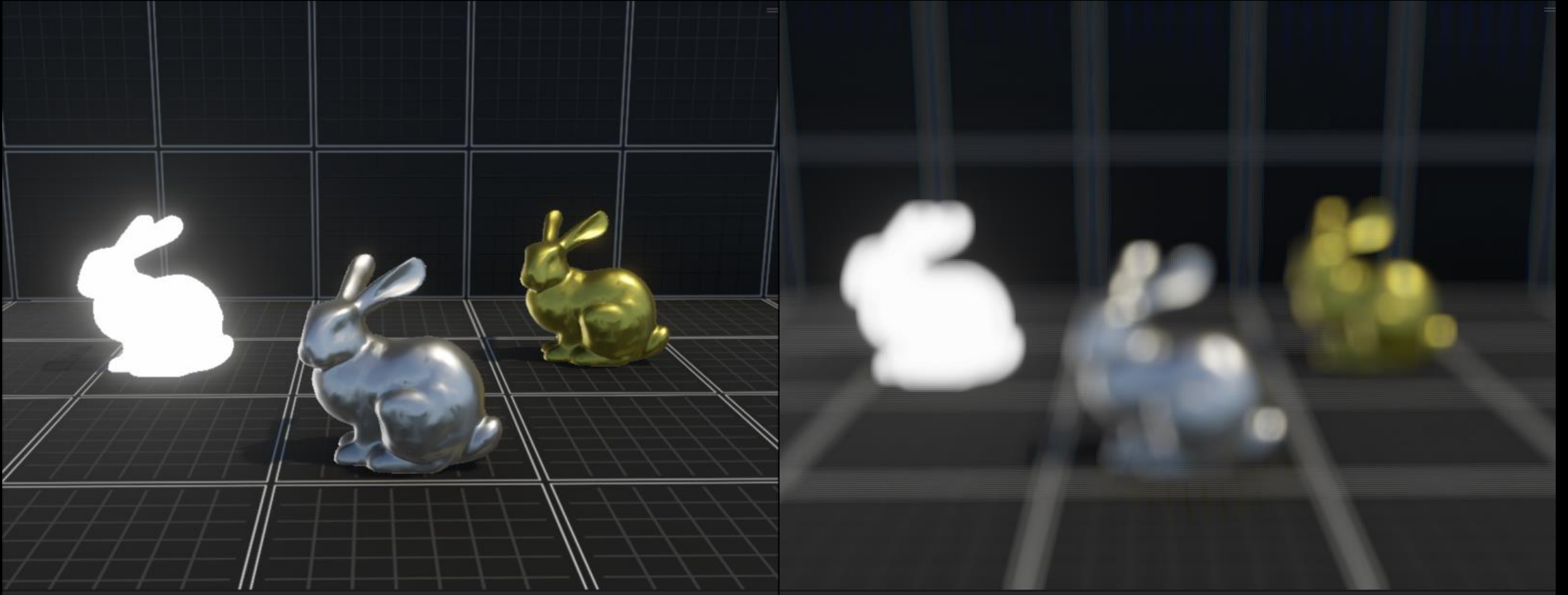
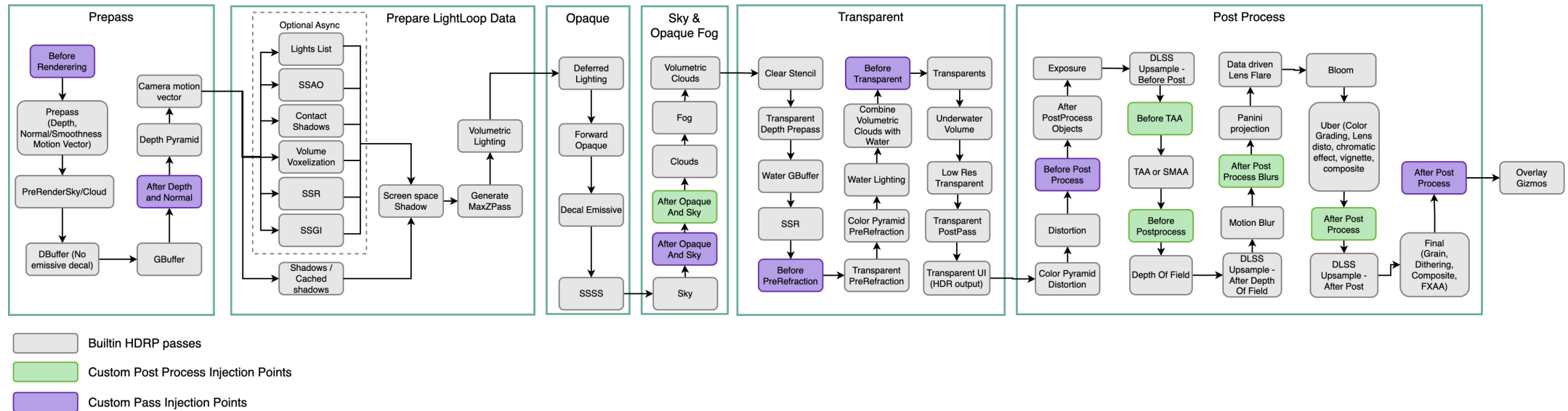


