Multiple View Generation for Auto-stereoscopic Displays

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immersive

Overview

1. Auto-stereoscopic Displays
2. Motivation
3. Contribution 1: Layered Rendering
4. Contribution 2: 3D-Image Warping
5. Contribution 3: Hole Filling
6. Conclusions
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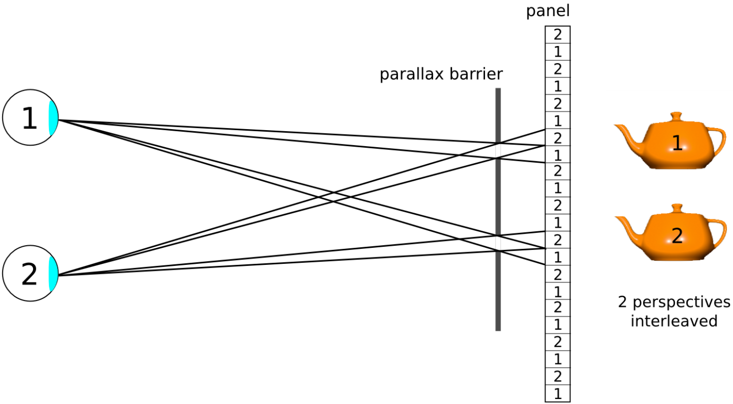
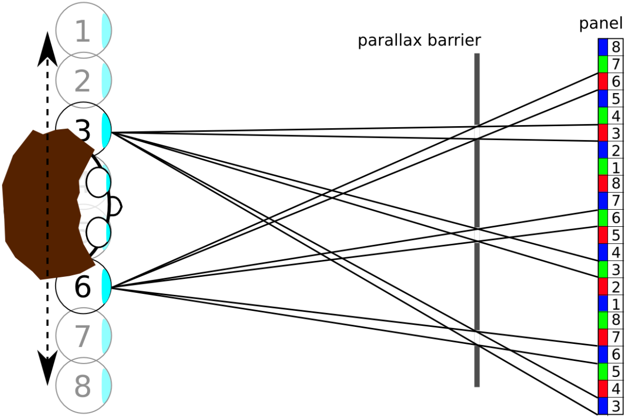
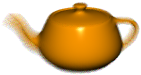
Auto-stereoscopic Displays



dual perspecitive auto-stereoscopic display: fixed user position or head tracking

Multi-View Auto-stereoscopic Displays

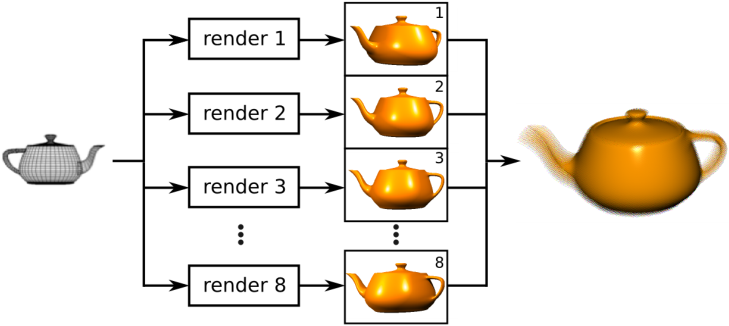




e.g. 8 perspectives interleaved on sub-pixel basis

multi-view auto-stereoscopic display: supports viewing corridor

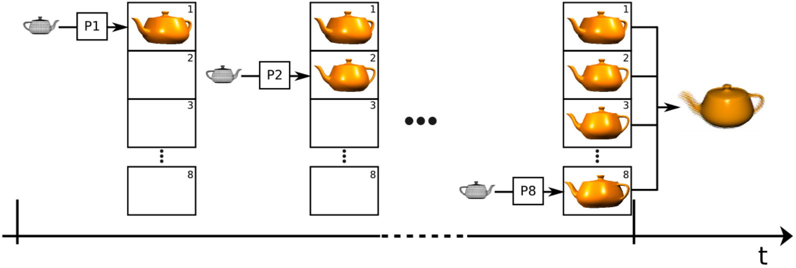
Multiple View Generation



1 graphics card -> basic approach: multiple passes

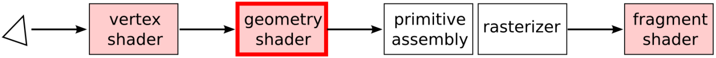
Challenge

multi-pass rendering: 8 passes



Recent Graphics Card Features

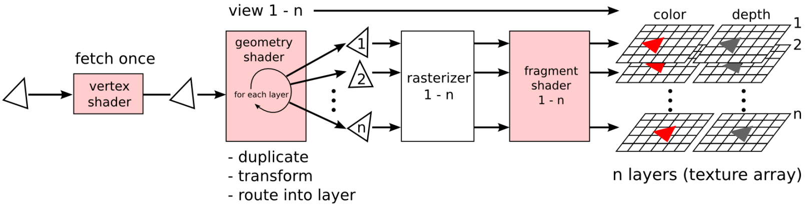
graphics pipeline with unified-shader model *



geometry shader:
- modify whole primitives
- duplicate primitives
- route into layer of texture array
- ...

