



COMP220: Graphics & Simulation
8: Post-Processing



Learning outcomes

By the end of this week, you should be able to:

- ▶ **Explain** what the framebuffer is and how it can be used to generate 2D effects.
- ▶ **Implement** post-processing effects in your application.

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 - ▶ **Introduce** the framebuffer and its uses.
 - ▶ **Describe** a variety of 2D post-processing effects.
- ▶ Workshop (sync):
 - ▶ **Extend** the use of OpenGL textures to store rendered results.
 - ▶ **Apply** a selection of post-processing techniques to the rendered texture in a shader.

Post-processing



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- ▶ Typically mimic effects caused by camera (or eye) hardware, e.g. lens flare, bloom, motion blur
- ▶ Traditionally this could only be done as an offline process
- ▶ With the advent of faster GPUs and programmable shaders, we can implement some of the effects in real time

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- ▶ This texture will contain the current view of the scene
- ▶ We then use a shader to implement a post-processing effect
- ▶ We then map the processed texture onto a full screen quad, which is rendered to the backbuffer

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- ▶ A **framebuffer** is just a combination of different buffers.
- ▶ A default framebuffer is created for you; you can create additional ones to render to instead.

COMP120 Refresher



Image Processing Techniques

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- ▶ Some of the algorithms you learned in COMP120 can be applied in GLSL:
 - ▶ Colour Replacement
 - ▶ Luminance calculation
 - ▶ Colour Correction
 - ▶ Black & White and Sepia Tone
 - ▶ Edge Detection

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- ▶ Key difference: we access the data via **texture coordinates**, rather than array indices.

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- ▶ GLSL has lots of inbuilt functions (e.g distance) which can aid in creating post-processing effects

Other Post Processing Techniques



Colour Correction

- ▶ Process of taking an image, convert each colour in the image to a some other colour
- ▶ Mimic a specific film stock, provide coherent look or provide a mood



Original Shot



Day-for-Night Color Corrected shot

Colour Correction Again

- ▶ Depending on the technique this could involve manipulating the colours using a Filter Kernel
- ▶ Or we could use a colour palette (see Colour Grading)



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- ▶ To achieve blurring we apply a filter to the texture lookup of the texture render target
- ▶ We can apply many different filters, one of the simplest is a Box Filter
- ▶ With a box filter we sample 4 points around the point we are interested in and take an average

Motion Blur

- ▶ If an object moves very fast through your Field of view it can appear that the object leaves a slight ghost of itself
- ▶ There are several ways of implementing this, we can use the actual speed of the object to determine the amount of blur



Motion Blur

- Or we can simply take the results of the last render update and blend them with current render results and blend based on a lerp



Depth of Field

- ▶ DOF attempts to simulate the effect where objects that are too close or too far away appear out of focus
- ▶ We first have to consider in our scene what range of depth values will be considered in focus. We then need to blur everything that is outside this range



Depth of Field

- ▶ Once we have determined this we render a blurred scene to a render texture



Bloom

- ▶ This attempts to simulate the overloading of the optic nerve if extremely bright areas of a surface are visible
- ▶ First we render to a smaller render target, usually 1/4 size



Bloom

- ▶ We then apply a filter (usually Gauss) to this reduced render target, if we apply this filter in multiple passes then we achieve a smoother blur
- ▶ We then blend the blurred image onto the screen with the original scene



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- ▶ Essentially we keep rendering to a texturing using different fragment shaders each time
- ▶ These could be stored in a data structure such as a stack
- ▶ Once we have completed the last effect on the stack, we then switch to normal rendering and display the result

Next steps

- ▶ **Review** the additional asynchronous material for more background on the framebuffer and various post-processing (or image processing) effects.
- ▶ **Attend** the workshop to learn how to save a rendered scene to a texture in OpenGL and apply effects to it in a shader.