Circular Separable Convolution Lens Blur

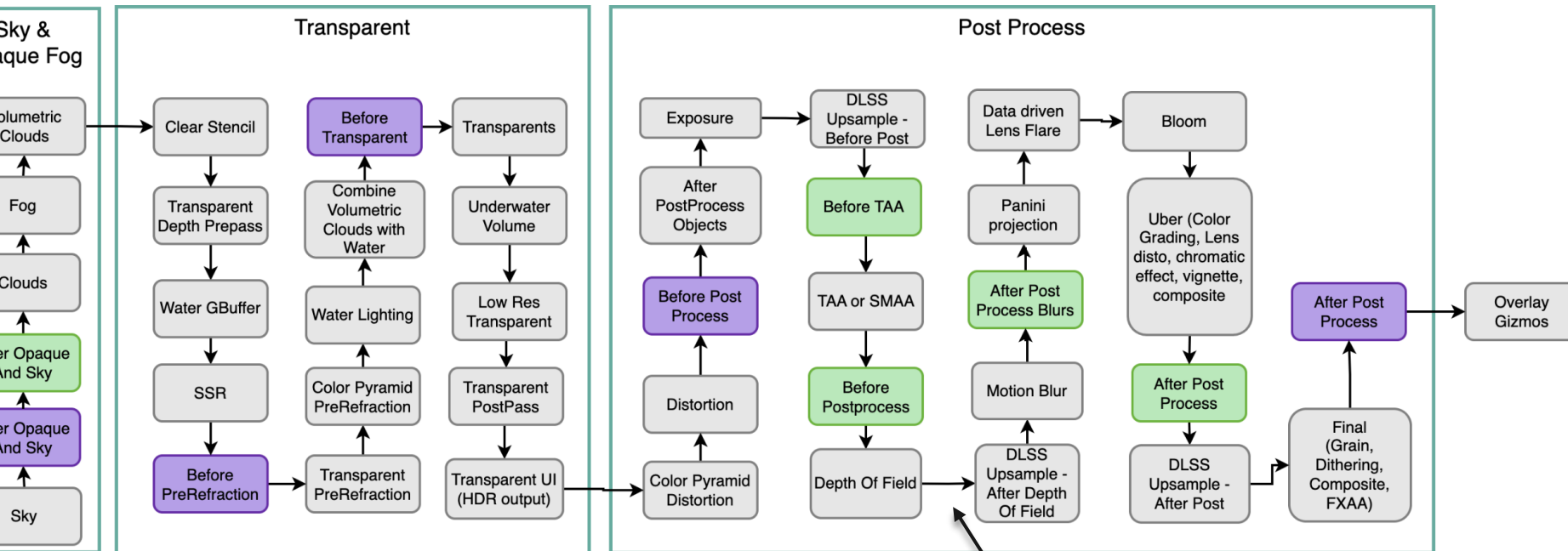
GPU COMPUTE SHADER IMPLEMENTATION IN UNITY USING HLSL AND C#



Unity's Universal Rendering Pipeline (URP)

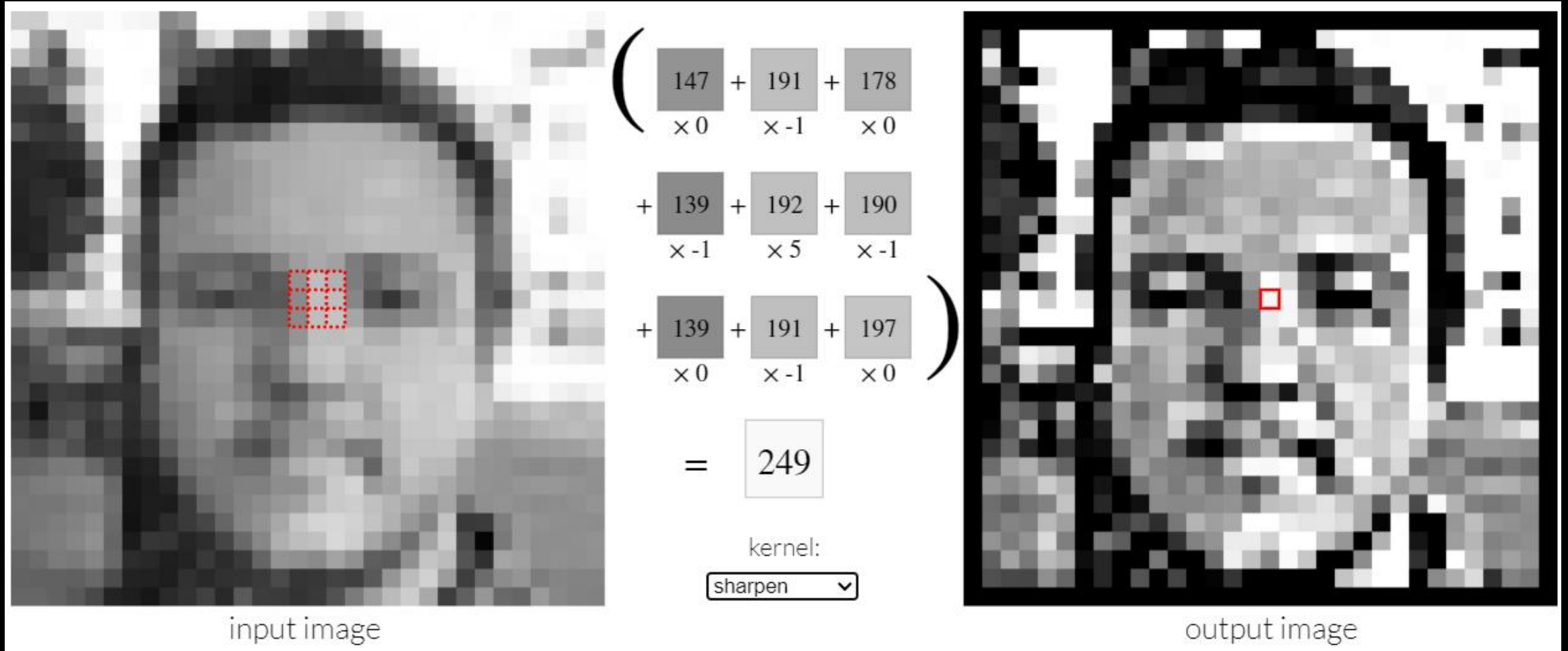


Unity's Universal Rendering Pipeline (URP)



Interrupted this part of the render pipeline.

