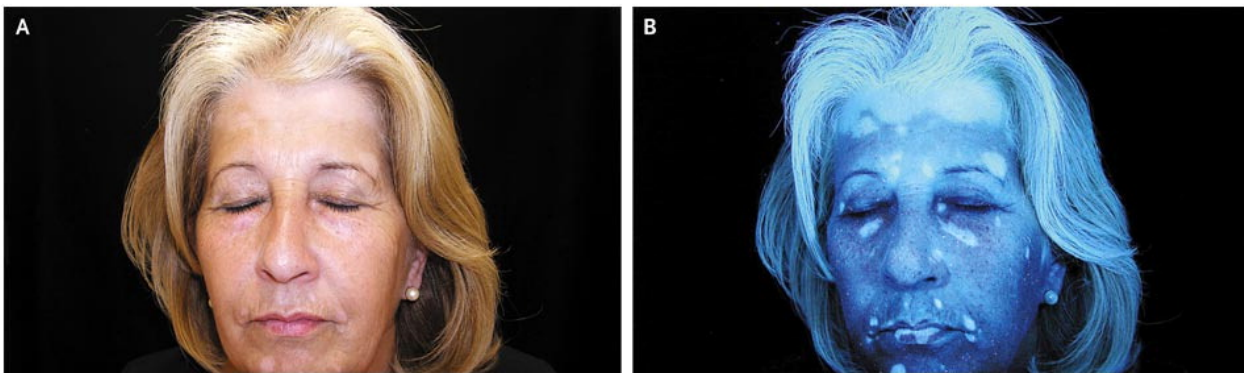
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we squint, all in an effort to reduce the amount of light that shines into your eyes. With sunglasses on, light is filtered. The result, you are able to see better on a bright sunny day.

Types of Contrast Filters

The list and types of contrast filters is endless. One could say prescription eyeglasses filter blurriness, a very subjective statement. Regardless, having the right prescription eyeglasses should help you see better. Unfortunately, we can't cover every filter type here. **In forensics, there are light filters, powder filters, chemical filters, camera filters and digital filters, among many others.** Light filters are very common. Black Lights or Woods Lamps have been used to see better for decades.

In the example below, from [*The New England Journal of Medicine*](#), this 58-year-old woman had white facial patches that had progressively increased in size during a period of several months. A physical examination revealed hypo-pigmented macules that were symmetrically distributed on her face. These lesions became more evident after an examination with a Wood's Lamp light filter consistent with vitiligo, the loss of skin color in blotches.



Photos Courtesy of: New England Journal of Medicine

In this picture above, the overhead lights were turned down or off and then a Wood's Lamp light filter was turned on. The results are striking. With the assistance of a light filter, the woman's facial patches are visible in both pictures, because you now know where to look! This is an excellent example of a contrast filter and how to use it.

Chemical Filters

According to the [*Journal of Oral and Maxillofacial Pathology*](#), chemical filters (like Toluidine Blue (TB), a thiazine metachromatic dye) selectively stain acidic tissue components. TB stains tissues based on the principle of metachromasia. The dye reacts with the tissues to produce a color different from that of the original dye and from the rest of the tissue. Metachromasia is a phenomenon whereby a dye may absorb light at different wavelengths depending on its concentration and surroundings and it has the ability to change its color without changing its chemical structure. The physical changes that bring about this color change are a specialized, orderly form of dye aggregation. For metachromasia to occur, there must be free



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electronegative groups on the surface of tissues. In layman's terms, TB adheres to damaged tissue so you can locate and identify injury. It helps you see better by providing contrast.



Ano-genital injury depicting multiple lacerations and toluidine blue dye uptake, down the perineum and around the anus.

Photo Credit: SDFI-TeleMedicine

Camera Filters

Camera filters, both glass and plastic, have been used for hundreds of years and are the most common filter used in photography, digital or otherwise. The picture below is self-explanatory.