*processing units are assigned where needed -> load balancing

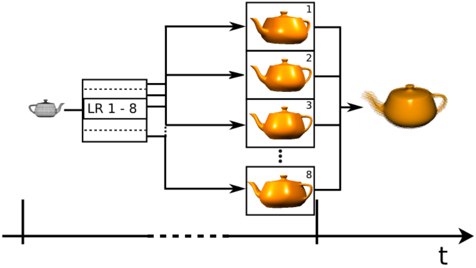
Layered Rendering



-> multiple views in single pass

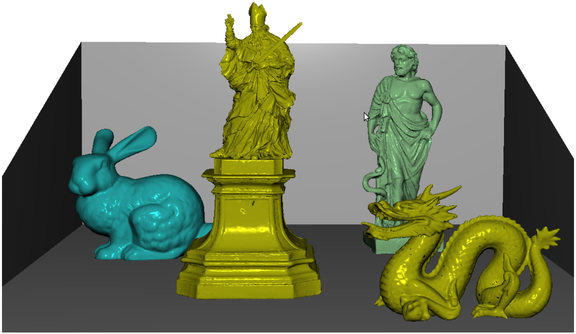
Layered Rendering

layered rendering for multiple view generation: 1 pass



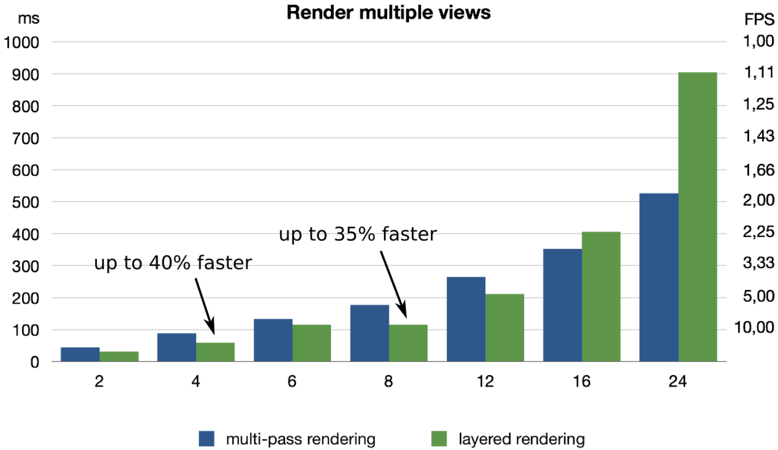
[FdSB08] : Painter's Algorithm
[Mar09] : texture arrays

Test Configurations

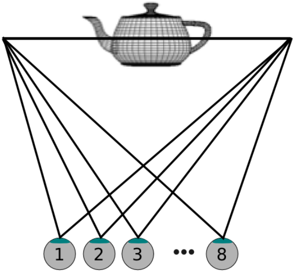


- 1.2 M triangles
- rendering resolution 1920x1080
- Intel Core i7 CPU 940 2.93GHz and Nvidia GeForce GTX 480

