

# Some Real Time Rendering

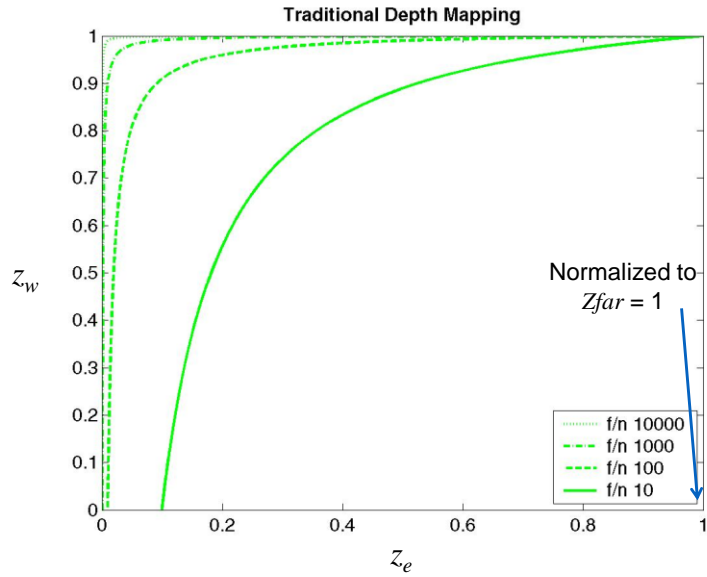
## Depth Buffer

Quick recap:

- Contains our  $-1/z$  (depth) in range  $0..1s$
- Painter's algorithm
- Depth test & ordering

But:

- Z-fighting
- Lots of resolution wasted
- Improvements: negate, minimize  $f/n$ , logarithmic..
- And.... Transparent objects ?



Stanford CS 248

<http://www.adriancourreges.com/blog/2016/09/09/doom-2016-graphics-study/>

<http://www.adriancourreges.com/blog/2015/11/02/gta-v-graphics-study/>

Let's start easy..

## Fog

What:

- Simple, but very useful
- Increases with distance
- Approximation:  $\text{final\_color} = \text{lerp}(\text{pixel\_color}, \text{fog\_color}, f)$

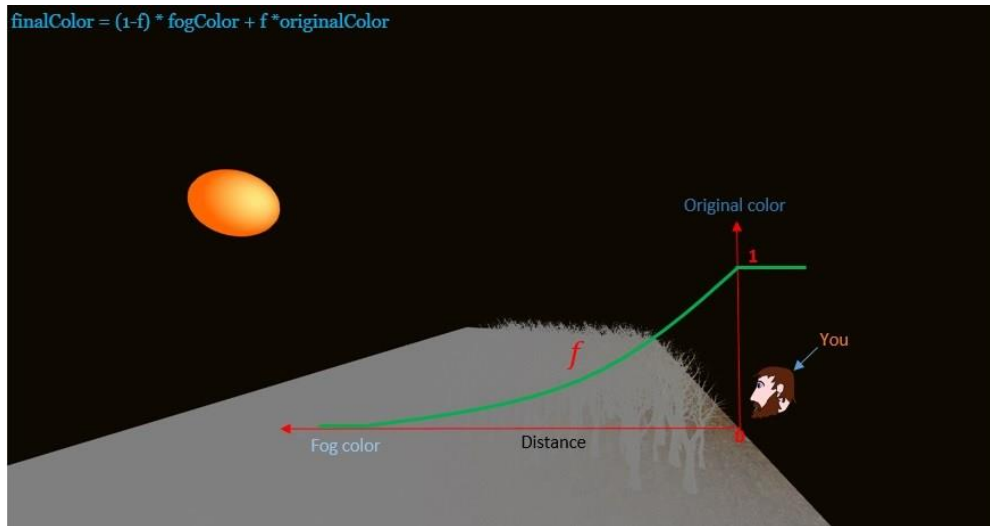
Some examples for f:

- Linear
- Exponential (sq)
- Range check
- Tendency towards more physical oriented systems



