



Digimarc for Images 4.0 | Technical Brief

Introducing Chroma

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History

In 1996, Digimarc digital watermarking was added to Adobe® Photoshop® to communicate copyright and licensing information in digital images and artwork. More than 10 years later, Digimarc's watermarking plug-in remains the longest-standing third-party tool bundled with Adobe image-editing products.

During this period the Internet has evolved from a little known academic tool into the ubiquitous World Wide Web. Images are now everywhere on the Web, and millions more are added every week. Frequently, images are downloaded, transformed by scaling, cropping, reformatting, and combining in collages, and then reposted, often without crediting the owner. Ownership information included in the image metadata when initially posted usually does not survive scaling and other such transformations. However, Digimarc's digital watermark typically does survive these transformations, allowing the ownership information to be recovered.

Digimarc's original watermarking technology, now known as the "Classic" watermark, has been used in all previous versions of Digimarc® for Images, resulting in a proven track record of identifying unattributed images for over 10 years. Due to advancements in computer processing power and Internet bandwidth, the size of images posted online have increased exponentially resulting in greater challenges for the Classic watermark today. Many images are shared on social and photo networks and often undergo transformations and manipulations that can make the watermark unrecoverable.

The latest release of Digimarc for Images is designed for this fast-paced, transformative digital world, and employs a new breakthrough watermarking technology called "Chroma." Chroma watermarking was developed to address the most common requests of Digimarc's customers — making the watermark truly imperceptible and ensuring that it survives greater levels of scaling and reformatting. Significant improvements in Chroma watermarking improve both image quality and overall robustness, making the watermark less perceptible and much easier to recover.

How Classic and Chroma Watermarks Interact with the Human Visual System

Classic watermarking uses the luminance of an image to create a digital watermark. Luminance can be described as a component of an image's contrast or as the lightness (or darkness) component in an image's tone scale. The human eye is sensitive to modifications to an image's luminance, more so when higher watermark strengths are used to increase robustness. In Classic mode, one can embed a persistent watermark that remains fairly imperceptible while surviving some level of scaling and formatting.

A Chroma watermark uses the chrominance component of an image's color space. The human eye is less sensitive to differences in chrominance, so a stronger watermark can be imperceptibly embedded in areas of an image that the eye has difficulty resolving. The new Chroma mode also greatly improves the amount of scaling the watermark will survive and reduces the visual artifacts that can result from a more robust watermark.

Figure 1 below illustrates the difference between Classic and Chroma modes effect on the human visual system. The grayscale image appears more detailed than the yellow image — the vertical bars are more apparent. But the yellow image is just the grayscale image viewed as the yellow channel of a CMYK file (or the blue channel of an RGB file). One can't see the bars as well in the yellow image

because the human eye can't resolve the higher frequencies in the image when it switches from gray to yellow. The Chroma watermark embedder exploits this feature of the human visual system to hide more of the watermark signal in color regions where the human eye has less acuity.

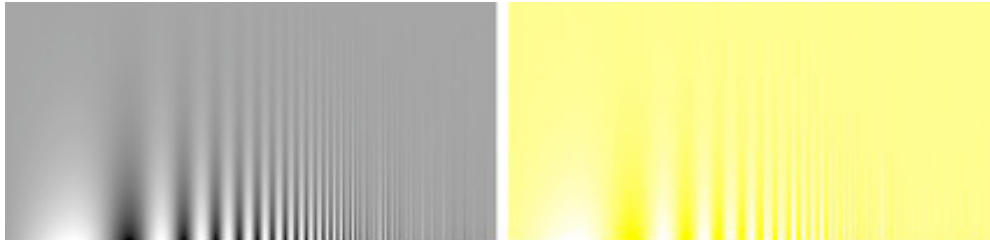


Figure 1.

Classic and Chroma Robustness

The ability of Chroma embedding to hide a stronger watermark in an image allows the watermark to survive a greater range of scaling. A Classic watermark is still recoverable from most images after scaling the image to about 60% of its original size. In contrast, a Chroma watermark can be recovered from most images at 25% of their original size. Depending on the content and size of the original, it is often possible to recover a Chroma watermark at 15% of the original image size.

Figure 2 compares Classic and Chroma watermarking modes in common image manipulation situations.

	Classic	Chroma
Works with RGB images	✓	✓
Works with CMYK	✓	✓
Works with Grayscale	✓	—
Persists when rotated	✓	✓
Persists when flipped	✓	✓
Persists when scaled to:		
200% of original	✓	✓
75% of original	✓	✓
60% of original	✓	✓
50% of original	Likely	✓
25% of original	Unlikely	✓
15% of original	Doubtful	Likely


Figure 2.

* Results can vary and depend on image content, size, and the settings used in your embedding process.

Results are based on original image sizes greater than 512 x 512 pixels.

Additional Technical Information

All Digimarc for Images 4.0 products include Chroma watermarking technology. With this release, Chroma mode is the default setting for all Digimarc for Images embedder products. The embedder automatically selects Chroma mode when watermarking RGB and CMYK images. You can configure the embedder to embed Classic digital watermarks at any time, if desired.



The Digimarc for Images 4.0 readers used in Photoshop, Internet Explorer, Windows Explorer, and the Digimarc Search Service have also been upgraded to read both Chroma and Classic watermarks.

Grayscale or black-and-white images have no chrominance components, so the embedder cannot watermark them in Chroma mode. The embedder automatically switches to Classic mode for all grayscale images.

Also, for images smaller than the recommended minimum size of 256 x 256 pixels, the Classic watermark may give you better results. In this case, you should consider increasing the durability setting to improve detection.

How Does This Apply to Your Images?

Most photographers spend countless hours taking hundreds of photos of an object just to get the perfect shot. Once the shot is captured, they may spend many additional hours perfecting it in their imaging application. For many photographers, the final image may be a personal creation to be shared or a professional creation to be licensed; nevertheless, communicating ownership is important in any case.

Let's take for example that you have created a 1200 x 900 pixel image to display on your website and watermarked it with the new Chroma watermark. Once that image is transformed, or scaled down by about 50% to show as a preview, the watermark will still persist. Now suppose someone browsing your site downloads the preview image, reduces it by another 50%, and posts it to their website without permission or attribution. Since the image is now only 25% of its original size, a Classic watermark would probably not be recoverable. But the more robust Chroma watermark is — it can still be read to prove that the photo is yours.

Additional Resources



Digimarc for Images Blog

blog.digimarc.com/images

Your source for entertaining and informative discussion of digital watermarking for digital images.



Digimarc Videos

www.digimarc.com/video

Directory of informative videos designed to educate and demonstrate Digimarc's innovative technology and solutions.

Introduction to Digimarc's new Chroma digital watermarking technology

www.digimarc.com/chroma



Digimarc's newest digital watermarking technology for images is introduced and compared to our original Classic technology. For on-screen comparison purposes, images used in the video are available for download.

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