

Computer Graphics

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Chapter 2

Two Dimensional Graphics

In computer graphics, the process by which smooth curves and other lines become jagged because the resolution of the graphics device or file is not high enough to represent a smooth curve is called **Aliasing**.

Aliasing can also be seen in the outlines of characters drawn on the screen and in diagonal or curved boundaries between any two regions of different color.



Aliased 'W'

Aliased



When you try to represent the image using pixels, many real-number coordinates will map to the same integer pixel coordinates; they can all be considered as different names or “**aliases**” for the same pixel.)

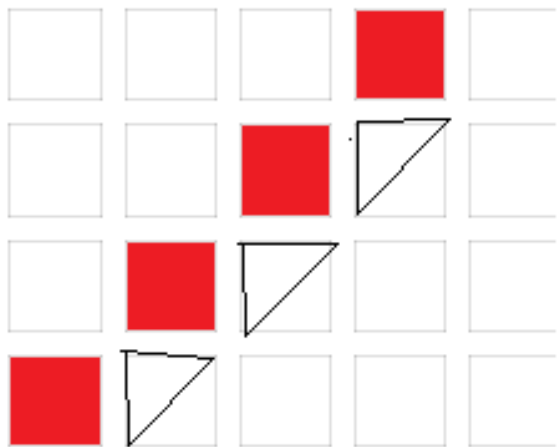
Antialiasing is a term for techniques that are designed to **mitigate the effects of aliasing**. The idea is that when a pixel is only partially covered by a shape, the color of the pixel should be a mixture of the color of the shape and the color of the background.



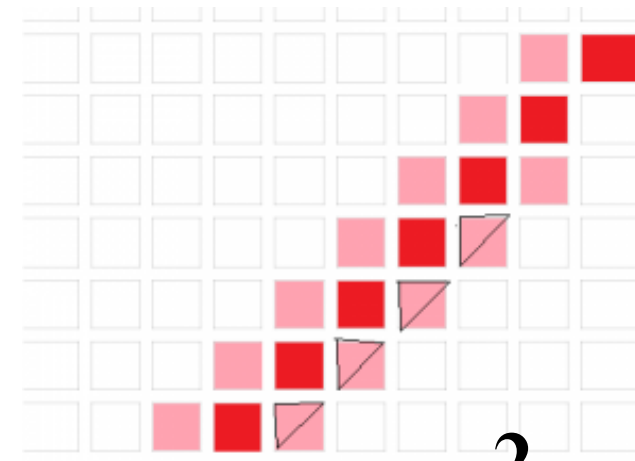
Antialiased 'W'