Convolutional Image Processing



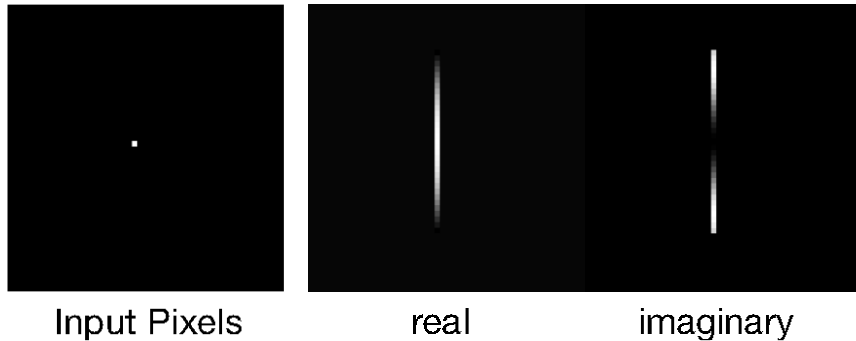
The diagram illustrates a 3x3 convolution operation. On the left, the "input image" shows a grayscale photo of a person's face with a 3x3 region highlighted by a red dashed box. In the center, the calculation for the output pixel is shown:

$$\begin{pmatrix} 147 \times 0 + 191 \times -1 + 178 \times 0 \\ + 139 \times -1 + 192 \times 5 + 190 \times -1 \\ + 139 \times 0 + 191 \times -1 + 197 \times 0 \end{pmatrix} = 249$$

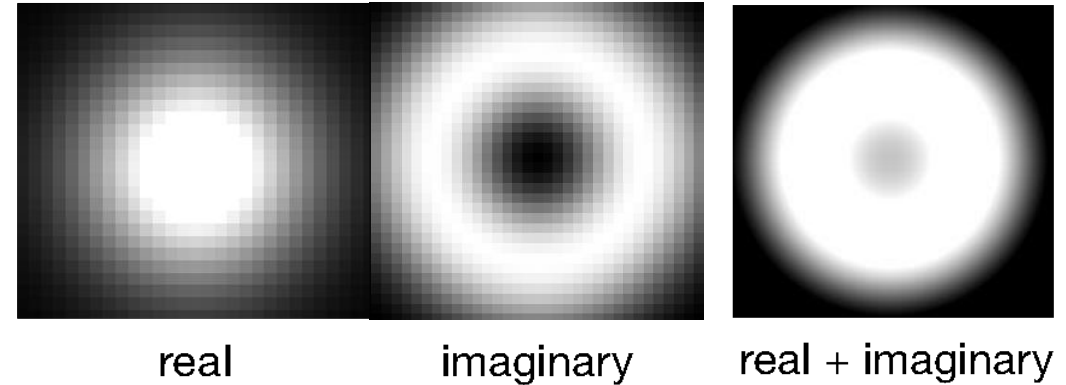
Below the calculation, the kernel is identified as "sharpen" with a dropdown arrow.

On the right, the "output image" shows the result of the convolution, where the processed region is highlighted by a red solid box. The output image has a thick black border.

Modelling the circle of confusion using real and imaginary components.