Layered Rendering: Results

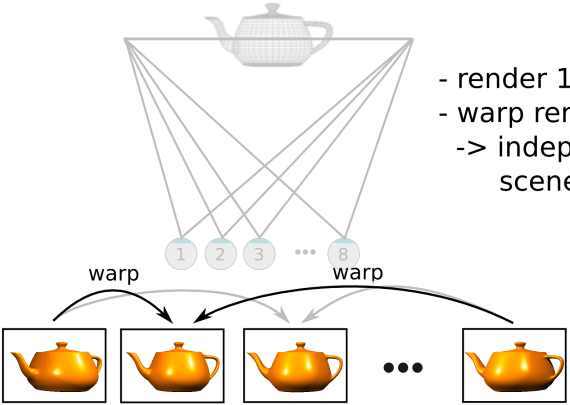


Auto-stereoscopic Displays: Characteristic



- adjacent views
  -> close together

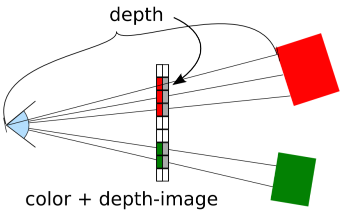
Idea: 3D-Image Warping



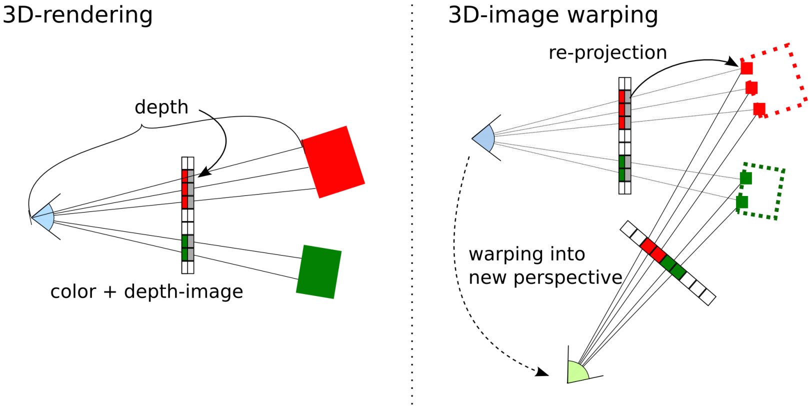
- render 1 + 8
- warp remaining
  -> independent of
  scene complexity

3D-Image Warping

3D-rendering

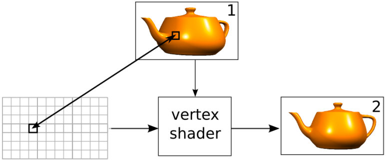


3D-Image Warping



3D-Image Warping: Standard Approach

gpu-accelerated warping of a reference view

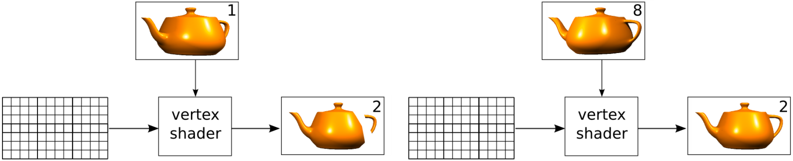


proxy geometry

-> warping one view into a new perspective

3D-Image Warping: Standard Approach

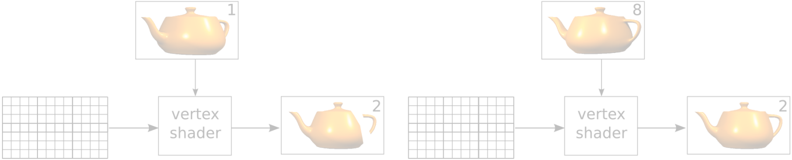
warping reference view 1+8 into perspective 2: two passes



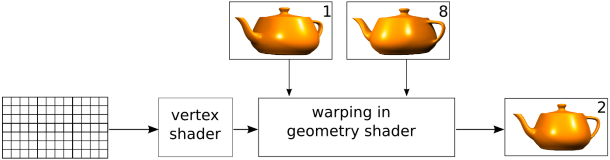
-> warping 1+8 into the same target perspective

