Diplomarbeitspräsentationen der Fakultät für Informatik

FAKULTÄT FÜR !NFORMATIK

Faculty of Informatics

Robust Hard Shadows

Martin Stingl

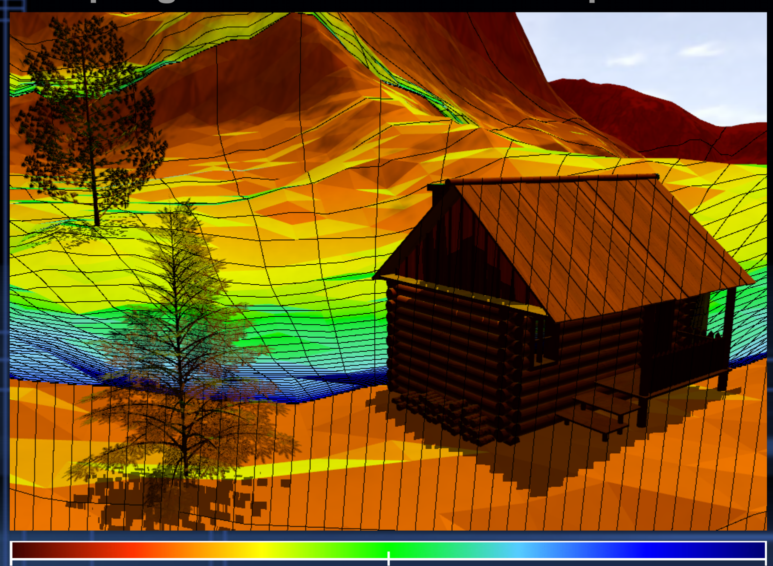
Magisterstudium
Computergraphik & Digitale Bildverarbeitung

Technische Universität Wien
Institut für Computergraphik und Algorithmen
Arbeitsbereich Computergraphik
Betreuer: Associate Prof. Dipl.-Ing. Dipl.-Ing. Dr.techn. Michael Wimmer

Problem

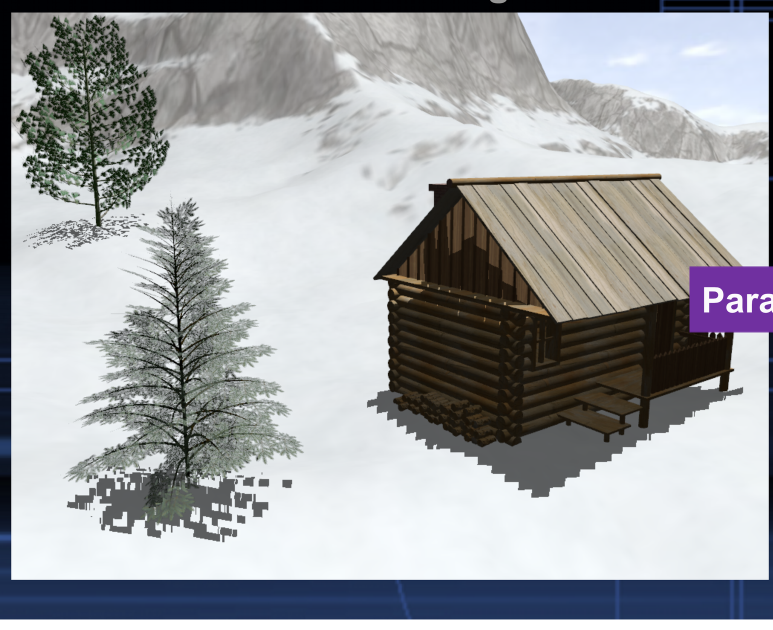
- shadow mapping has become the first choice to generate shadows in virtual environments for real-time applications like e.g. video games
- many methods and ways have been introduced to improve performance, shadow quality and minimize the occurring errors like e.g. shadow map aliasing
- Problem 1: because of the large number of methods, choosing the right one is very difficult
- Problem 2: it can be hard to find an appropriate parameter configuration for specific scenes

Sampling rate in the shadow map



undersampling proper sampling oversampling

Common shadow rendering

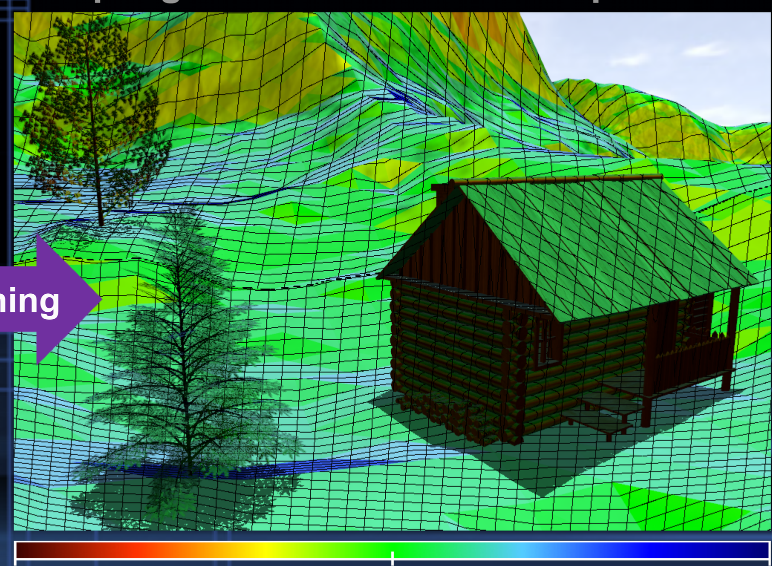


Parameter tuning

Goals

- analyze and discuss several commonly used advanced shadow mapping techniques
- compare them with each other considering the performance and quality improvements
- combine specific methods and determine the enhancement of their characteristics
- investigate the results for various parameter configurations and different scenarios
- use several visualization tools, to find an appropriate technique for each possible outdoor scene
- focus on fully hardware-accelerated techniques for real-time capability (~ 60 frames per second)