Linear fog

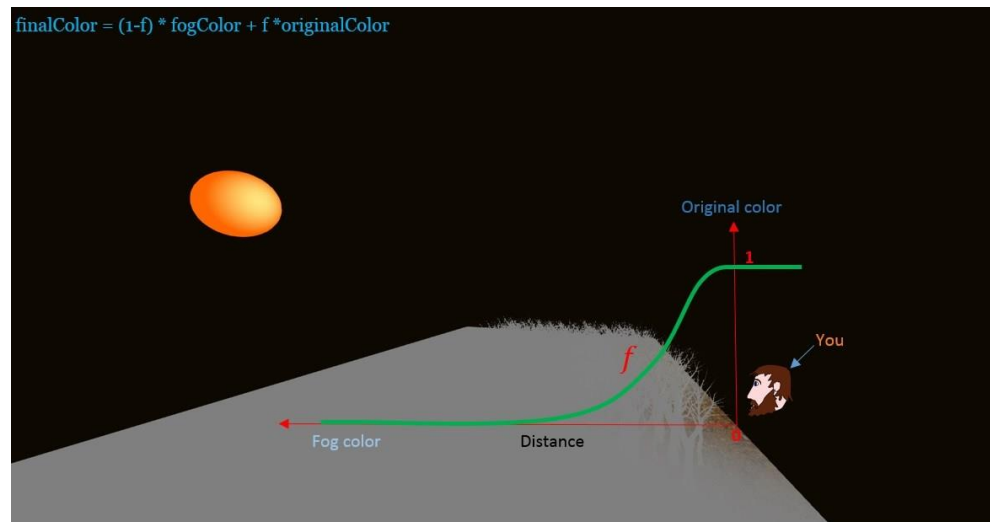
$$\text{finalColor} = (1-f) * \text{fogColor} + f * \text{originalColor}$$



Exponential fog

in2gpu.com

$$\text{finalColor} = (1-f) * \text{fogColor} + f * \text{originalColor}$$



Exponential Fog squared

in2gpu.com

<https://youtu.be/N4mkgbwLg7U?t=2645>

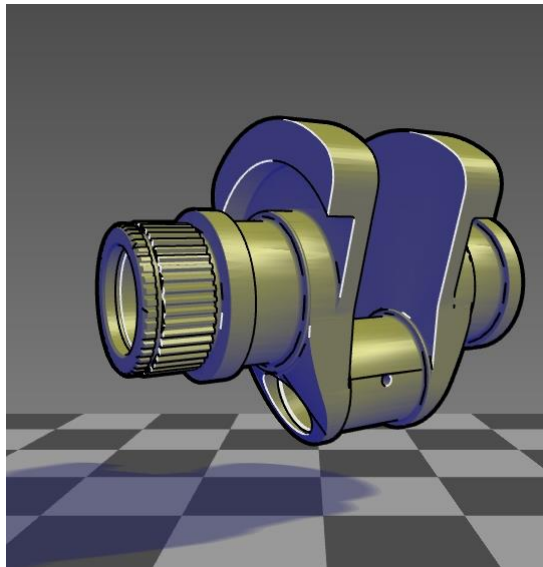
## Silhouettes and edges

Let's try:

- Just with geometry.. Render backfaces (Many other ways too)
- Just having the normal.. Surface angle
- Can also use the depth buffer.. Depth discontinuities
- Otherwise we go in the realm of image processing

But afterall:

- Mostly used for artistic purposes in NPR
- Usually combined with other techniques to achieve desired style



