



# Introduction

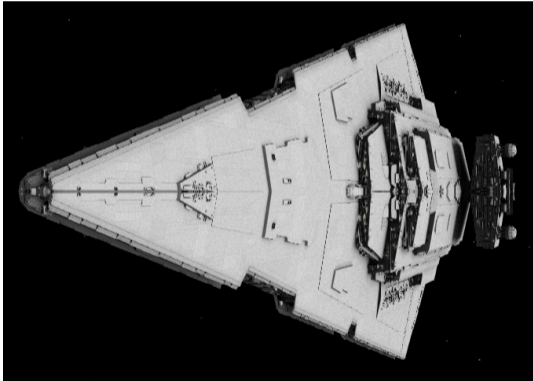
## FreeSpace Open



- 1 Engine based on Volition's FreeSpace 2 (1999)
- 2 Open sourced in 2002
- 3 Mostly incremental changes to the renderer since
- 4 Deferred shading since 2015

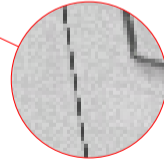
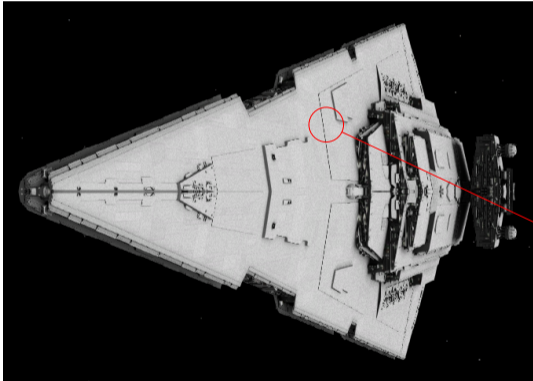
# Introduction

## Aliasing Problems



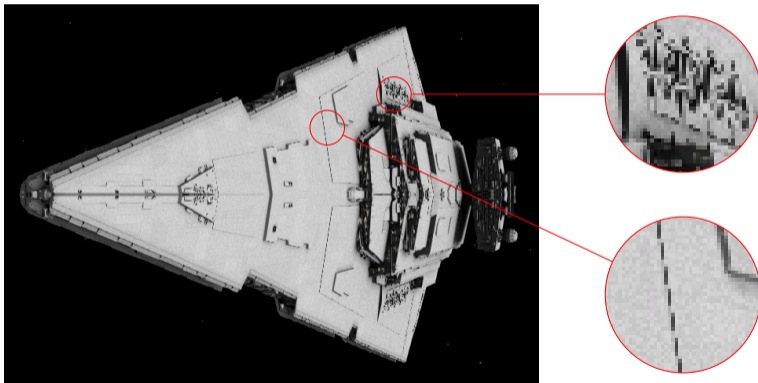
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## Aliasing Problems

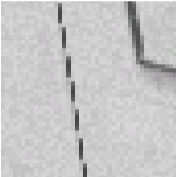


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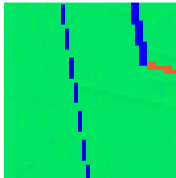
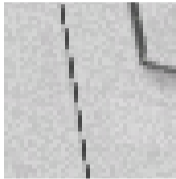
## Aliasing Problems



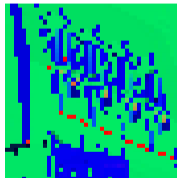
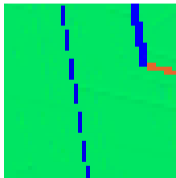
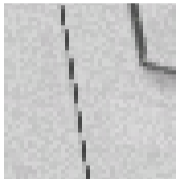
# Aliasing Causes



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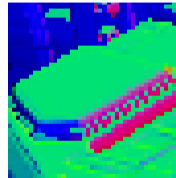
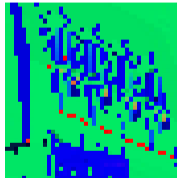
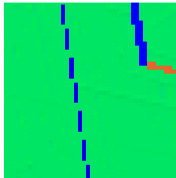
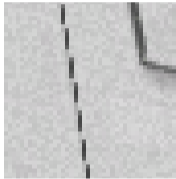




# Aliasing Causes



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# Potential Solutions



## Post-Process AA

- Insufficient
- FXAA / SMAA already used

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## Temporal AA

- Very old and organic pipeline
- Hard to integrate

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## Temporal AA

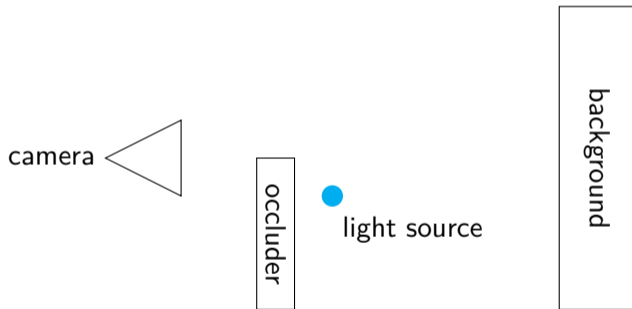
- Very old and organic pipeline
- Hard to integrate

