



Technical Brief

NVIDIA Quadro FX
Rotated Grid Full-Scene
Antialiasing (RG FSAA)



Overview

Many full-scene antialiasing (FSAA) techniques help diminish the appearance of stairstep artifacts, known as “jaggies.” Seen on lines and edges, jaggies arise from pixelized images. Unfortunately all FSAA techniques suffer from the same dilemma—in order to obtain high visual quality, performance must be sacrificed. Or, to obtain peak performance, visual quality must be sacrificed. Until now, no solution delivered the ultimate visual quality *and* high performance.

Most real-time FSAA techniques use multisampling, which embeds the antialiasing intelligence into the core GPU hardware. This makes the GPU more complex; however, the benefit is that antialiased visuals can be generated in real time.

In multisampling, the GPU uses multiple color samples to calculate the final pixel color. Think of these extra samples as extra virtual pixels. Because these functions are encoded into the GPU, there are limits to the complexity of the sampling algorithm. The NVIDIA Quadro® family of GPUs, however, can compute these “virtual pixels,” or additional samples, at full speed, with no reduction in engine performance.

Rotated Grid Full-Scene Antialiasing

The NVIDIA Quadro FX 4000 introduces a rotated-grid full-scene antialiasing (RG FSAA) sampling algorithm. Although based on the same number of subsamples, this new scheme brings greater complexity to the sampling pattern. This approach significantly increases color accuracy, while maintaining industry-leading performance.

In the FSAA approach, four subpixels are sampled in a symmetric two-by-two grid pattern for each pixel, and aligned horizontally and vertically. By rotating the pattern of the four subpixels, the new RG FSAA scheme provides effective sampling from a four-by-four diamond-shaped grid that is unaligned horizontally and vertically. The result is higher visual quality because of more subpixel color gradations in the horizontal and vertical dimensions.

In Figure 1, notice how the NV3XGL provides coverage for two vertical and horizontal values, but the NV4XGL coverage spans four values for the horizontal and vertical subpixel positions. The increased coverage produces higher color accuracy at the edges of polygons and lines.

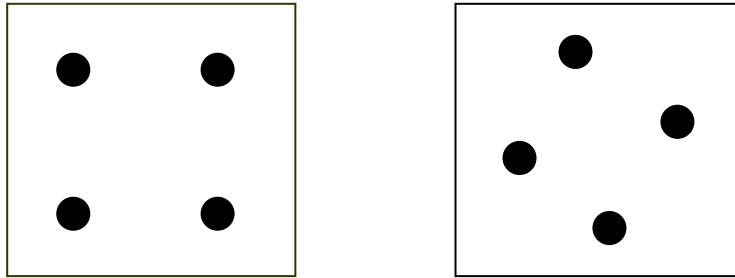


Figure 1. Pixel sampling patterns from NV3XGL (left) and NV4XGL (right) architectures, showing horizontal and vertical values.

Increased Quality

Because of the extra color value coverage, the RG FSAA algorithm for the NV4XGL significantly improves visual quality for edges and lines, compared with the regular multisample FSAA grid for the NV3XGL. The benefit to professional workstation applications is demonstrated in Figure 2, where a pair of screen captures show the benefits in visual quality when rotated-grid multisampling is used.

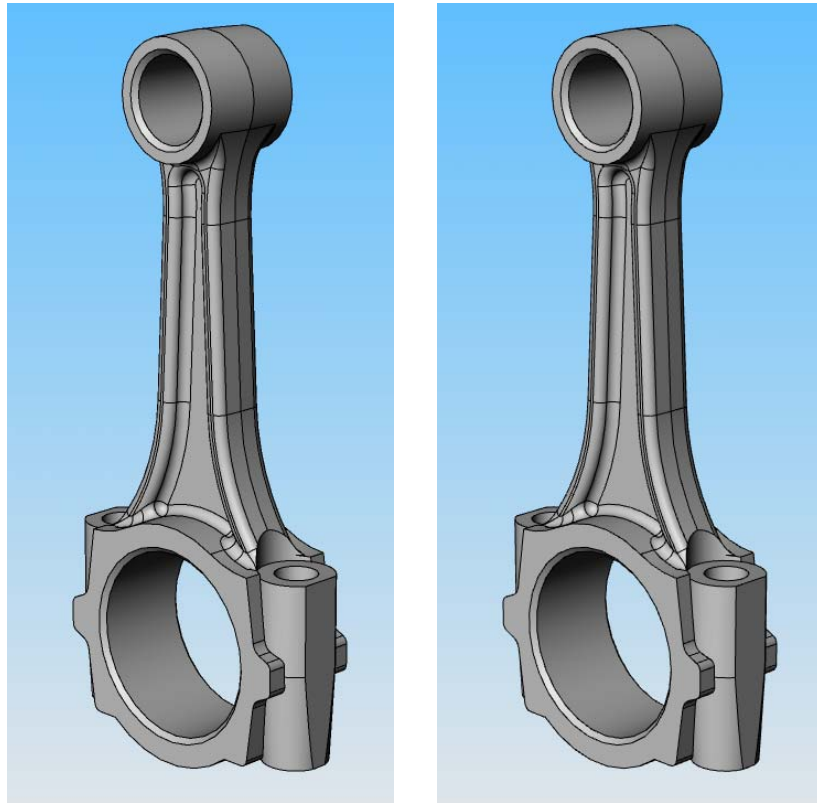


Figure 2. This CAD image on the left uses a regular sample grid; the image on the right uses a rotated multi-sample grid.

The RG FSAA algorithm for the NV4X is particularly beneficial for automotive and aerospace stylists and designers because many of their products have close horizontal and vertical lines. During digital product evaluation, “jaggies” are a major distraction and psychologically inhibit accurate evaluation of alternatives, particularly when a digital prototype is virtually placed in a photorealistic environment.

The major benefit of RG FSAA for visual quality is clearly demonstrated in Figure 3. The magnified screen captures taken from an automotive styling application show the superior visual quality of rotated-grid multisampling. Figure 4 and Figure 5 show unmagnified screenshots of the same example.



Figure 3. The image on the left uses a regular multisample pattern; the image on the right uses a rotated multisample pattern.



Figure 4. Unmagnified screen capture from an automotive styling application, showing multisampling using regular grid.



Figure 5. Unmagnified screen capture from an automotive styling application, showing the superior visual quality of multisampling using a rotated grid.

Conclusion

The rotated-grid full-screen antialiasing (RG FSAA) algorithm sampling offered in the NVIDIA Quadro FX 4000 introduces a new era of graphics image quality at unprecedented performance levels. This algorithm solves what has traditionally been a compromise between performance and quality.

The improved visual quality for professional workstation users is strikingly obvious, and takes computer graphics a major step closer to reality.



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