Anti-Aliased

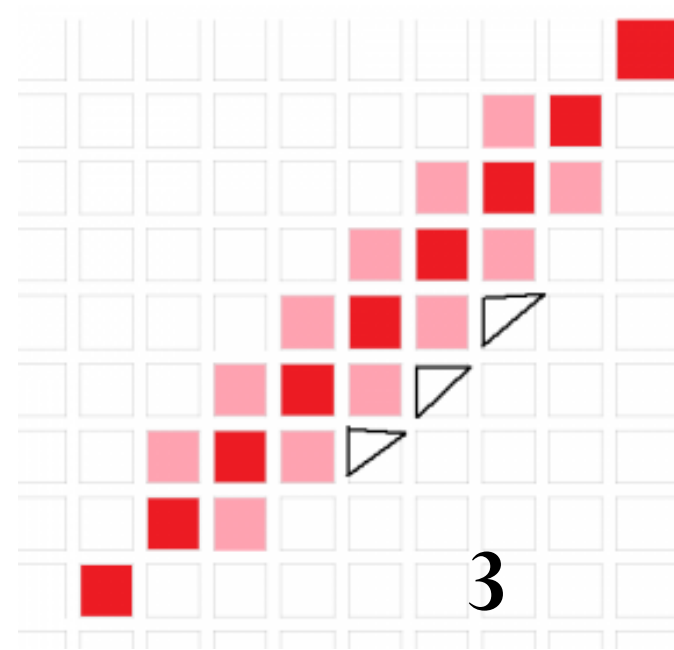




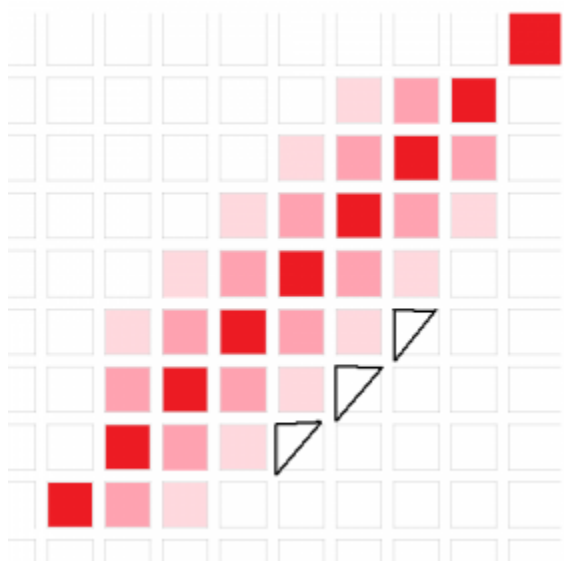
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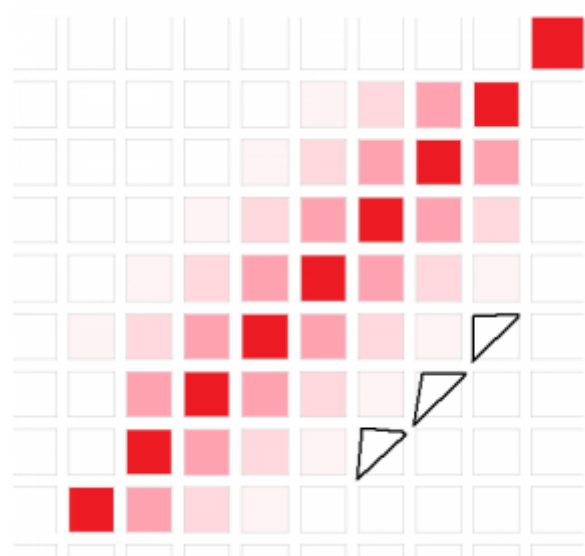
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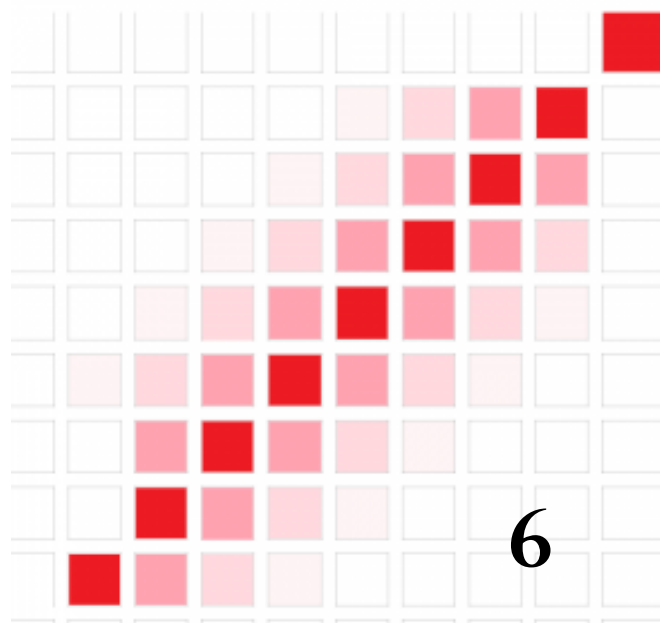
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4



5



6

Most anti-aliasing methods can be categorized into two types:

1. Spatial anti-aliasing
2. Post-process anti-aliasing

The goal of each is to create sharper images by removing jaggier, but they work in different ways.

Spatial anti-aliasing

- You have an image at a lower resolution that's full of jaggies.
- The image is rendered at a higher resolution
- At the high resolution, color samples are taken of the excess pixels (new pixels that weren't present in the low-resolution image)
- The high-resolution image is shrunk down to the original resolution, and each pixel receives a new color that's averaged from the sampled pixels.

Types of spatial anti-aliasing

- Super sampling anti-aliasing (SSAA)
- Multi sample anti-aliasing (MSAA)

Super sampling anti-aliasing (**SSAA**) is one of the most effective spatial methods. It's also known as "full-scene anti-aliasing" (**FSAA**).

