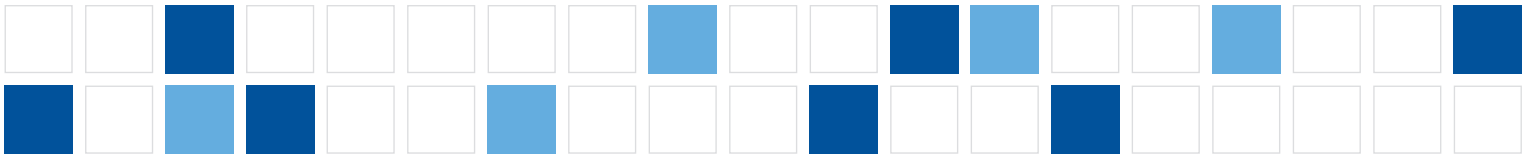

Glyph Antialiasing technology

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Glyph Antialiasing technology

Matrox introduces Glyph Antialiasing technology, providing hardware accelerated antialiased text with programmable gamma correction. This feature leverages the antialiased text provided in software within Windows® 2000 and Windows XP, adds programmable gamma correction and enables smooth, more readable text at no performance penalty.

Introduction

Have you ever wondered why it is that many people prefer to print out documents to read them instead of reading them on their computer monitor? They prefer to do so partly because of the difference in quality between text rendered on paper and text rendered on-screen. One of the key factors for this difference is resolution. Today's printers have a standard dot pitch of 300dpi (dots per inch), migrating toward 600dpi, versus the standard 96 dpi of computer displays. This means that at the same size, a given character will have a finer resolution on paper than on-screen.

The lack of resolution results in aliasing artifacts — staircase-like effects that are seen on edges which are meant to look smooth. Antialiasing is a method of minimizing aliasing artifacts to deliver visually smoother lines and edges. Antialiasing the individual characters, or *glyphs*, that make up the text significantly improves its readability and resolution.

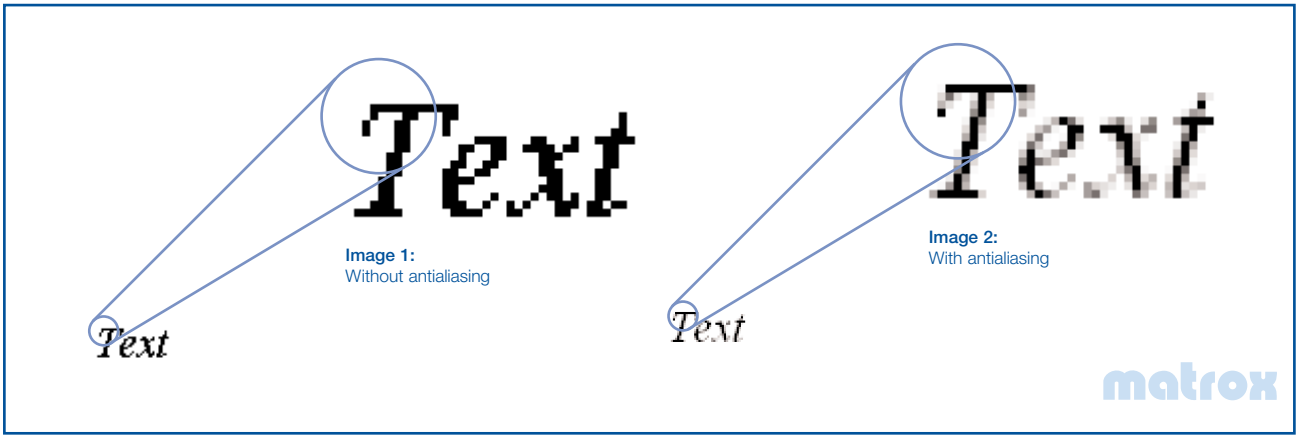


Image 1:
Without antialiasing

Image 2:
With antialiasing

These images are for illustration purposes only. The exact antialiasing effect can be seen on a PC monitor.

Text antialiasing

Aliasing occurs primarily because there are not enough pixels available on a typical monitor to properly display visually smooth lines and edges. Each pixel has a given size when it is attempting to display a continuous image. In its mathematical representation, a line may only cover part of certain pixels. These pixels require specific treatment. Partially covered pixels, referred to as edge pixels, occur along the edges of objects. A large percentage of pixels in text rendering are edge pixels. It is crucial to antialias these pixels in order to smooth jagged edges. This is done by adjusting the pixel color according to the amount of pixel coverage.[1]

1: Please consult the FAA-16x white paper for a more detailed explanation of aliasing in raster-based visual systems.