3D-Image Warping: Geometry Shader Approach

warping reference view 1+8 into perspective 2: two passes

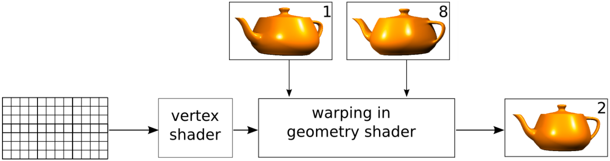


warping reference view 1+8 into perspective 2: one pass

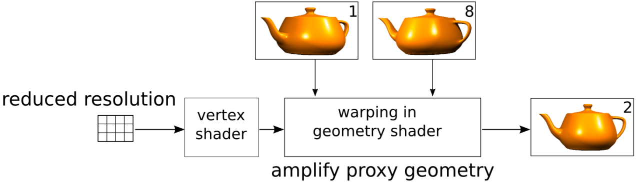


3D-Image Warping: Geometry Shader Approach

warping reference view 1+8 into perspective 2: one pass

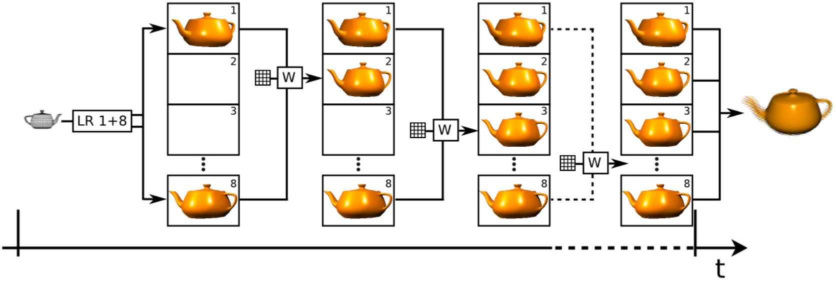


warping reference view 1+8 into perspective 2: one pass + reduced proxy geometry

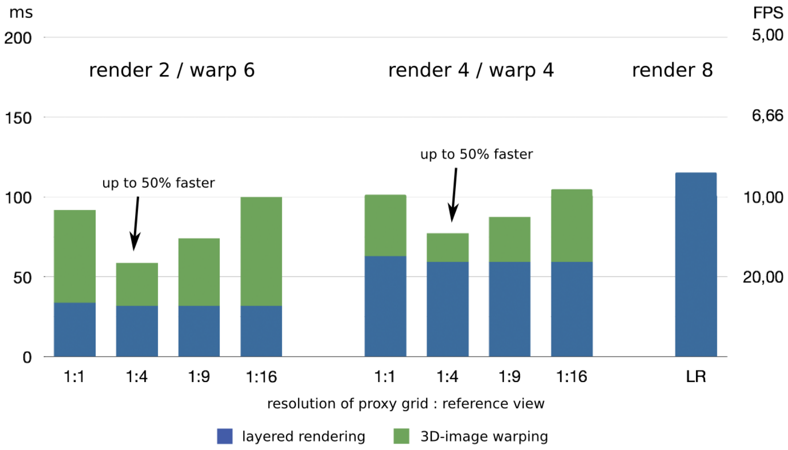


3D-Image Warping: Geometry Shader Approach

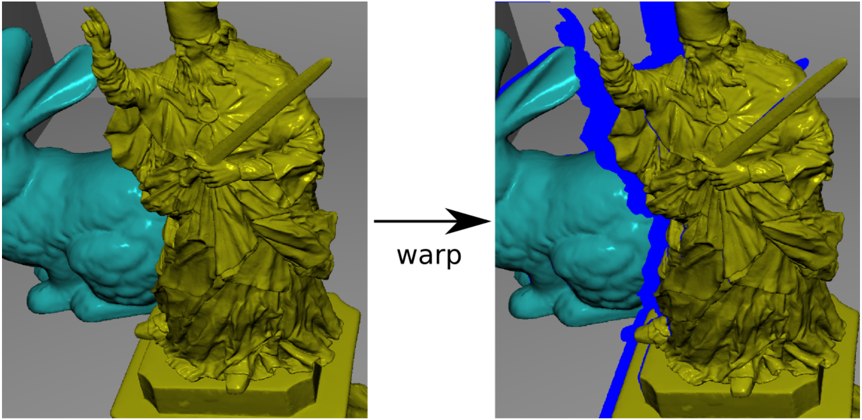
layered rendering + multi-pass warping: 1 + 6 passes



3D-Image Warping: Geometry Shader Results

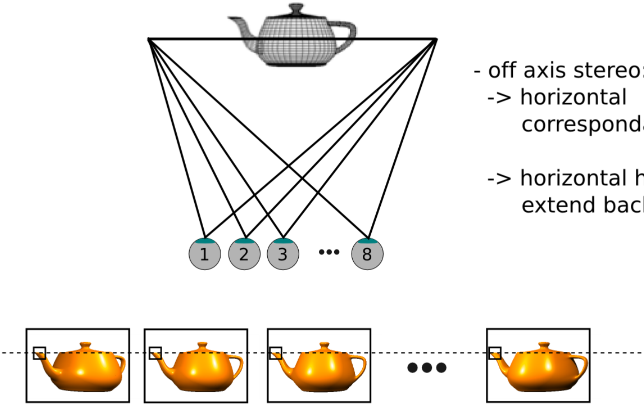


3D-Image Warping introduces Artifacts



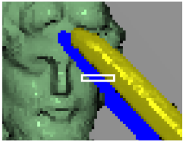
reference view   warped view (exag.)

