

Lesson 8 – Shadows

PV227 – GPU Rendering

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24. 11. 2015

Shadows

- “just” shadow mapping,
- hard shadows only.

Shadow Mapping

- projective shadowing,
- visibility by depth comparison.

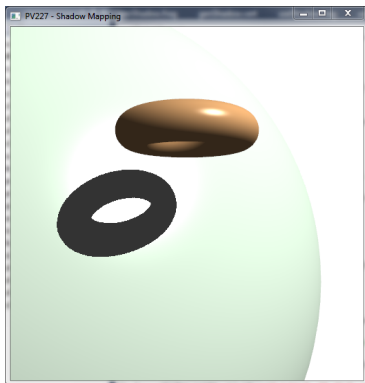


Figure: Shadow mapping.

Basic Theory

- scene rendered from the light (depth saved),
- scene rendered from the camera (depth compared).

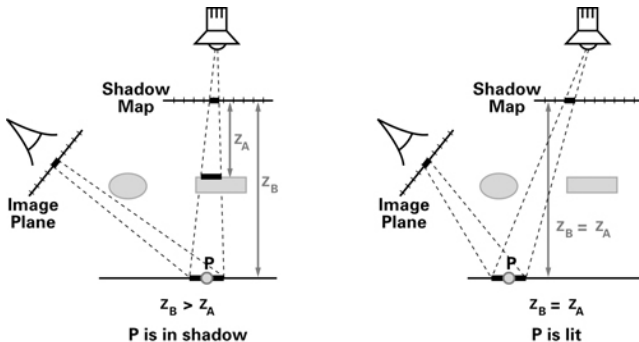


Figure: Taken from nvidia.com

More Theory

- separate shadow map for each light,
- only objects casting shadows need to be rendered,
- recomputed each time the light or the scene changes.

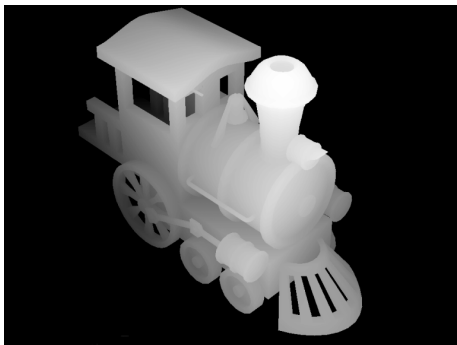


Figure: Taken from github.io

Artifacts

- perspective aliasing,
- projective aliasing,
- shadow acne,
- Peter panning,
- animation artifacts (shimmering).

Perspective Aliasing

- caused by mapping of pixels to shadow map texels,
- worse near the camera (many-to-one),
- solved by remapping the texture:
 - ▶ Perspective Shadow Maps (PSMs),
 - ▶ Logarithmic Perspective Shadow Maps (LogPSMs),
 - ▶ Cascaded Shadow Maps (CSMs),
 - ▶ ...

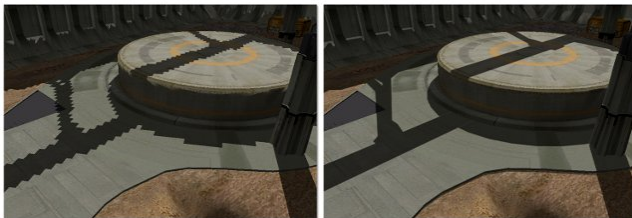


Figure: Taken from microsoft.com

Projective Aliasing

- caused by orientation of geometry to light (parallel rays),
- same solution as in the previous slide.

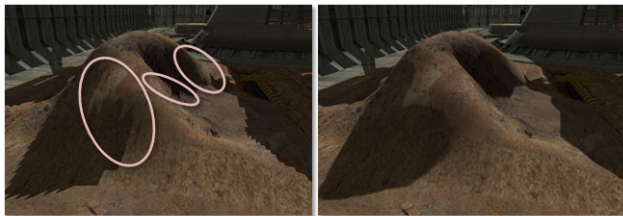


Figure: Taken from microsoft.com

Shadow Acne

- erroneous self shadowing,
- caused by quantizing depth over entire texel,
- caused by floating point imprecision,
- solved by adding bias and making near and far planes as close as possible.

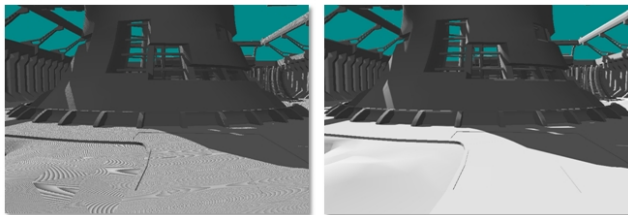


Figure: Taken from microsoft.com

Peter Panning

- shadow detached from object,
- caused by too high bias for solving shadow acne,
- solved by limiting bias and making near and far planes as close as possible.

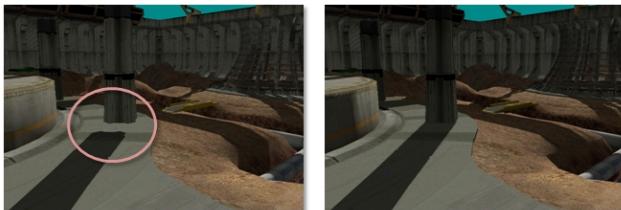


Figure: Taken from microsoft.com

Slope Scaled Bias

- adding bias depending on the orientation of the geometry,
- high for parallel, small for orthogonal directions,
- `glPolygonOffset`.

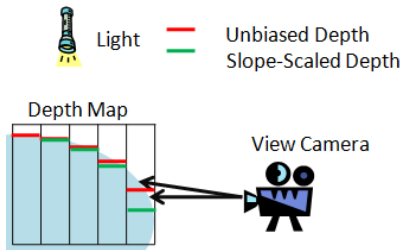


Figure: Taken from microsoft.com

Shimmering Shadow Edges

- animation artifact,
- brightening and darkening of shadow edges,
- caused by recalculation of shadow matrix,



Figure: Taken from microsoft.com

- `http://msdn.microsoft.com/en-us/library/windows/desktop/ee416324%28v=vs.85%29.aspx`
- more discussion, other artifact elimination techniques.