Glyph Antialiasing technology

Image 3 is an oversampled representation of a 16pt Times New Roman, Italic font. It is rendered at four times its targeted size on both the x and y axes. This oversampled glyph is then filtered to its targeted size as shown in image 4. Image 5 shows a zoomed up version of the antialiased glyph.

Notice how each pixel has a certain transparency level that represents the coverage of each pixel; this creates the antialiasing effect. In this example, there are 16 levels of intensity possible for each pixel. When the image is small enough, the eye integrates the various changes in intensity and perceives a smooth image without any jagged edges.

Image 6 shows text that is rendered without any antialiasing and clearly illustrates the staircase effect on the diagonal lines. Image 7—a zoomed up version—provides a better perspective of the aliasing.

Image 3:
Oversampled glyph

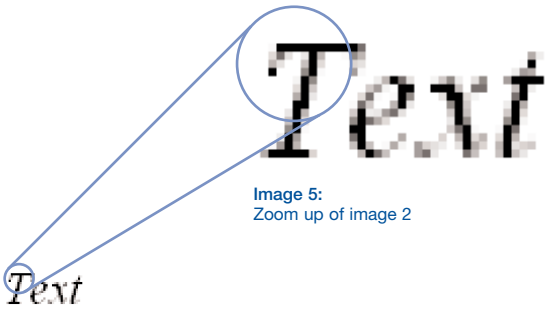


Image 5:
Zoom up of image 2

Image 4:
Filtered standard size character

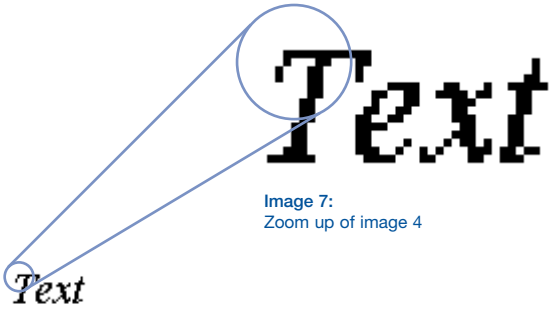


Image 7:
Zoom up of image 4

Image 6:
Same character without AA

These images are for illustration purposes only. The exact antialiasing effect can be seen on a PC monitor.

The current way of achieving this effect is to render the glyph at a higher resolution than the one at which it is going to be displayed. It is then filtered down to the appropriate resolution while keeping the sub-pixel coverage of each pixel—representing the antialiasing information of the glyph—when blending it into the background.

Glyph Antialiasing technology

Text antialiasing on the Microsoft® Windows® desktop

- Microsoft Windows 2000 and Windows XP offer antialiased gamma-corrected text in software. Antialiasing text using software acceleration results in a significant performance drop, which can be as high as 30 percent[2].

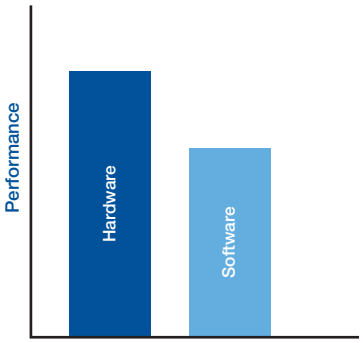


Image 8: The graphics processor has the option of accelerating the rendering of antialiased text in order to improve overall performance.

Gamma correction

- In order to provide accurate antialiased text, the graphics processor needs to account for gamma correction. The concept of gamma comes from the fact that the intensity produced by a cathode ray tube (CRT) monitor is proportional to the input voltage raised to the power **gamma**.

Image 9 illustrates that the response of the display is not linear. An input signal that is double the voltage of another will not produce an output value that has double the intensity. In order to compensate for this non-linearity, the inverse effect needs to be applied in order to help achieve a predictable color output from PC monitors (Image 10). In Windows 2000 and Windows XP this inverse effect is applied directly to the content of the frame buffer where the images are stored in a non-linear format, with a gamma value of 2.2.