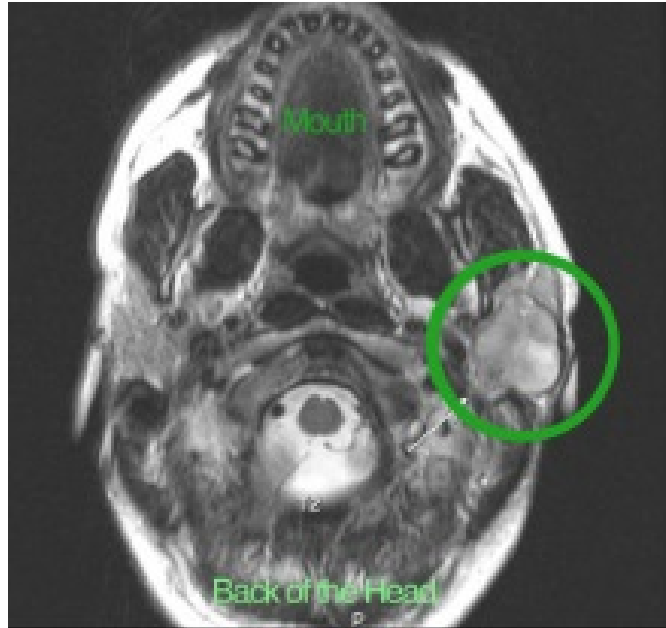
Photo Credit: Kain Kalju.

Other Contrast Filters

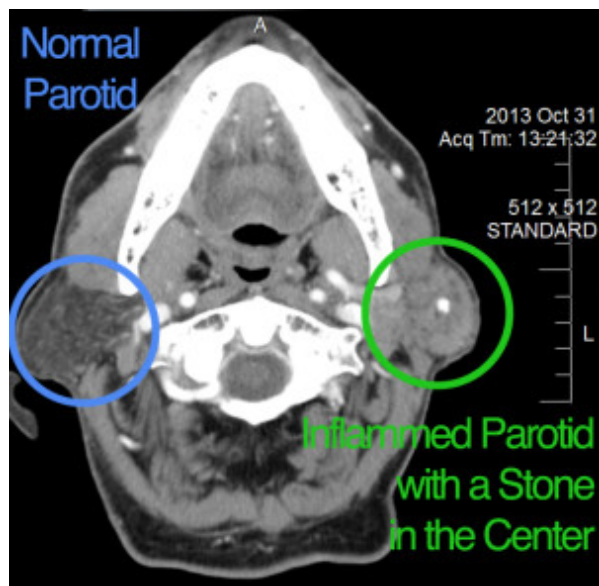
Let's spend a few seconds on a variety of other types of contrast filters before we talk about digital filters, specifically SDFI's Negative Invert filter. X-Ray photographs, MRI photographs and CT scans are excellent examples of medically filtered pictures. These filtering tools are common within the medical community and widely accepted. Unlike the Wood's Lamp light filter, we don't compare these filtered images side by side with the actual subject given that the primary benefit of X-Rays, MRI's and CT scan is not having to do exploratory surgery. With digital filters, you can compare side by side.



Courtesy of [Journal of Clinical Microbiology](#)



Courtesy of [Center for Advanced Parotid Surgery](#)



Courtesy of [Center for Advanced Parotid Surgery](#)

Digital Filters

Within the forensic community, filters are applied globally, over the entire image at the same time. A common example of this is shown below where a digital brightness filter is used. Here we can take a dark image, one where the camera flash did not go off, and we can brighten it, similar to turning on an overhead light.