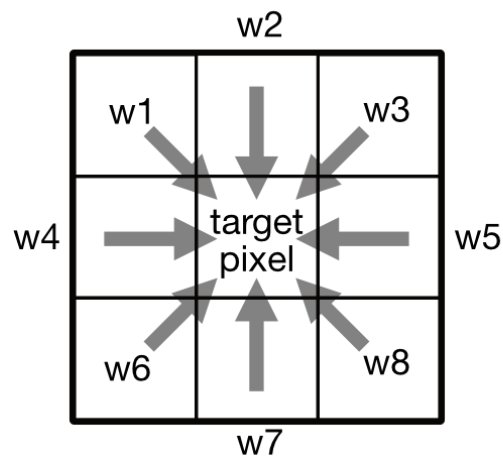


$$F(x) = e^{-ax^2}(\cos(bx^2) + i \sin(bx^2))$$

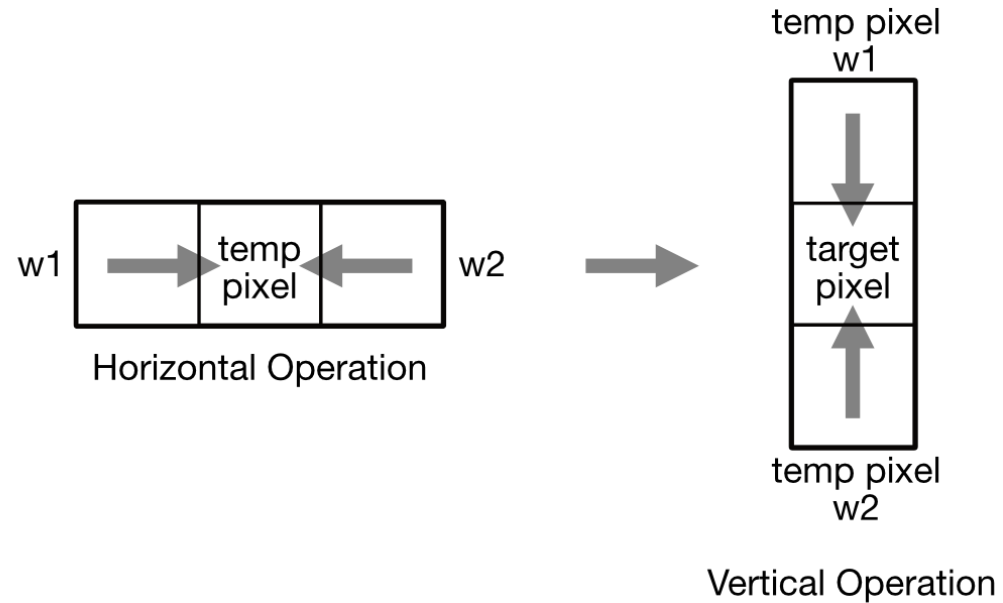


$$Color(x) = A * F_{real}(x) + B * F_{imaginary}(x)$$

Brute Force vs Separable Convolution



Brute Force Convolution $O(n^2)$



Separable Convolution $O(n)$

More Components = Better Precision = Bokeh Bokeh

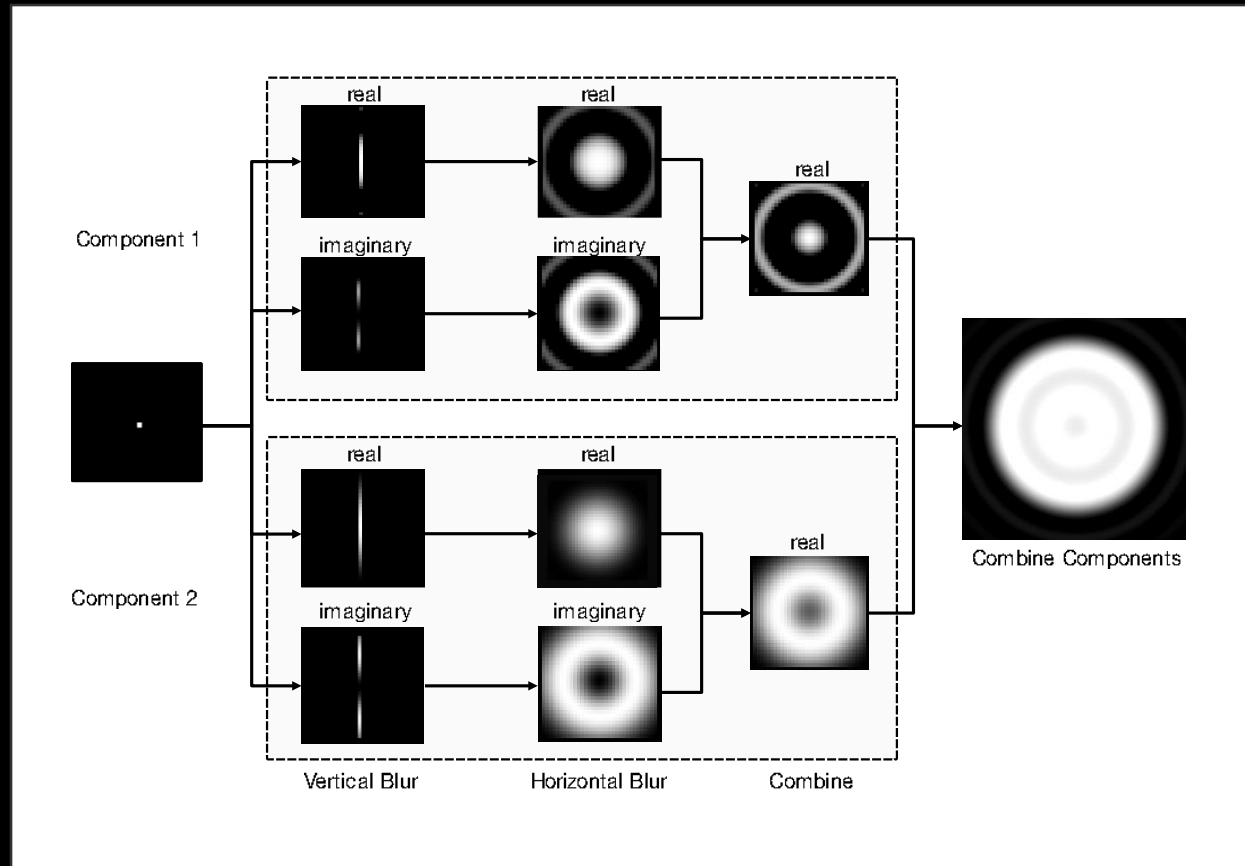
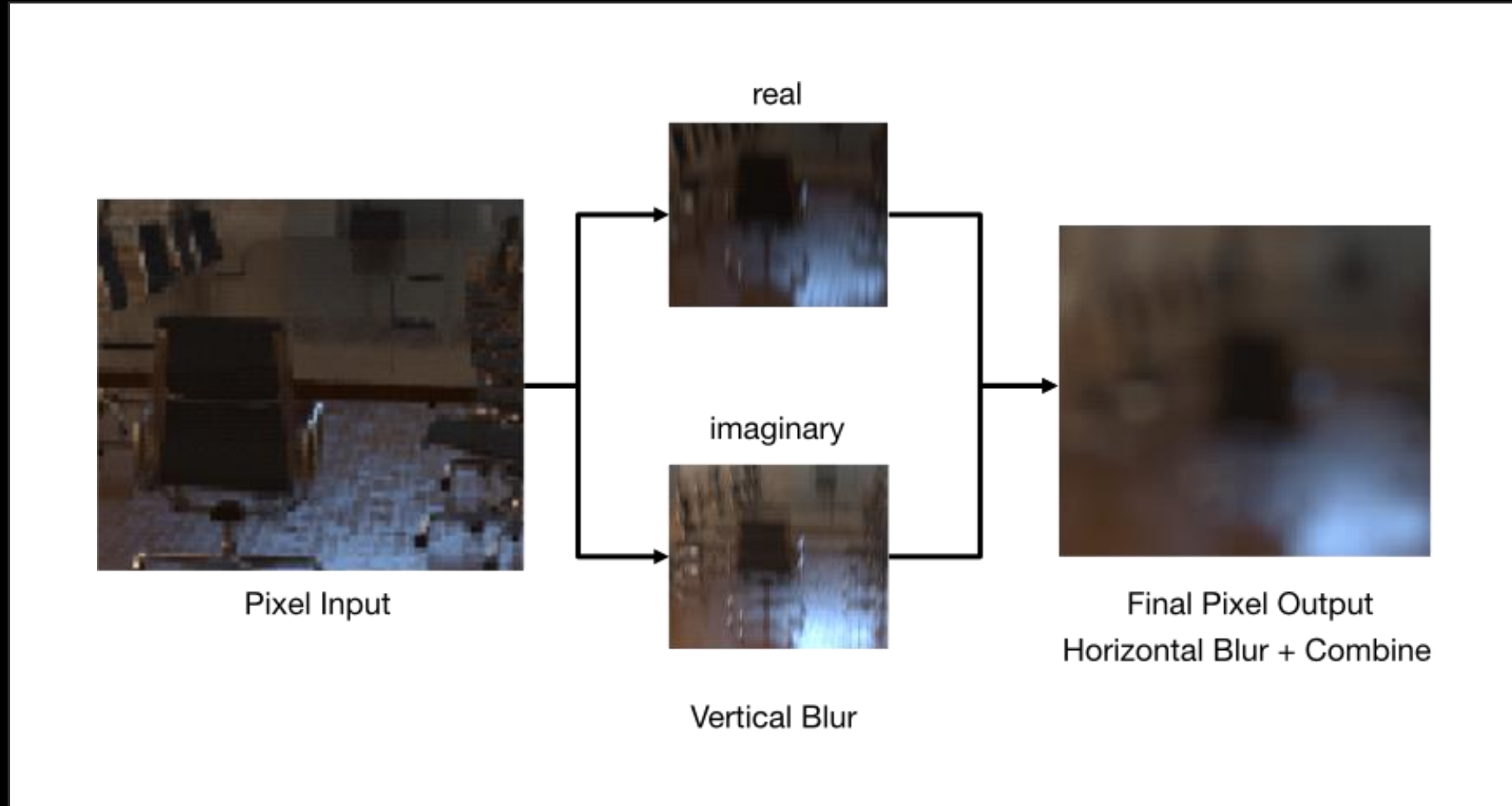
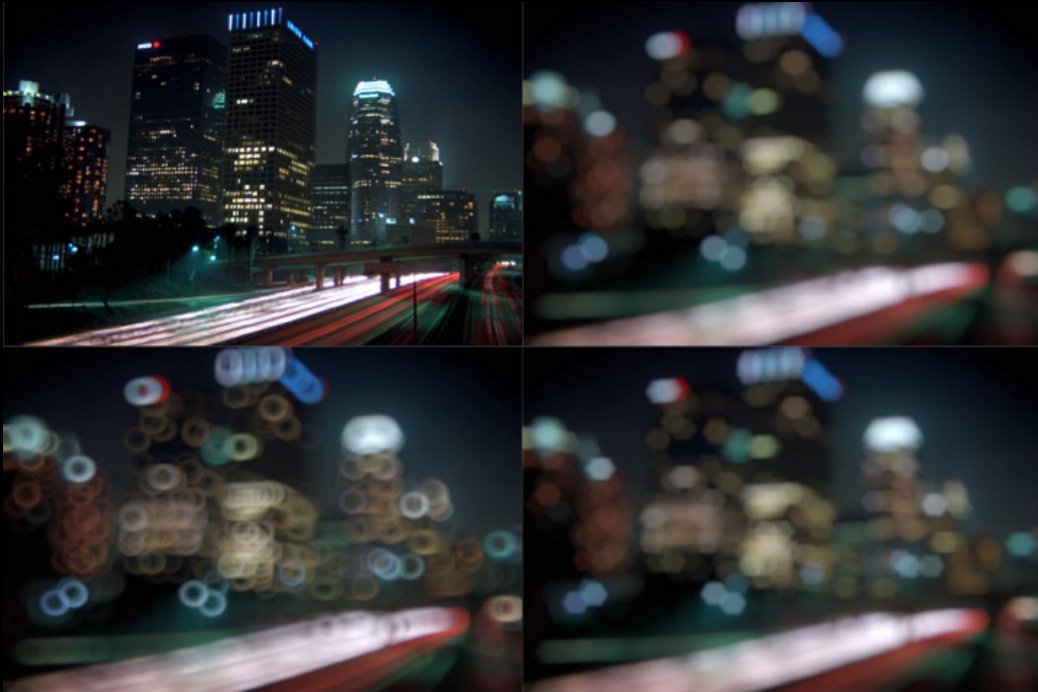


