

# SSAO & HDR

Advanced Shaders by Eddie Lee

# HDR

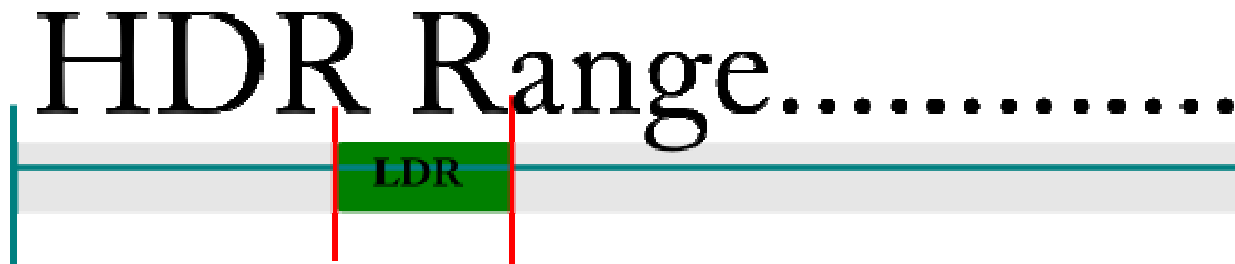


- What is **HDR**?
  - ▣ Bright things really bright
  - ▣ Dark things really dark
- Human eye perceives ratio of 1,000,000:1
- Computer monitors only shows a fraction of contrast ratio
- Texture/Render Target Format
  - ▣ **Original**: 8-bits per channel (32-bits per pixel)
  - ▣ **HDR**: 32-bits per channel (128-bits per pixel)

# HDR

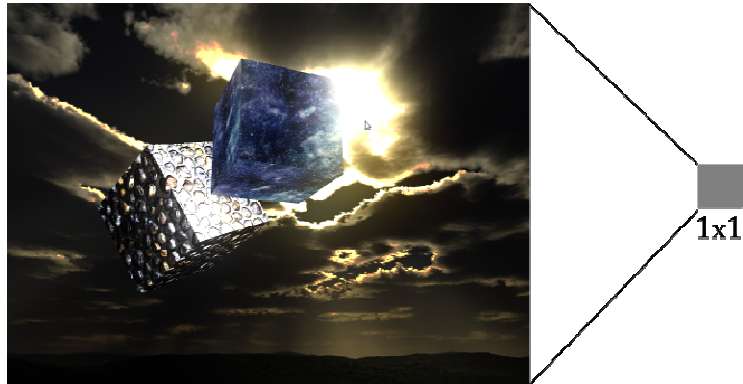
## □ Tone mapping

- Finds suitable range to render HDR=>LDR
- Roughly simulates the way the eye adjusts to high range
  - Eyes adjust to really **bright** or really **dark**
- Maps HDR -> LD



# HDR

- Tone-mapping
  - Calc average luminescence of scene (1x1 texture)



- Math! (Non-linear operation)

$$\mathbf{lum} = \mathbf{lumPixel} * \mathbf{middleGray} / \mathbf{lumAvg}$$

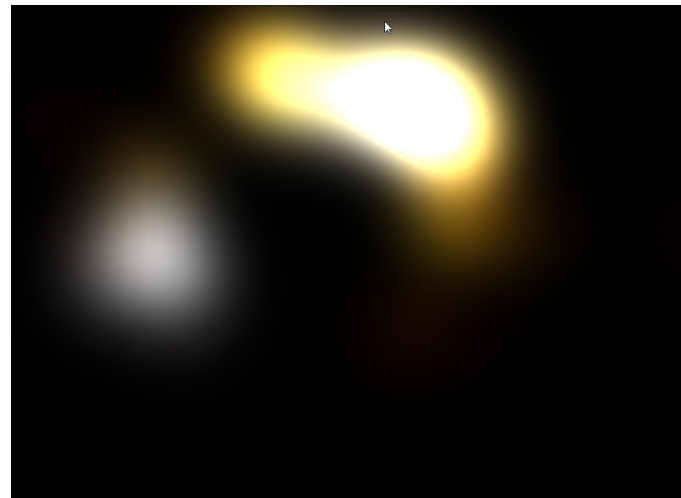
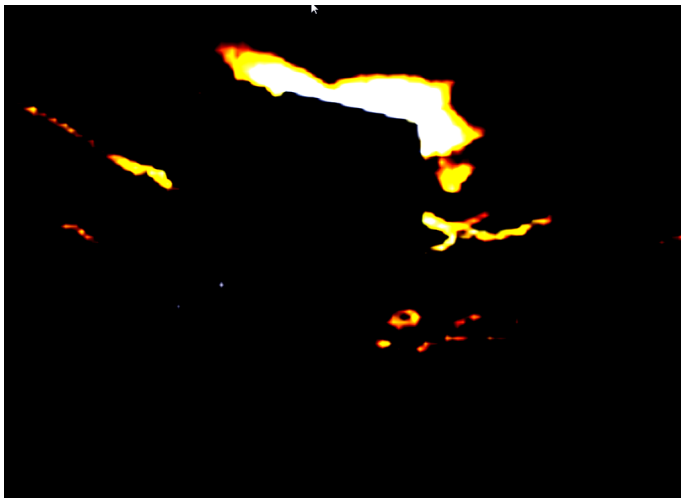
$$\mathbf{lumScaled} = \mathbf{lum} (1 + \mathbf{lum} / (\mathbf{maxLum}^2)) / (1 + \mathbf{lum})$$