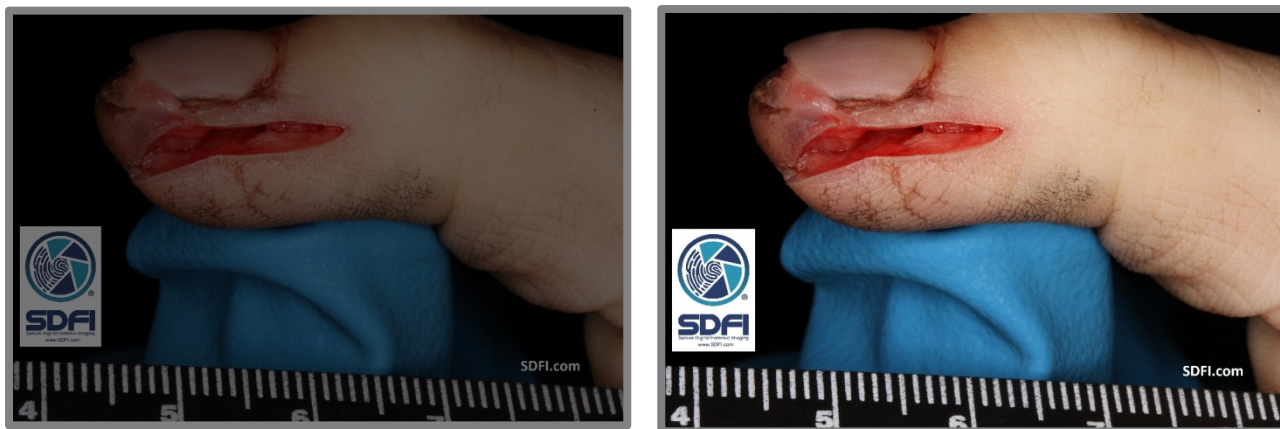


Photo Credit: SDFI - TeleMedicine

SDFI's Negative Filter

The old film-based photography process first produces “negative” film strips. They were converted to printed paper, based on “positives” after capture, through a chemical process so that we could look at a normal photograph. Digital negative filters do the same thing based on additive and subtractive pixel color values originally captured by a digital camera. A color positive is represented by additive RGB color values. A color negative is represented by subtractive CMY color values.

There are 16,777,216 possible colors in a 24-bit pixel. Many pixels together can produce a variety of color tones. How light or dark these “tones” are depends on the numbered color values within each pixel. It is critically important to know that color tones are seen relative to other color(s) shown in that area of an image. How dark or light a “tone” is perceived depends on what other color pixels are shown around it. How our brain processes and perceives color is beyond the scope of this article.

When the negative filter is applied to a color positive image by itself, a static string of computer code effectively converts primary additive colors to their opposite secondary subtractive color values. Red areas of the image tend to appear “cyan-ish,” green areas tend to appear “magenta-ish” and blue areas tend to appear “yellow-ish”.

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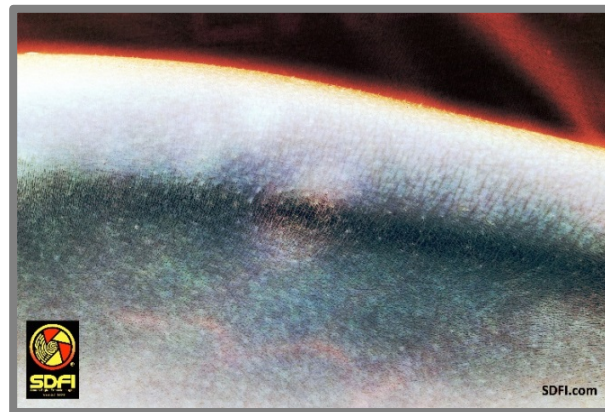
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Color Positive



Photo Credit: SDFI-TeleMedicine

Same Image after Applying the SDFI Negative Filter



SDFI's Invert Filter

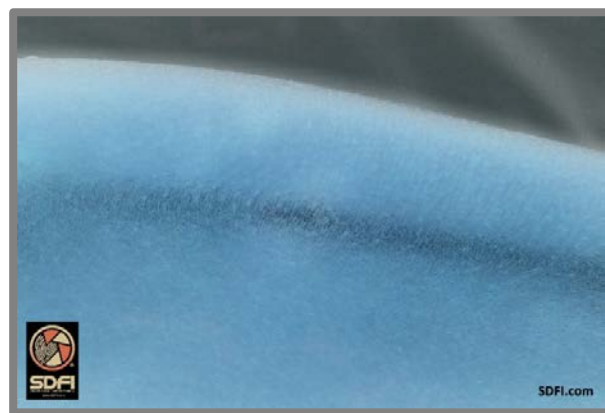
The Invert Filter, by itself, inverts the numeric color value in each pixel to produce an opposite numeric color value.

Color Positive



Photo Credit: SDFI-TeleMedicine

Same Image after Applying the SDFI Invert Filter



Display color, like the color you see when you look at your computer screen, is made up of RGB colors or (R)ed, (G)reen and (B)lue colors. Computer screens and standard JPG color images display a range of colors. Each of those individual RGB colors is defined by a number from 0 through 255. 0 is black, 128 is gray and 255 is white.

Again, each of the three colors in this color model, Red, Green and Blue, has their own range of color between 0 and 255. The number 0 has value, meaning it is worth something when discussing and presenting images on a standard computer screen. This means that you can have 255 reds from 1, 0, 0 to 255, 0, 0. ("0, 0, 0" represents pure black, "255, 0, 0" represents a "pure high red".) Each pixel in a 24-bit JPG color image has a combination of RGB colors in



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it. This means that even if there is “No Visible Red” in a pixel, your computer allocates space for the color red in each and every pixel throughout an entire image (A single image might have 15,000,000 pixels. A million or more pixels together is called a Megapixel.)