## Multi-Sample AA

- Deferred shading incompatibility
- Lighting artifacts

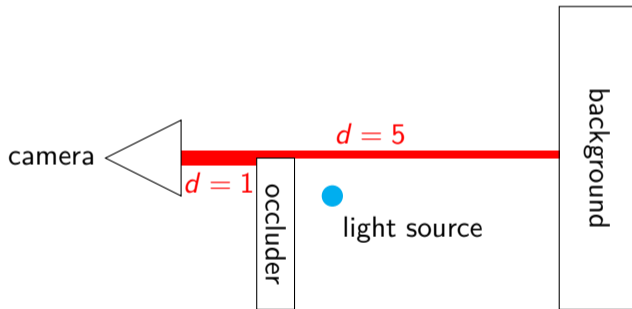
# Deferred Shading and MSAA

## Artifact Causes



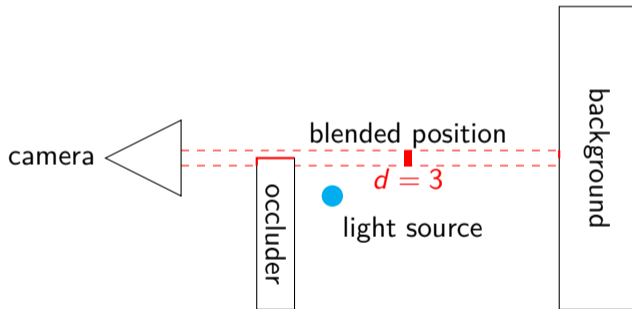
# Deferred Shading and MSAA

## Artifact Causes



# Deferred Shading and MSAA

## Artifact Causes



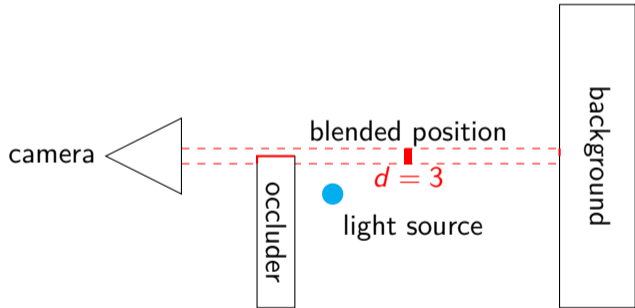


# Deferred Shading and MSAA

## Artifact Causes



enhanced for projector visibility



# Deferred Shading and MSAA

## Avoiding Artifacts



- No resolve of g-buffer
- Shading per-sample instead of per fragment
  - ⇒ Shading is computationally expensive
- Shading per-sample only if necessary
  - ⇒ Introduces complexity into existing shaders
  - ⇒ Still potentially expensive depending on the scene

# Deferred Shading and MSAA

## Depth Aware G-Buffer Resolve

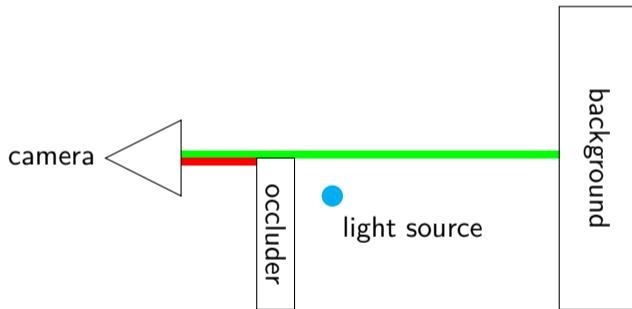


### Core idea

Only blend samples depicting adjacent geometry

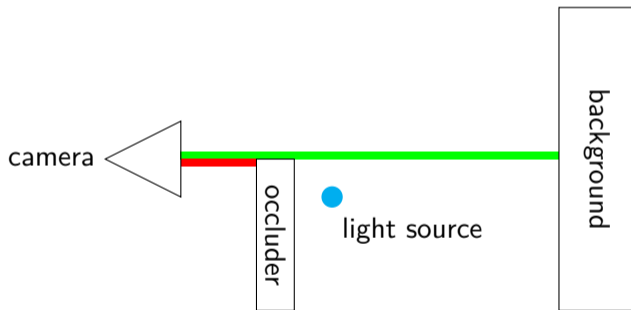
# Deferred Shading and MSAA

## Depth Aware G-Buffer Resolve



# Deferred Shading and MSAA

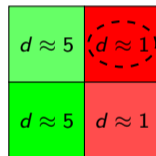
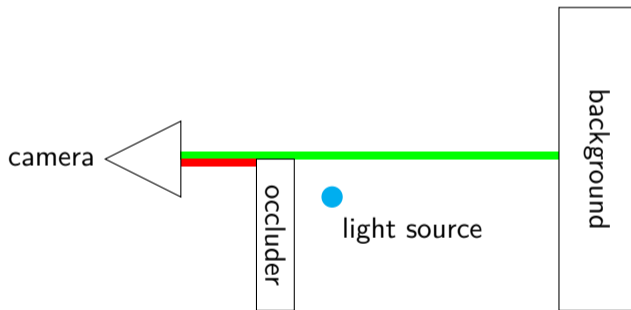
## Depth Aware G-Buffer Resolve