SSAA is great for processing images that are photorealistic because it gives realistic images a softer look that makes them appear more lifelike. But there's a couple of downsides.

First, images that feature lots of horizontal or vertical lines may be negatively affected. These lines are sharp by nature, but they'll appear soft when SSAA is used.

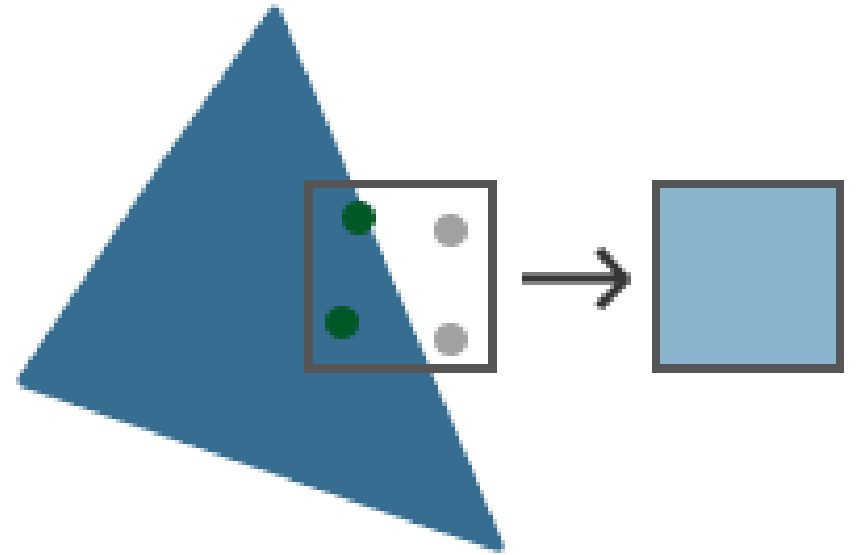
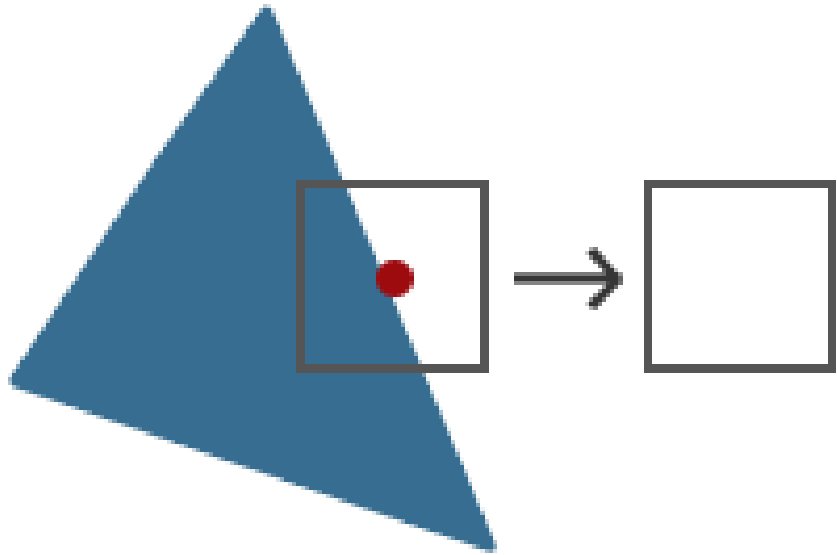
Second, SSAA requires that the entire image must be processed before the jaggies can be smoothed (hence the term, “full-scene”). Since PC games must be rendered in real-time, **SSAA requires a huge amount of computing power to operate at speeds sufficient for gaming.** For that reason, SSAA isn’t commonly used in gaming anymore.

Multi sample anti-aliasing (**MSAA**) When a GPU is rendering an image on your display, it makes a distinction between two different objects: a polygon and a texture.

- First, the GPU draws the polygon: the general shape or outline of an in-game object.

- Then, the GPU fills in the polygon with a texture

In multi sample anti-aliasing (MSAA), **only the edges of the polygons are smoothed out - MSAA does not smooth out the textures.** This cuts down on processing power a little bit (but not a lot). MSAA is a popular anti-aliasing method among PC gamers.