In this color model, the three primary additive colors, Red, Green and Blue, are always discussed in the “Red, Green, Blue” color order. Subsequently, the numeric value of these colors is also discussed in RGB color order. “0,0,0” is a pixel that is seen as black. “128, 128, 128” is a pixel seen as gray. “255, 255, 255” is a pixel that is seen as white. Each of the three numbers, separated by a comma, represents each of the three primary additive (R)ed, (G)reen and (B)lue colors in this color model and they are always referred to as RGB.

- 255, 0, 0 can be considered “pure high red”. Inverted, red has the opposite numeric value of 0, 255, 255 or cyan.
- 0, 255, 0 can be considered “pure high green”. Inverted, green has the opposite numeric value of 255, 0, 255 or magenta.
- 0, 0, 255 can be considered “pure high blue”. Inverted, blue has the opposite numeric value of 255, 255, 0 or yellow.

Applying SDFI’s Negative Invert Filter

When applied, the SDFI Negative Invert Filter provides a high contrast image that should ONLY be shown beside the original color positive for comparison.

Color Positive



Photo credit SDFI-TeleMedicine

Same Image after Applying the SDFI Negative Invert Filter



Important Legal Information

A filtered image is **NOT** valid or legal without the original beside it. NEVER evaluate any filtered image without having access to the original to compare to. To ensure that pictures are legal and original, SDFI users capture a RAW file alongside the JPG file. Regardless of your professional discipline, e.g., investigator, prosecutor, defense attorney, forensic examiner, you

should always ask for the original to ensure that the image hasn't been changed. RAW files are your legal original.

For More Information

We hope you have found this discussion of various filters helpful. For more information on this topic, please see the SDFI guide entitled: [*Using SDFI's Negative Invert Filter In Court*](#). If you have questions about this training bulletin, please email SDFI® - TeleMedicine at Support@SDFI.com, or, you can call 310-492-5372.

To learn more about SDFI, please visit www.SDFI.com. If you plan on joining us at our upcoming conference in New Orleans, please visit SDFI's display where you will have an opportunity to ask questions.

SDFI® Word and Acronym Glossary

CMY: Secondary Negative Subtractive Color(s) = Cyan, Magenta, Yellow.

Color Tone = How light or dark a color is, rather than what the actual numeric value of color is.

Cyan-ish = A mixed array of color that typically shows more cyan than other colors.

Digital Image = A digital image is a representation of a two-dimensional image using ones and zeros (binary).

Digital Photograph = See "Digital Image" above.

Digital Picture = See "Digital Image" above.

High Cyan = 0,255,255. The highest values of green and blue mixed together without any red.

High Magenta = 255,0,255. The highest values of red and blue mixed together without any green.

High Yellow = 255,255,0. The highest values of red and green mixed together without any blue.

Invert = The "exact" reversal of numeric color values in a pixel or an array of pixels.

Invert Filter = A global software filter that exactly reverses the numeric color values within a pixel or an array of pixels.

JPG or JPEG = Joint Photographic Experts Group.

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Magenta-ish = A mixed array of color that typically shows more magenta than other colors.

Negative = In reference to a negative color image showing a majority of negative color values, cyan, magenta and yellow.

Negative Filter = A global software filter that uses a matrix of software code to perform an inversion of the additive positive color values in a positive digital image to a subtractive negative color value . [-1, 0, 0, 0, 255, 0, -1, 0, 0, 255, 0, 0, -1, 0, 255, 0, 0, 0, 1, 0]

Negative Invert Filter = A combination of two separate filters, used one after another, to display high contrast in an image.

Pixel = Acronym for “Picture Element”

Positive = In reference to a “normal” color image showing a majority of positive color values, red, green and blue.

Pure High Blue = 0,0,255. A description of the highest value of blue shown in a 24 bit image without any Red or Green mixed in. “Pure High Blue” can also be used to describe color in 48 bit RAW images. 48-Bit Pure High Red = 0,0,65536.

Pure High Green = 0,255,0. A description of the highest value of green shown in a 24 bit image without any Red or Blue mixed in. “Pure High Green” can also be used to describe color in 48 bit RAW images. 48-Bit Pure High Red = 0,65536,0.

Pure High Red = 255,0,0. A description of the highest value of red shown in a 24 bit image without any Green or Blue mixed in. “Pure High Red” can also be used to describe color in 48 bit RAW images. 48-Bit Pure High Red = 65536,0,0.

RGB: Primary Positive Additive Color(s) = Red, Green, Blue.

Yellow-ish = A mixed array of color that typically shows more yellow than other color values.

