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Description of the anti-aliasing methods

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Anti-Aliasing is a combination of technical and algorithmic tools used to remove the stair step effect appearing on the boundaries of two-dimensional or three-dimensional images when reproducing them on a display device.

In Super-Sample Anti-Aliasing method, SSAA, the image to be displayed is calculated with higher resolution than the resolution of the display device. To display the image it must be reduced by averaging. This is the simplest and the most CPU intensive anti-aliasing technology. Sampling may have different physical locations in pixels. By the way of sample placement, sampling methods are divided into OGSS - Ordered Grid Super-Sampling and Rotated Grid Super-Sampling [1]. The name Ordered Grid specifies the position of calculations relative to a single pixel, where selected excess points are located in the form of an ordered lattice.

In Rotated Grid Super-Sampling method excess samples are placed on the turned around grid. This method gives good results especially for lines close to horizontal or vertical. Another method of excess sampling is Sparse Grid Super-Sampling. In Sparse Grid Super-Sampling additional points are also located on the orderly grid, but the sample takes place only on certain nodes of the grid [1]. This method is a compromise between speed and image quality.

The main advantage of Super-Sampling method is that it has simple hardware implementation and does not depend on character and the specific objects in the scene displayed.

The main disadvantages of these methods lie in the large computational complexity, which significantly affect the performance of imaging, and in the use of large arrays of memory. Therefore, the actual problem is to reduce the number of samples by image analysis only on the edges of the graphics.

Multisampling Method, MSAA, was created as an alternative

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to supersampling [2]. The basic principle was to find a compromise between quality and loading, to minimize the computational load, and at the same time, to smooth the effect of "steps". MSAA follows this principle with two basic techniques. The first technique is called edge anti-aliasing, where the smoothing effect is applied only to the edges of objects. A graphic output device displays the biggest possible scene space with no anti-aliasing, but then performs additional processing of the samples of pixels located at the edges of the object that would benefit most from anti-aliasing. Before any smoothing is done, Z-test is performed: the difference in depth within a single pixel indicates that it contains the edge of the object, and therefore requires imposition of MSAA.

The second technology MSAA lies in reducing the load on the sample. Some calculations are performed only once per pixel, such as pixel shaders, textures and request sampling color [2]. Only the meanings of depth and templates are calculated with the total number of samples.

Smoothing MSAA was accepted de facto as a standard after its release. It provides an excellent balance of image quality and speed compared to super-sampling. However, the smoothing MSAA can still be very hard for middle and lower graphics levels. In addition, the regional smoothing technique, such as MSAA, does not improve the texture quality as effectively as super-sampling method [2]. This means that the textures (especially objects with transparent textures) will continue to have edges of the "ladder" that this method does not remove.

Subpixel Reconstruction Anti-Aliasing Method, SRAA, is a mechanism of per pixel interpolation that is applied to the final image [3]. Anti-aliasing is applied to an image that has been elaborated by the shader by applying super-sweep and depth buffers for normals. It is actually a post-processing image filter. Comparing with the super-sampling methods, where smoothing is performed at the stage of shaders, in SRAA minimal loss of productivity can be observed, because SRAA is applied to the entire image as a whole and is characterized by high processing speed [3].

The developers of the method present their studies, which show SRAA's significant advantage over methods of super-sampling. For example, to smooth the image with a resolution of 1280×720 redundant sampling methods spend 5-10 minutes. SRAA performs smoothing in 1.8 minutes and the quality of the

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resulting image is similar to the results of the traditional anti-aliasing modes 4-16x. Also, the method has a fixed SRAA Runtime filtering, which also simplifies its use [3].

Temporal Anti-Aliasing Method, TXAA, is a method of smoothing the cinematic image quality. It is designed to reduce the time aliasing (drift and shimmer with movement) [4]. For filtration of pixels on the screen TXAA uses sample samples both inside and outside of the pixel, combined with samples from previous frames, to ensure the highest quality of filtration. TXAA has improved spatial filtering compared to MSAA, such as when the image displays leaf edges or objects in motion [4].

References:

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