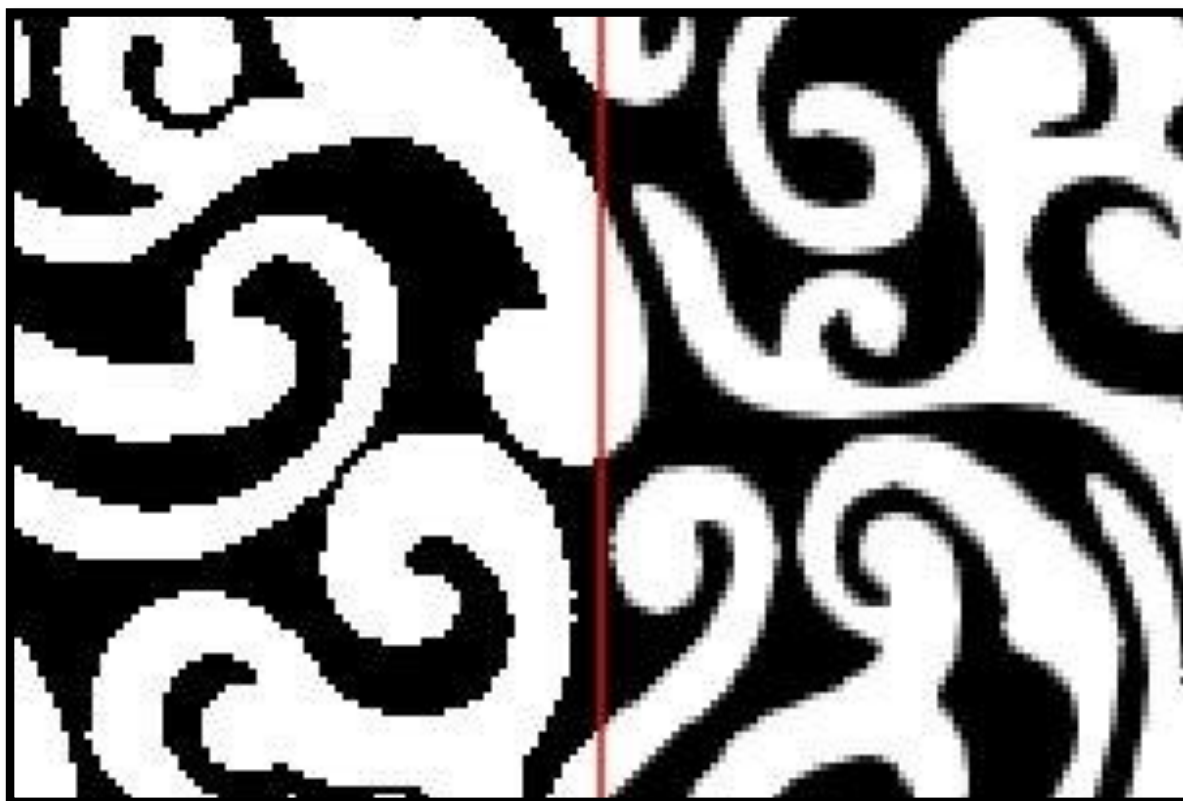
Types of post process anti-aliasing

- Morphological anti-aliasing (MLAA)
- Fast approximation anti-aliasing (FXAA)

Morphological antialiasing (MLAA) is a technique for minimizing the distortion artifacts known as aliasing when representing a high-resolution image at a lower resolution.

Contrary to multisampling anti-aliasing (MSAA), which does not work for deferred rendering.

MLAA is a post-process filtering which detects borders in the resulting image and then finds specific patterns in these. Anti-aliasing is achieved by blending pixels in these borders, according to the pattern they belong to and their position within the pattern.