Image Convolution and Combine Example



Reference Of Lens Blur & Bokeh To Measure Success

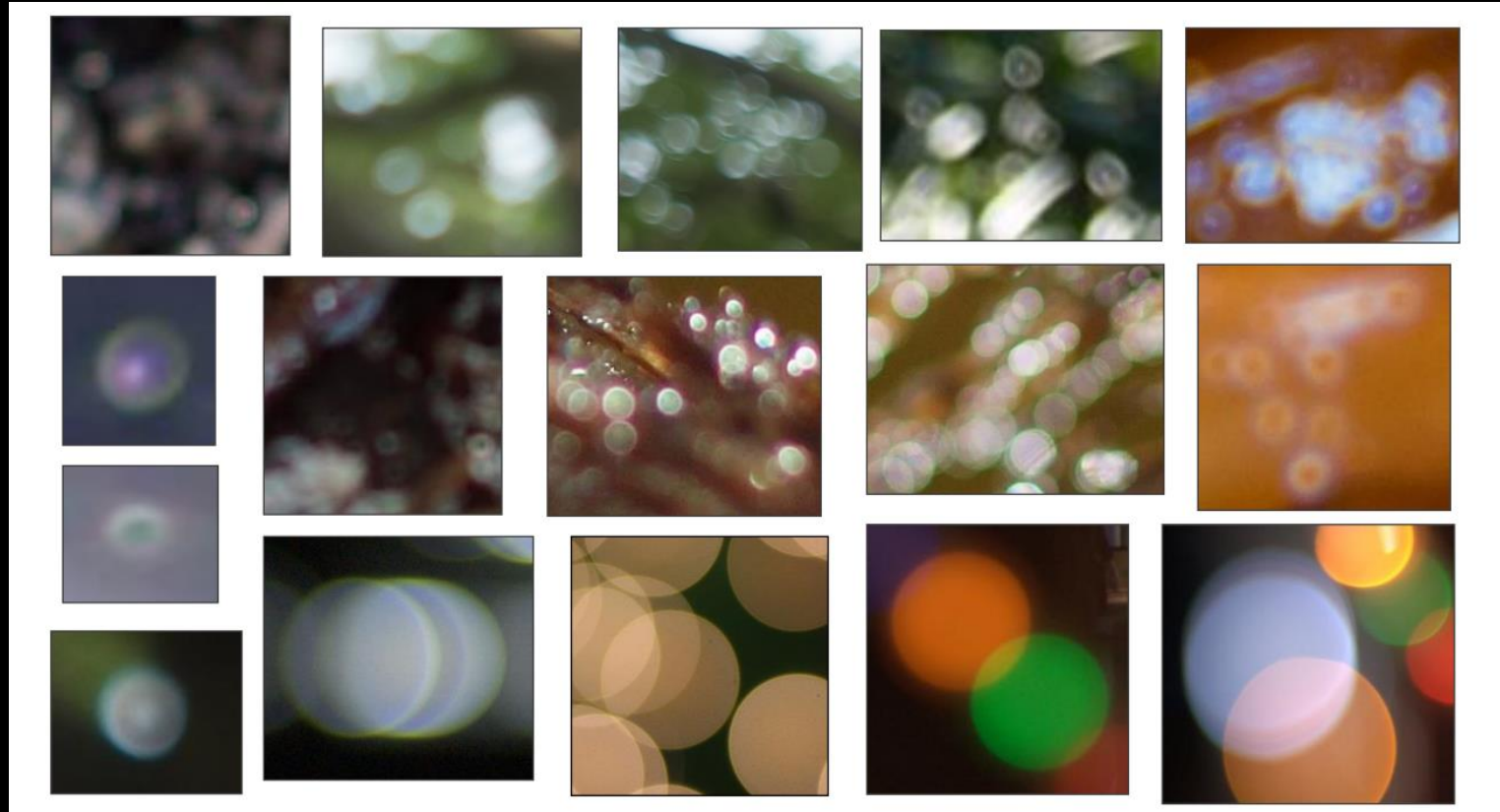


Boris Effects (BCC Lens Blur)