Surface angle

Interactive Technical Illustration '98

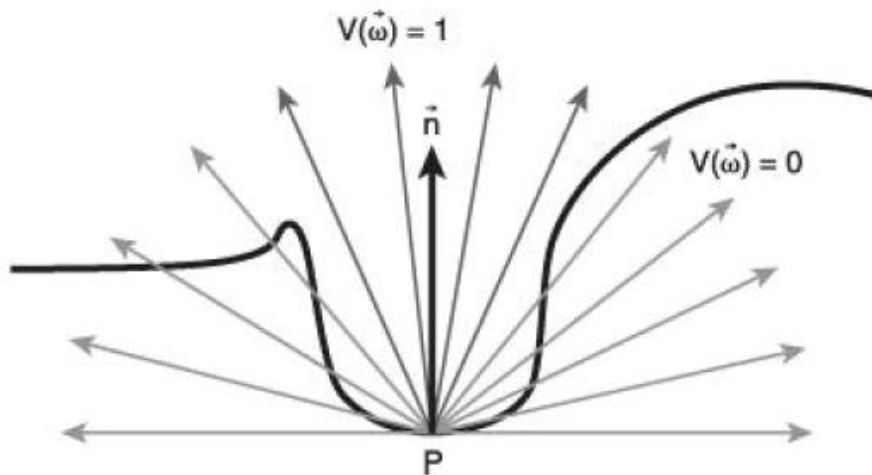
# Ambient Occlusion

Let's start from..

- Ambient lighting
- No directional variance
- What about (local) shadowing ?

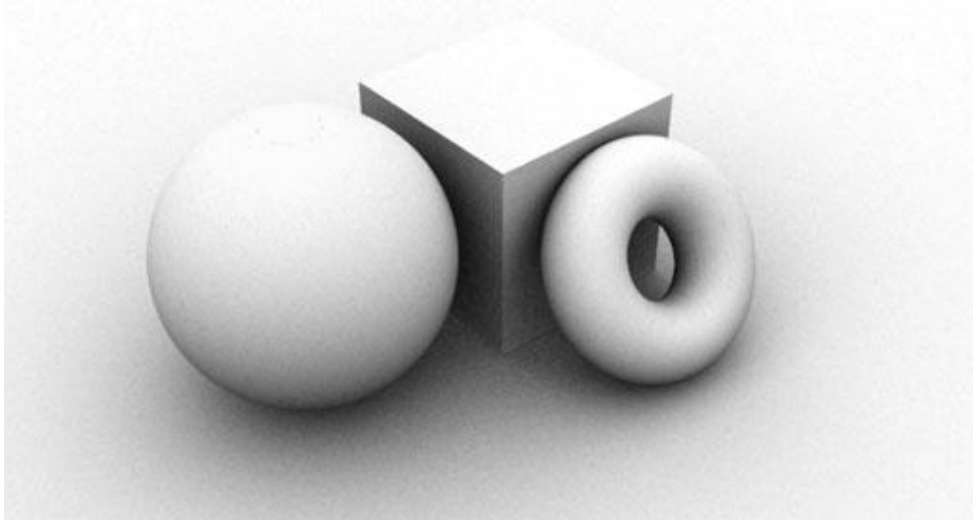
Some ways

- Raycasting
- Baking
- Screen Space



<http://www.cse.chalmers.se/edu/course/TDA361/>

What it should look like



What it should look like



Solid Angle Arnold Renderer



# Screen Space Ambient Occlusion

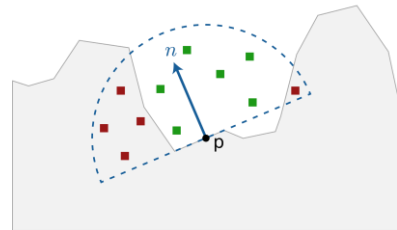
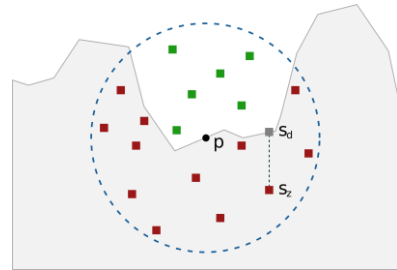
Local approximation