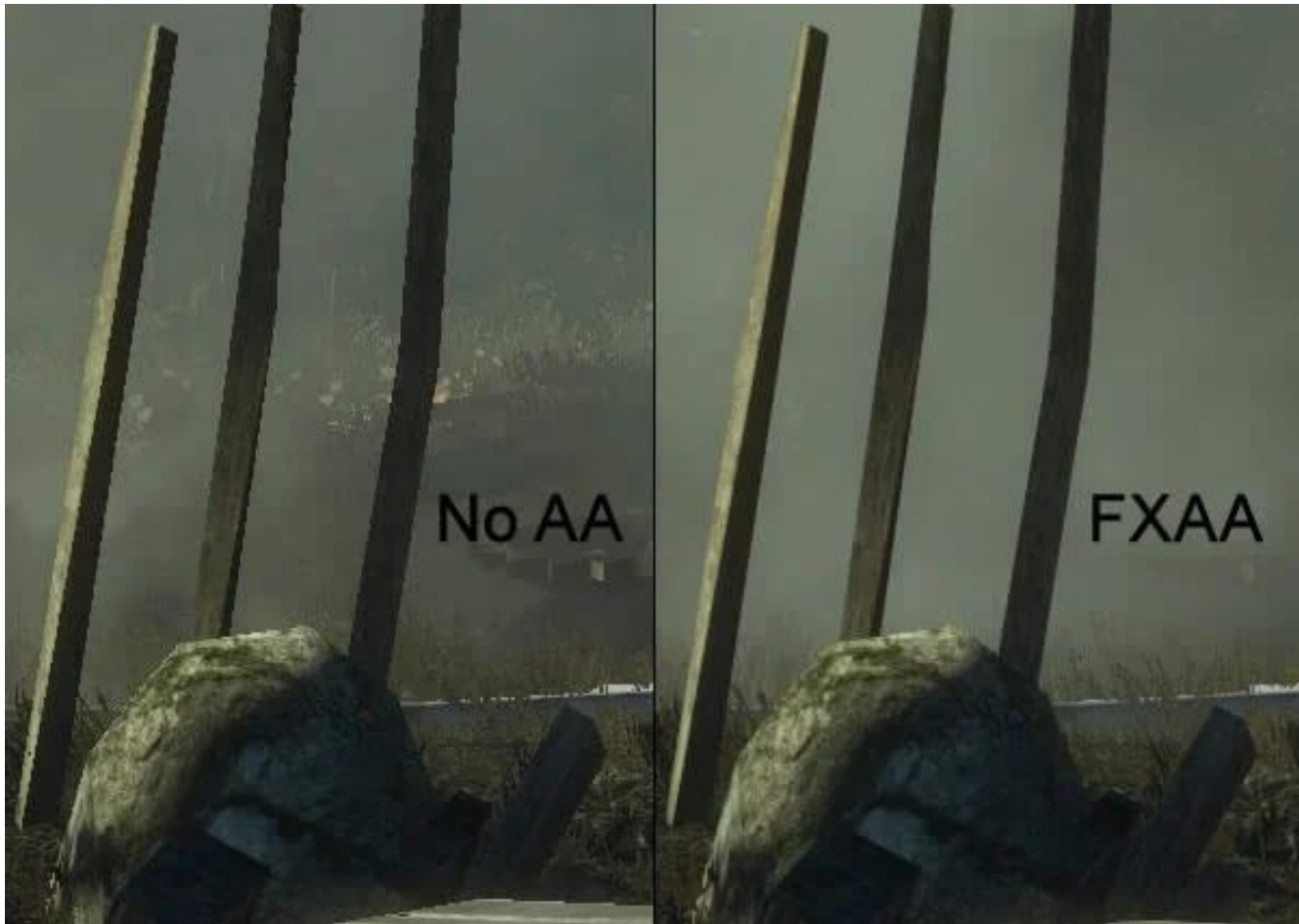


No
MLAA

MLAA

Fast approximation anti-aliasing is that it does not require large amounts of computing power. It achieves this by **smoothing undesirable jagged edges** ("jaggies") as pixels, according to how they appear on-screen, rather than analyzing the 3D model itself, as in conventional spatial anti-aliasing.

Since it is not based on the actual geometry, it will smooth not only edges between triangles, but also edges inside alpha-blended textures, or those resulting from pixel shade effects, which are immune to the effects of multisampling anti-aliasing.



There are a lot of anti-aliasing methods out there, so you're probably wondering which one you should use. **It varies from person to person** based on several factors, but really comes down to personal preference. And, also, how powerful of a GPU your budget can handle.

These questions will help you get the most mileage from your technique of choice:

- How graphically demanding are your games?
- What kind of gaming hardware do you have?
- What graphics features do you prefer to be sharp and which ones are you okay with being blurry or pixelated?