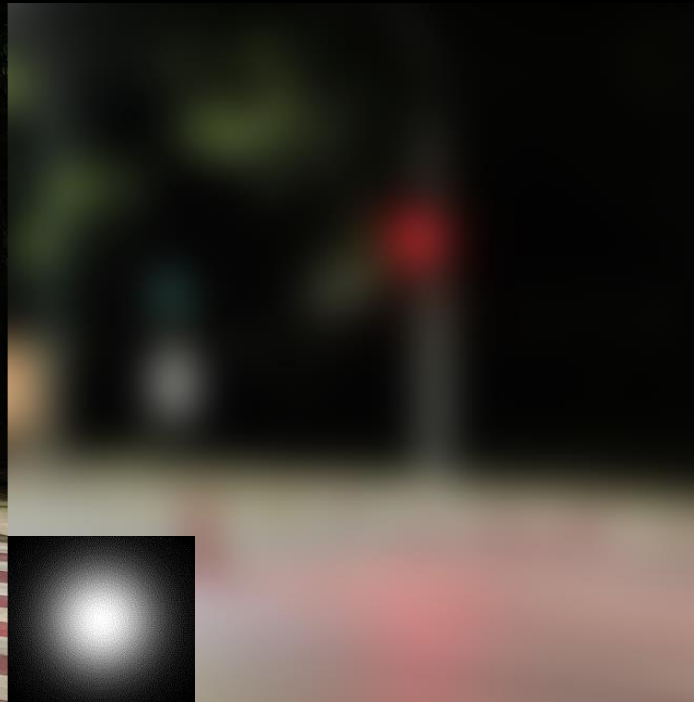
Unreal Engine 4

Reference Of Lens Blur & Bokeh To Measure Success

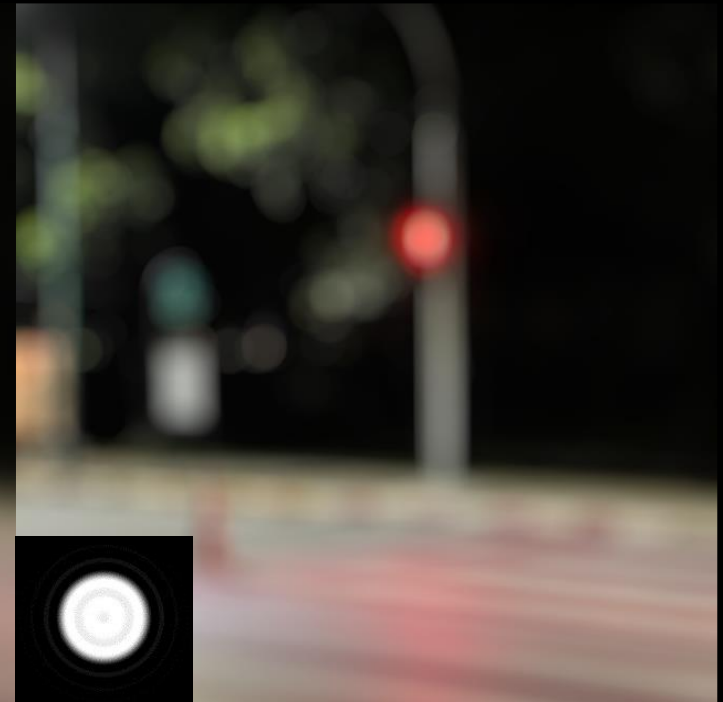


Real Life Photography (Silicon Studios)