$d \approx 5$	$d \approx 1$
$d \approx 5$	$d \approx 1$

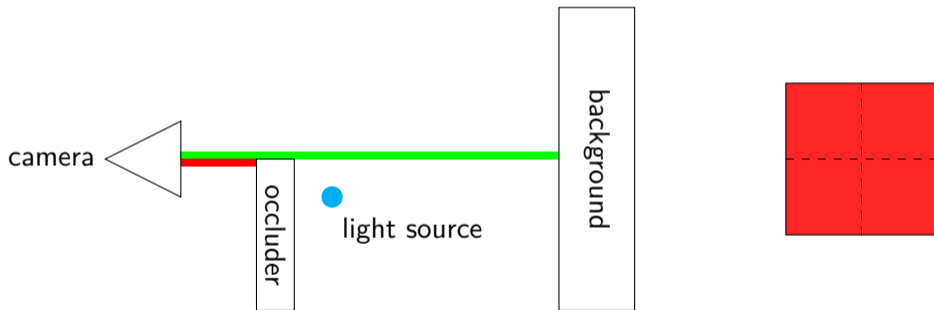
# Deferred Shading and MSAA

## Depth Aware G-Buffer Resolve



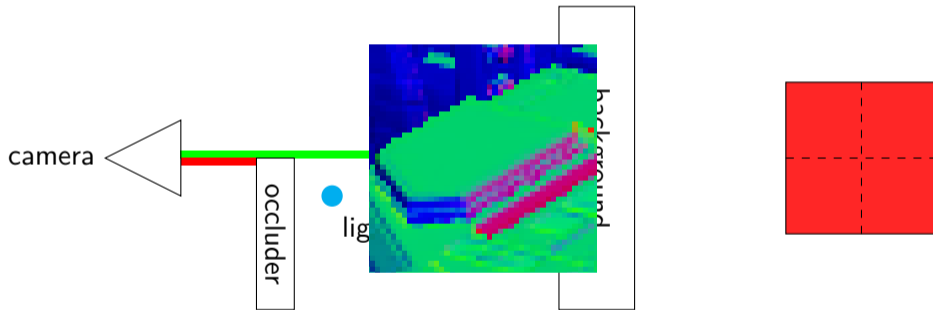
# Deferred Shading and MSAA

## Depth Aware G-Buffer Resolve



# Deferred Shading and MSAA

## Depth Aware G-Buffer Resolve





# Deferred Shading and MSAA

## Depth Weighing Algorithms



Mean:

$$d \approx 3$$

$d \approx 5$	$d \approx 1$
$d \approx 5$	$d \approx 1$

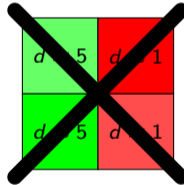
# Deferred Shading and MSAA

## Depth Weighing Algorithms



Mean:

$$d \approx 3$$

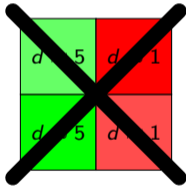


# Deferred Shading and MSAA

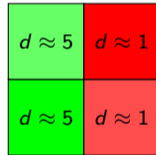
## Depth Weighing Algorithms



Mean:  
 $d \approx 3$



Min ("Front-First"):  
 $d \approx 1$

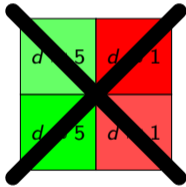


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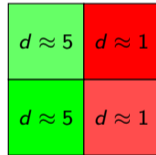
## Depth Weighing Algorithms



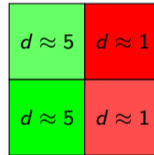
Mean:  
 $d \approx 3$



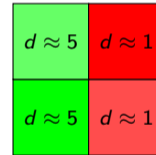
Min ("Front-First"):  
 $d \approx 1$



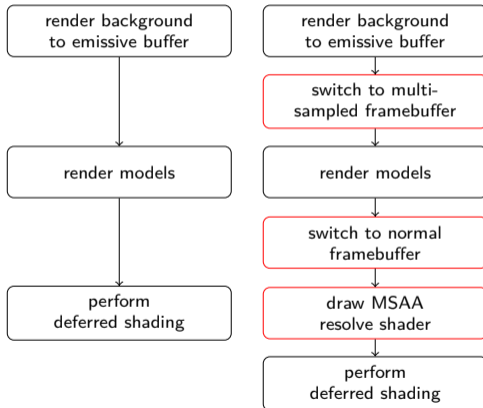
Median:  
 $d \approx 1$  or  $d \approx 5$



Max ("Back-First"):  
 $d \approx 5$



# Conclusion



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