2x

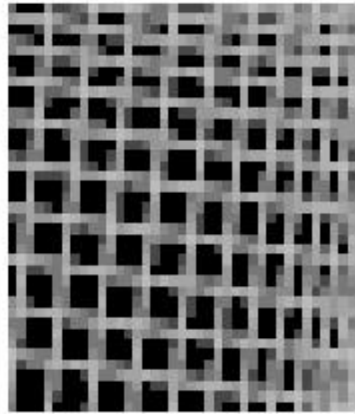
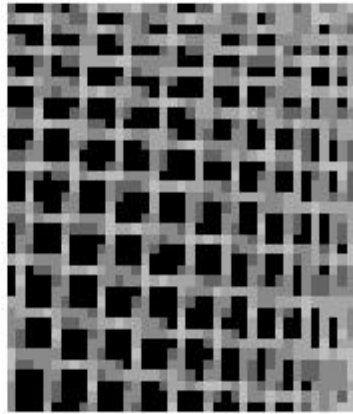
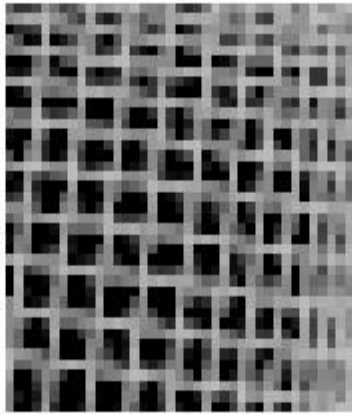
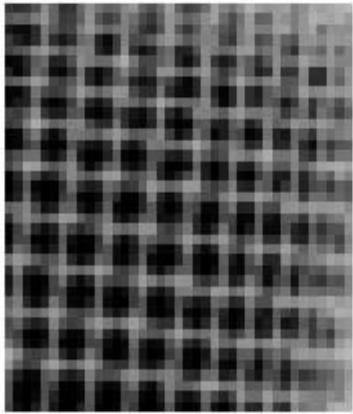
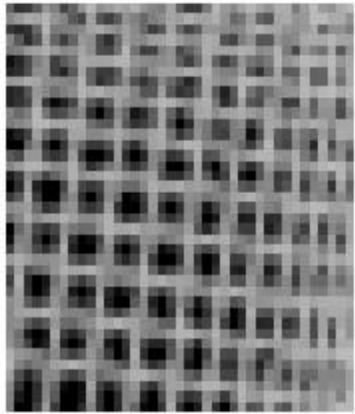
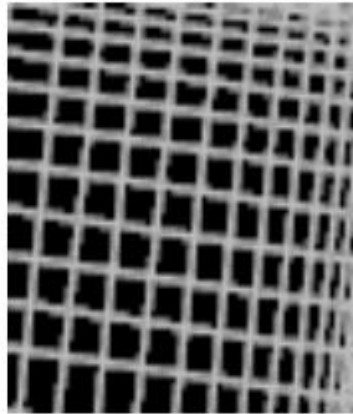
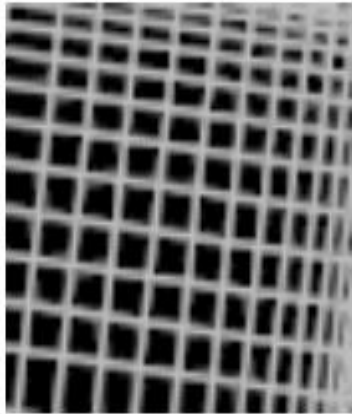
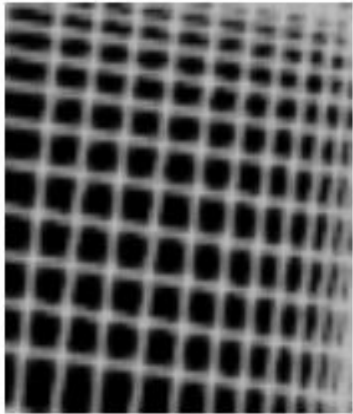
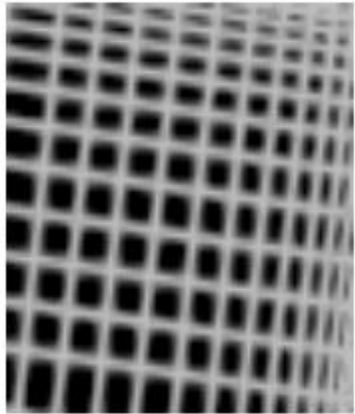


4x



8x





MLAA

FXAA

SMAA 4x

MSAA 4x

MSAA 8x