Use depth buffer

Generate random samples

Test depths

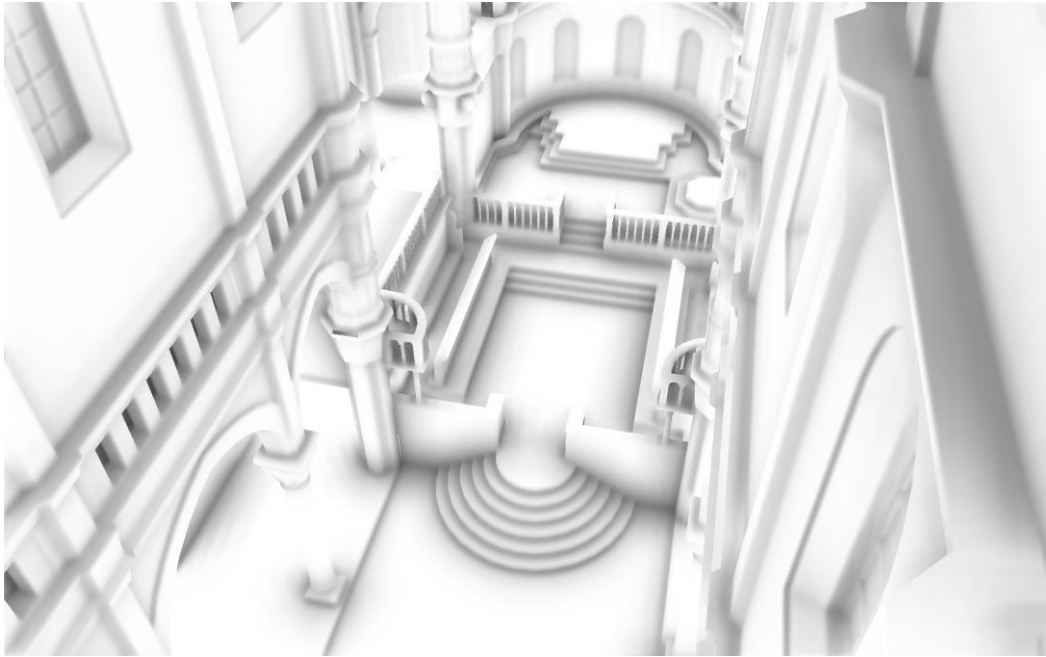
Sum positive contributions



<http://frederikaalund.com/a-comparative-study-of>

<https://www.shadertoy.com/view/Ms33WB>