$$\mathbf{Result} = \mathbf{color} * \mathbf{lumScaled}$$

# HDR

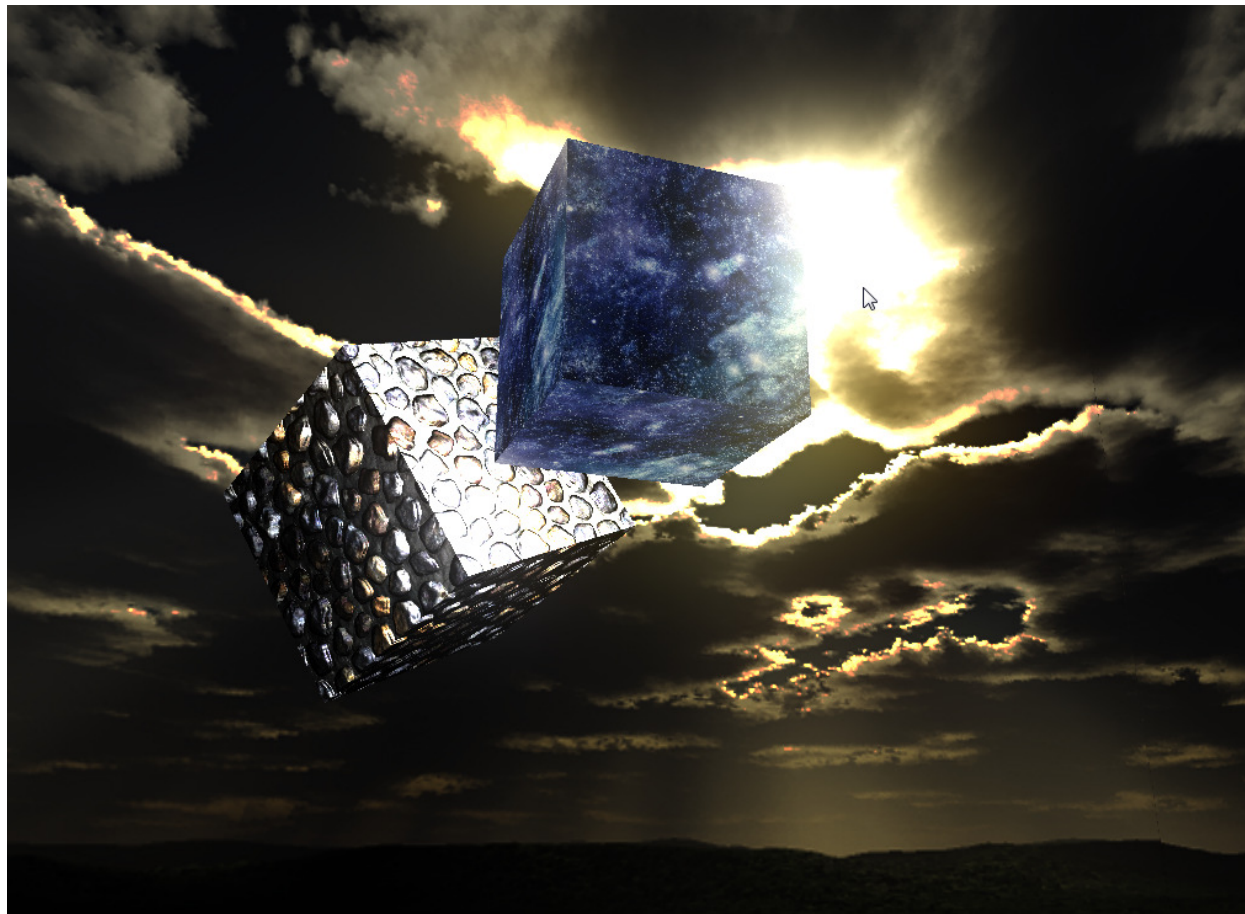
## □ Bloom

- Simulates scattering of light in human lens
- Anything above the LDR range is “bloomed”



# HDR

**finalColor** = toneMapColor + bloom



# SSAO

- Simulates **global illumination** by approximating **ambient occlusion**
- Uses only the **depth buffer**
- Advantages
  - ▣ Independent of scene complexity
  - ▣ Works with dynamic scenes
  - ▣ No CPU, all love in **GPU**
- Disadvantages
  - ▣ View-dependent artifacts