Results Implementation MATLAB

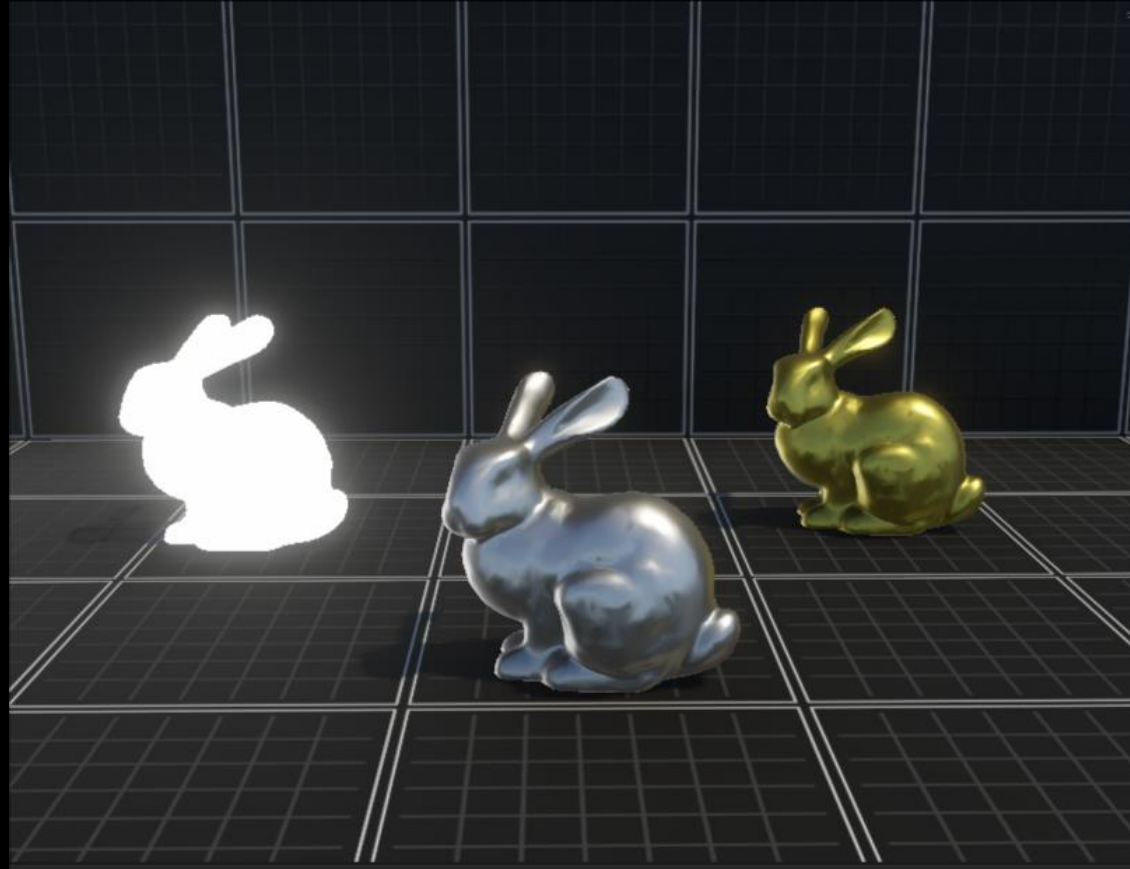


Gaussian



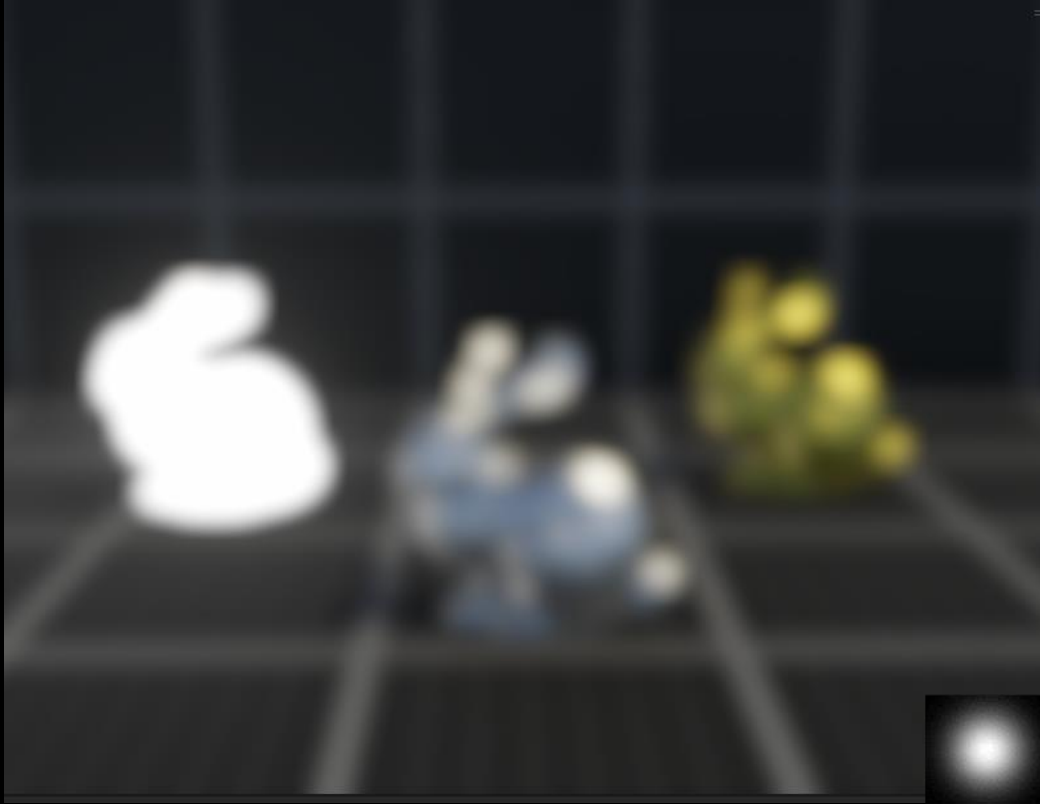
CscLb (5 components)