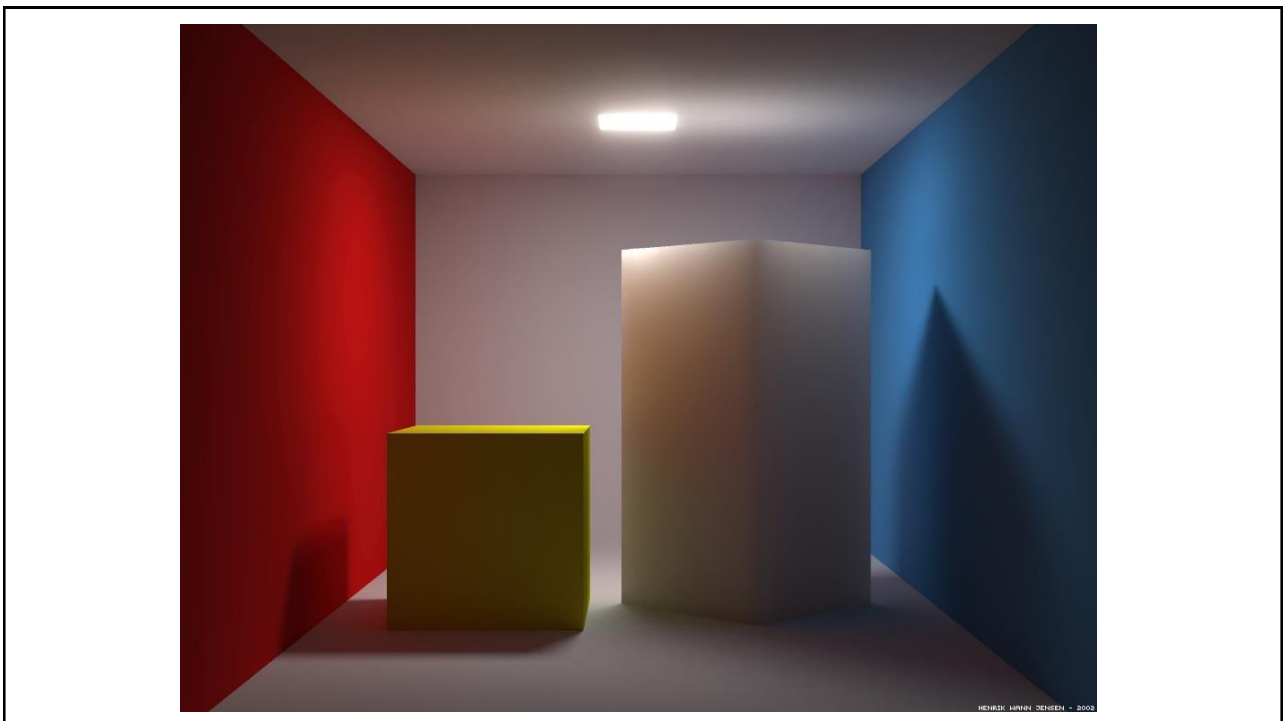
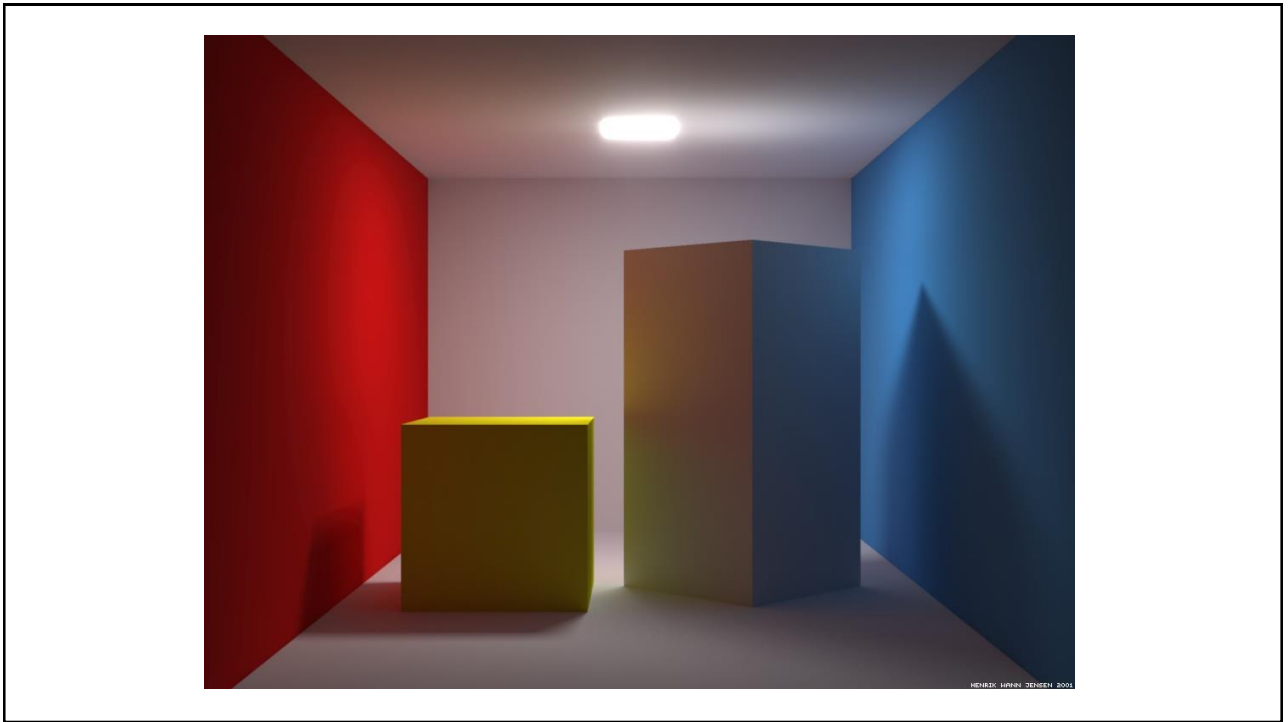
[http://alteredqualia.com/three/examples/webgl\\_postprocessing\\_ssao.html](http://alteredqualia.com/three/examples/webgl_postprocessing_ssao.html)