# SSAO

## □ Depth Buffer

- Stored non-linearly
- Use 32-bit for highest precision
- Convert non-linear depth => linear

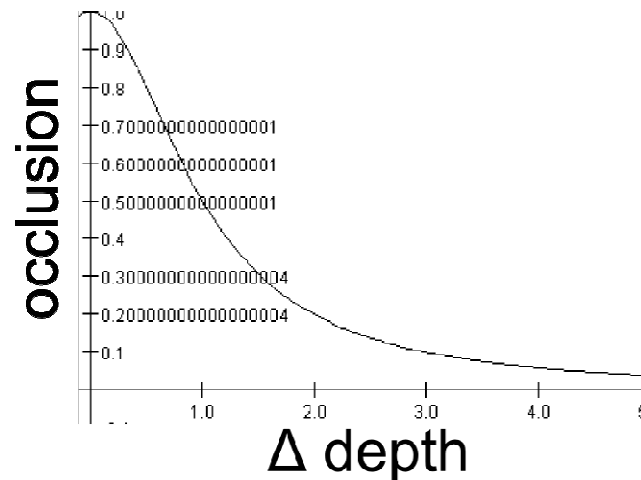
$$z = z_{\text{Near}} / ( z_{\text{Far}} - \text{depth} * (z_{\text{Far}} - z_{\text{Near}}) ) * z_{\text{Far}}$$



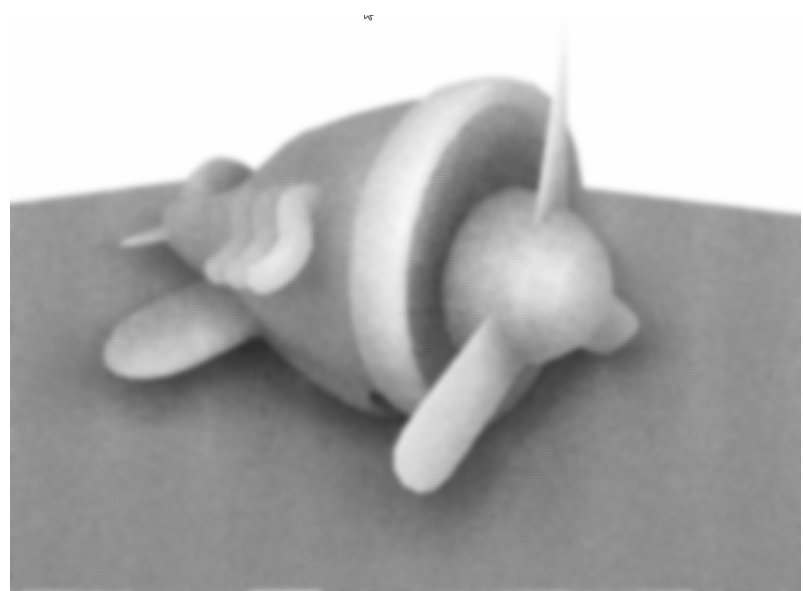
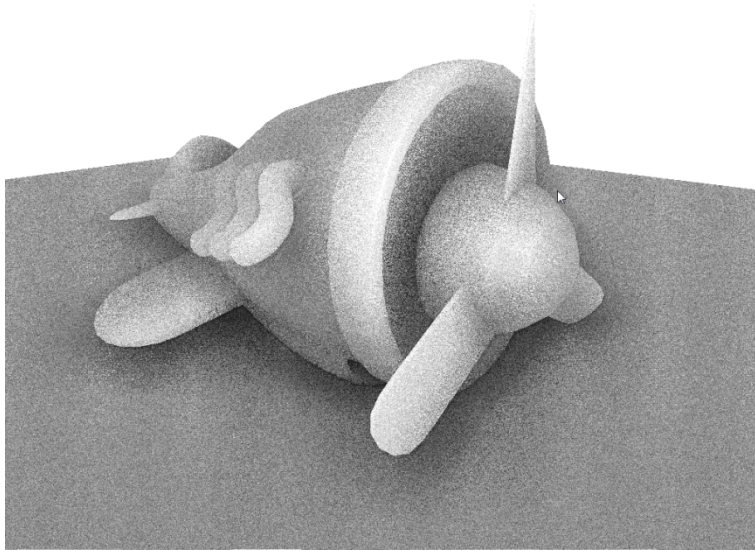
# SSAO

## Basic Algorithm (Pixel Shader)

- For each **depth**, sample surrounding depth pixels:
  - If sample is **behind** depth, ignore
  - Use random directions to eliminate artifacts
  - **Occlusion** =  $\text{step}(0, \text{diffDepth}) / (\text{diffDepth}^2 + 1)$



# SSAOO



# Demo Time!