Results Implementation UNITY



Test Scene

Results Implementation UNITY

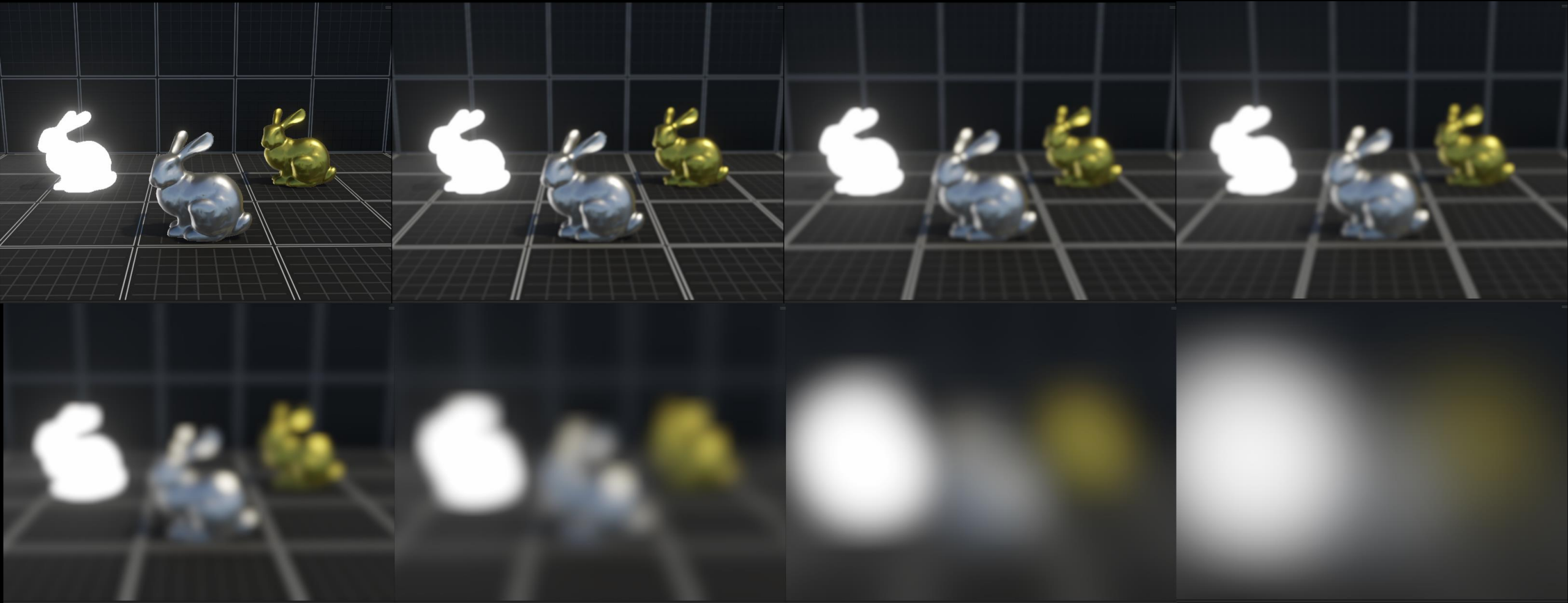


Gaussian



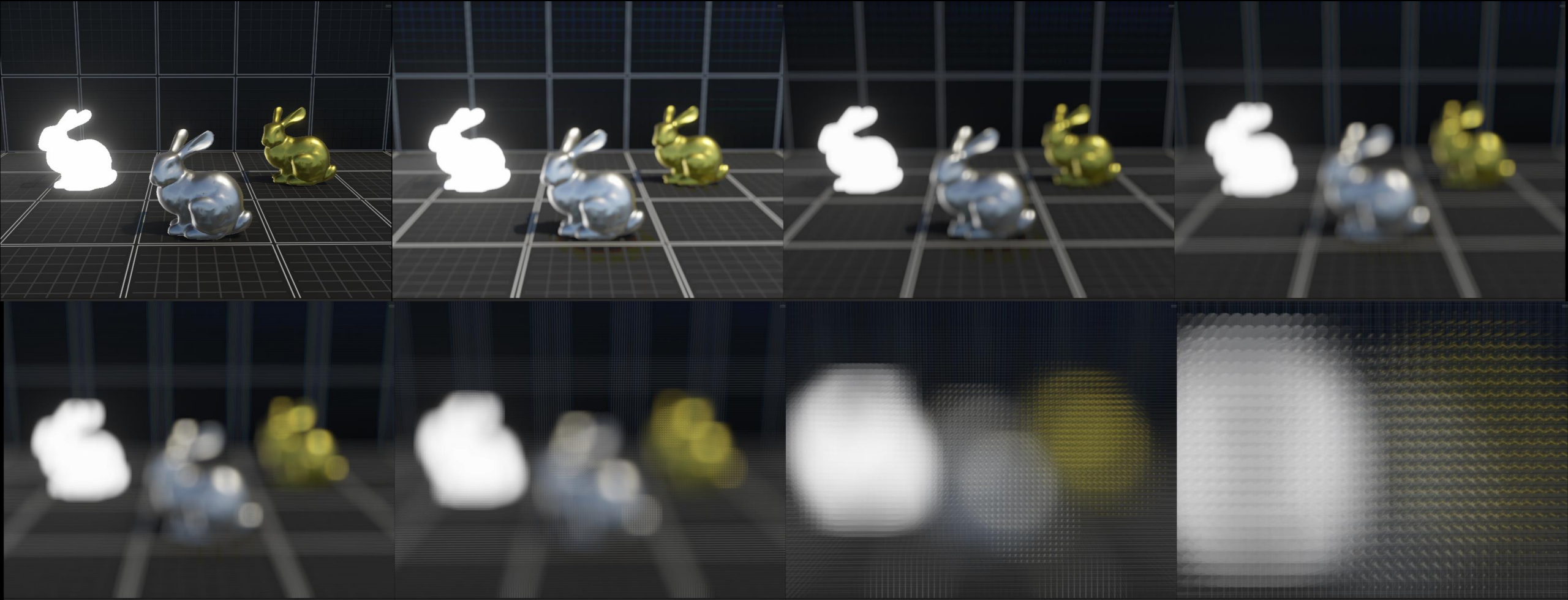
CscLb (2 components)

Results Implementation UNITY



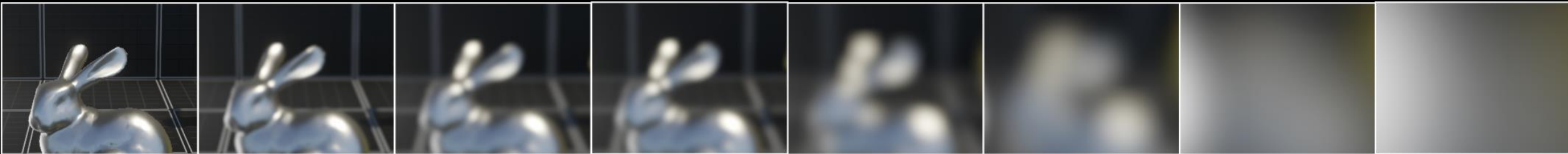
Gaussian

Results Implementation UNITY

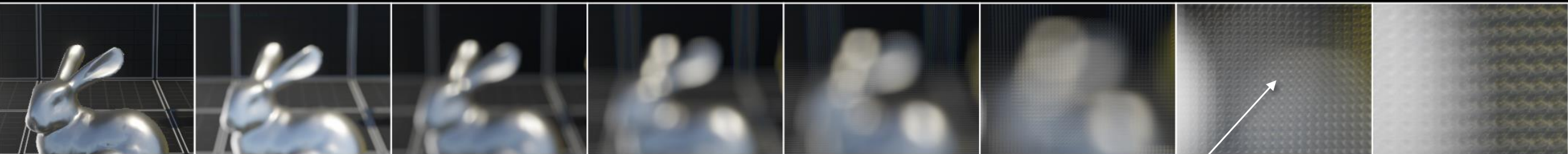


CscLb (2 Components)

Results Implementation UNITY



Gaussian



CscLb

Low precision artifacts due to small
component count.

I consider this a success.