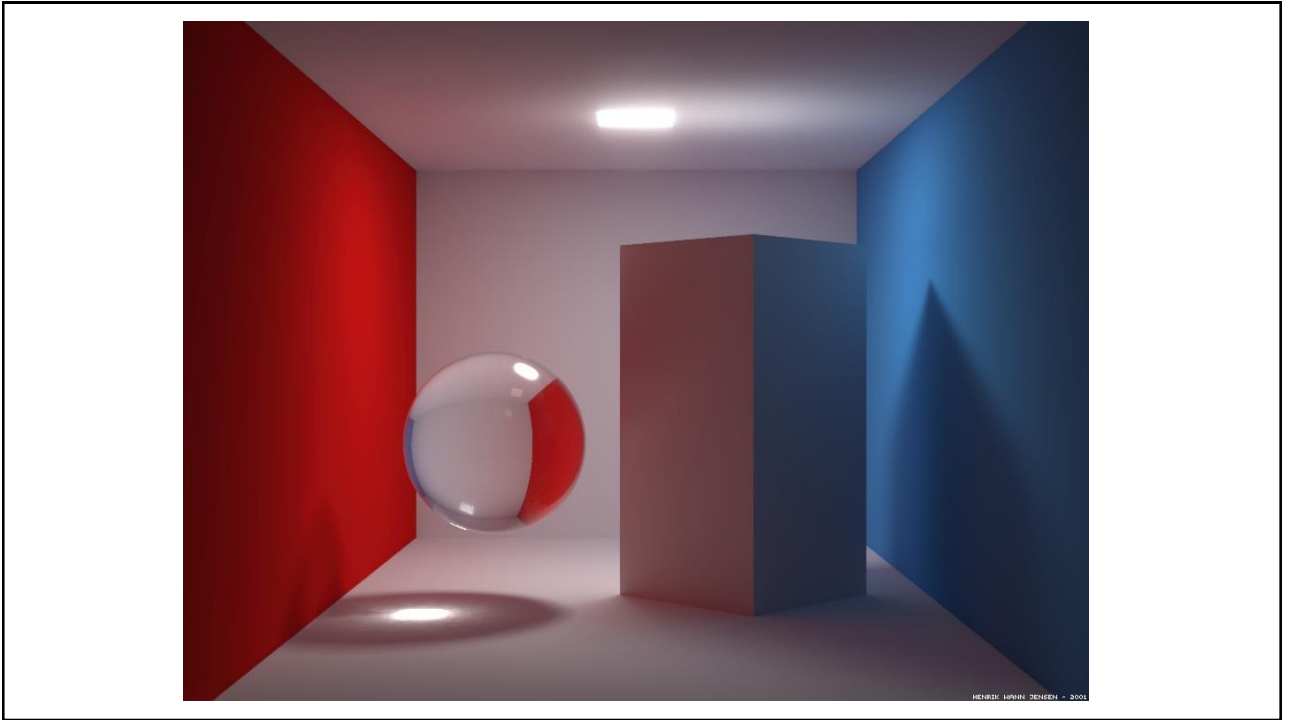


Nvidia HBAO+

## Global Illumination

- Photorealism is the goal (might not be yours)
- Approximating the rendering equation
- Offline: Raycasting
- Offline: Pathtracing
- Environment mapping
- More..





## Global Illumination

From a real time perspective:

- Approximated combining multiple techniques for the different components
- Direct Illumination
- Indirect Illumination (recursive here)
- Shadows
- Ambient Occlusion
- Reflections, refractions...

# Current Solutions

VXGI

<https://developer.nvidia.com/vxgi>

<http://simonstechblog.blogspot.ca/2014/10/>

<http://polycount.com/discussion/135481/radiosity-in-video-games>