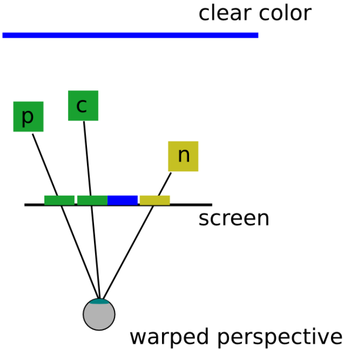
Idea: Hole filling



- off axis stereo:
  - -> horizontal correspondance
  - -> horizontal hole filling extend background

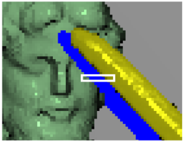
3D-Image Warping: Hole Filling Principle

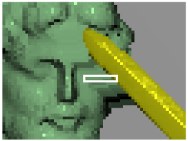


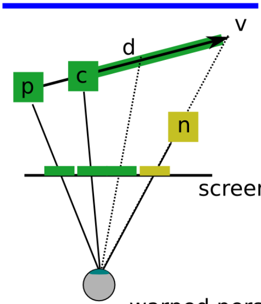


1. warp adjacent pixels p + c + n in geometry shader

3D-Image Warping: Hole Filling Principle II

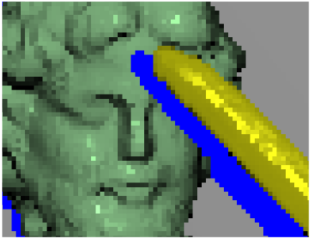


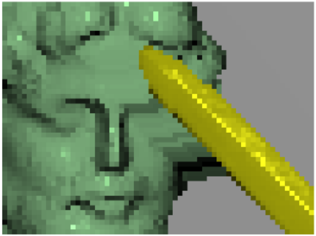




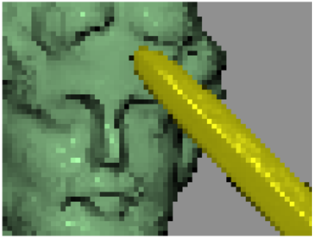
1. warp adjacent pixels p + c + n in geometry shader
2. if gap (hole) is above threshold
   -> extend a LINE from c along d to v

3D-Image Warping: Hole Filling Results



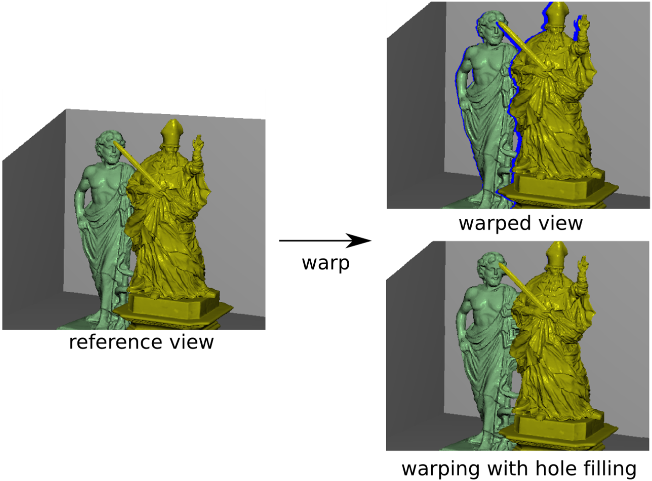


hole filling



correct result

3D-Image Warping: Hole Filling Results



Conclusions

- layered rendering up to 40% faster compared to multi-pass rendering
- 3D-image warping benefits from geometry-shader integration: up to 50% faster compared to single-view warping
- reducing proxy-geometry resolution up to 50% faster (1:4)
- hole filling at low cost with promising results

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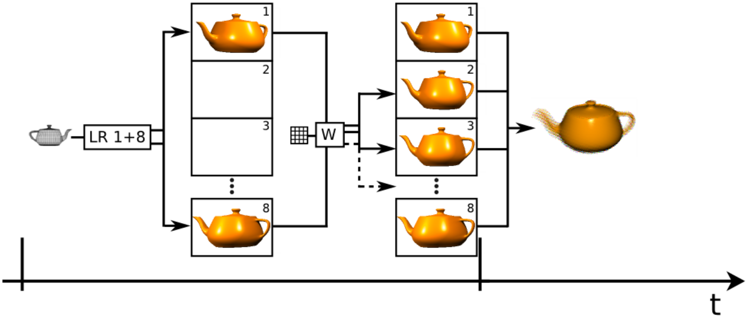
Future Work

- layered rendering + layered warping: 1 + 1 passes



- improved hole filling

References

Mar09 Jonathan Marbach: *Gpu acceleration of stereoscopic and multi-view rendering for virtual reality applications*, In Proceedings of the 16th ACM Symposium on Virtual Reality Software and Technology, pages 103 – 110, ACM, 2009

FdSB08 Vincent Nozick Francois de Sorbier and Venceslas Biri: *Gpu rendering for autostereoscopic displays*, In 4th International Symposium on 3D Data Processing, Visualization and Transmission, ACM, June 2008

Thank you!

Questions?