Image 9

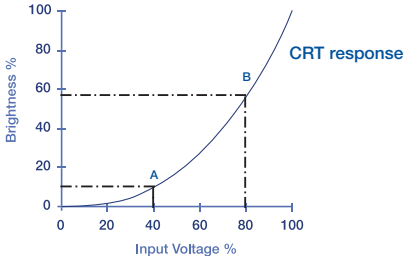


Image 10

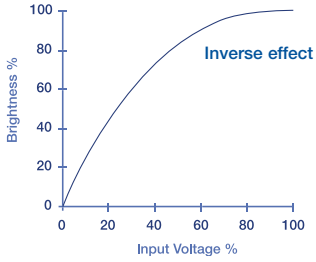
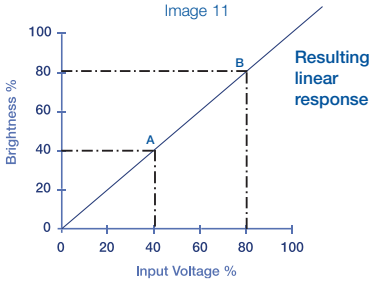


Image 11



Gamma chart - Intensity response of a CRT display

2: As per the WinBench Business 99 Version 2.0 benchmark.

Glyph Antialiasing technology

Gamma correction for antialiased text

- All of the calculations performed in graphics accelerators are done assuming a linear data representation, where the intensity of the pixel is directly proportional to its value. In order to obtain accurate results, a GPU receiving color information in gamma space needs to transform it into linear space prior to processing it. Otherwise, the color output by the GPU will be incorrect.

Image 12

de-gamma re-gamma

During the text antialiasing process, the glyph is blended with the desktop background in order to keep the sub-pixel coverage. Since the desktop is stored with a gamma value, the background needs to be converted to linear space (the "de-gamma step") prior to the blending. Once the blending operation is complete, the linear output value has to be converted to the gamma space that is expected by the desktop frame buffer (the "re-gamma step"). This will allow the result to match with the rest of the color information in the desktop.

Glyph Antialiasing technology

The following images show the difference made by accurate gamma correction on antialiased text rendering. Image 16 shows the artifacts of blending without doing gamma correction. The expected result of the blending operation is to have various intensity levels of the foreground color on top of the background, as per image 15. The blended antialiased pixels in image 16 are inaccurate as they are of a different color and include a component of black. This explains the shadow effect around the text in image 14.

Image 13: Antialiased text with a gamma correction of 2.2

Image 14: Antialiased text with no gamma correction

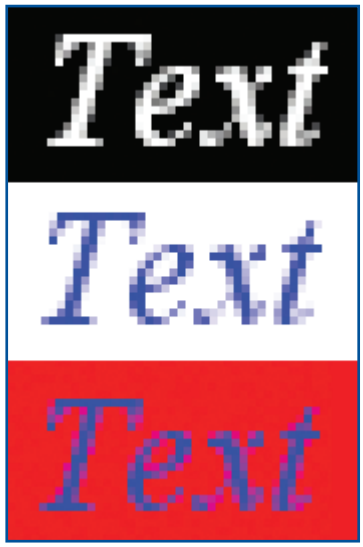


Image 15: Zoom up of image 9

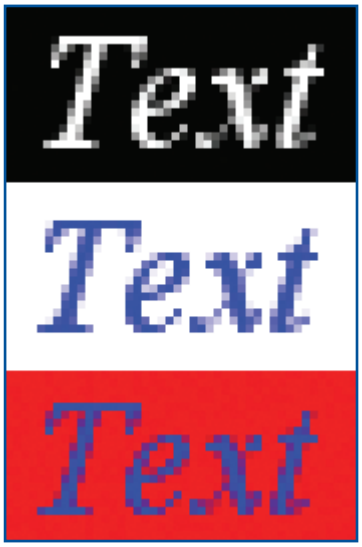


Image 16: Zoom up of image 10

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Glyph Antialiasing technology

Text antialiasing with Matrox Parhelia™-512

- Most current graphics accelerators do not accelerate antialiased text rendering. Windows, therefore, reverts to software acceleration, which has a significant impact on 2D performance—in the order of a 30 per cent penalty. The existing graphics accelerators that report hardware acceleration do not implement gamma correction for antialiased text rendering and, therefore, produce inaccurate text rendering.

Image 17: No gamma

Image 18: Gamma 1.7

Image 19: Gamma 2.2

Image 20: Gamma 2.8

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The software implementation of antialiased text rendering is set to a fixed gamma level. As different monitors have different gamma values, and since the visual acuity and color perception of each user can vary, it is preferable to let each user adjust the gamma value for text rendering.

Matrox Parhelia™-512 offers complete hardware acceleration of antialiased text with programmable gamma correction. Users will benefit from the added performance of hardware acceleration, along with the flexibility to adjust the gamma levels independently for text antialiasing according to their preferences.

With its massive 512-bit GPU and blazing 2D performance, Parheila-512 handles text antialiasing without a performance penalty. This is yet another example of how Parhelia-512 delivers the highest-fidelity graphics — with no compromises.