Sampling rate in the shadow map



undersampling proper sampling oversampling

Common shadow rendering

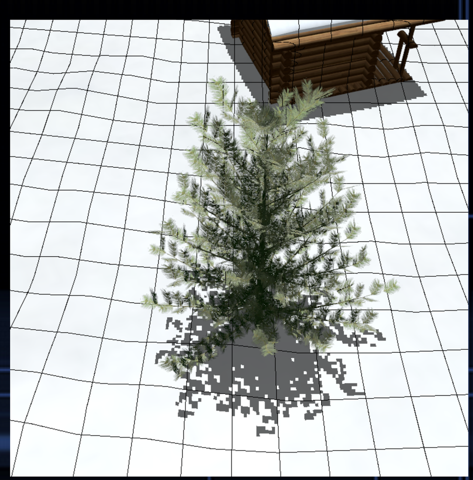
Related work 1: Basic shadow mapping

1. render the scene from the light's point of view and store the depth values into a depth map (shadow map).

2. while rendering the scene from the eye's point of view, perform a linear transformation that maps each point into light-space and apply a visibility test against the values in the shadow map (shadow test) to determine shadowed and unshadowed points.

Light view

Eye view[1]



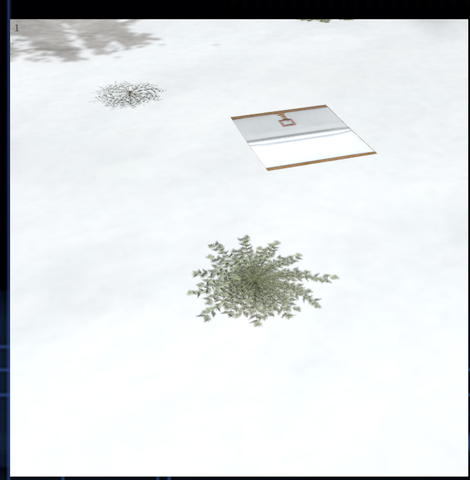
[1] includes a visualization of the shadow map texel boundaries

Related work 2: Warping

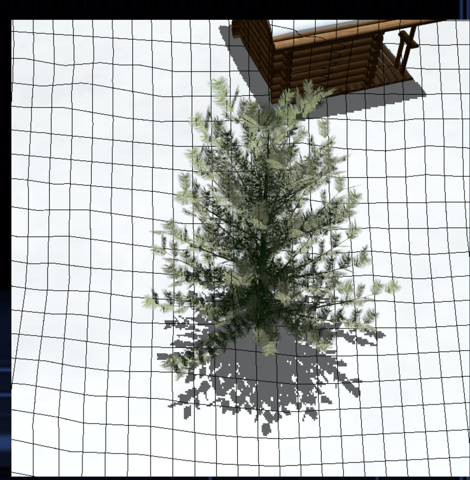
1. perform a perspective transform to the light-space (more samples nearby the eye and less samples distant from the eye) and render the scene from the light's point of view into the shadow map using the transformed light-space.

2. while rendering the scene from the eye's point of view, map each point into the transformed light-space and apply the shadow test.

Light view



Eye view[1]

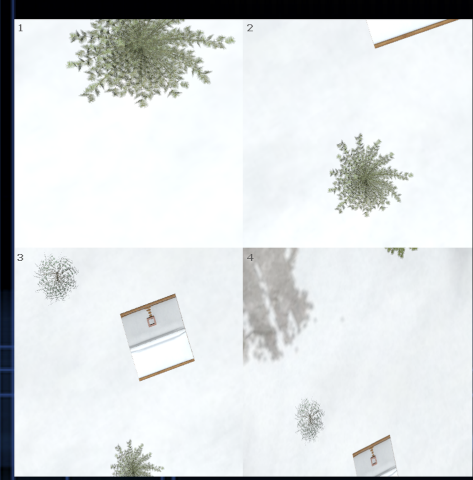


Related work 3: Z-partitioning

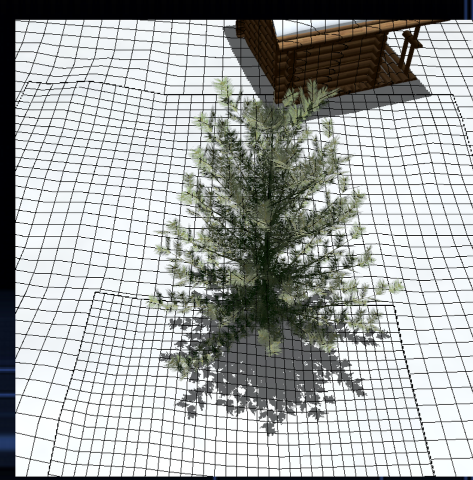
1. split the eye view frustum into several split frusta and render the scene objects of each split frustum from the light's point of view into a single shadow map.

2. while rendering the scene from the eye's point of view, determine for each point the corresponding split frustum, map the point into the correct shadow map-space and apply the shadow test using the corresponding shadow map.

Light views



Eye view[1]



Contributions

Features of the new shadow mapping framework:

- It supports basic shadow mapping, warping, z-partitioning and several other advanced shadow mapping techniques

- It supports reasonable combinations of various methods (e.g. warping + z-partitioning)

- It allows experimenting with the implemented methods and interactively adjusting almost every interesting parameter

- It provides several visualization tools for comparison and analysis of the applied techniques

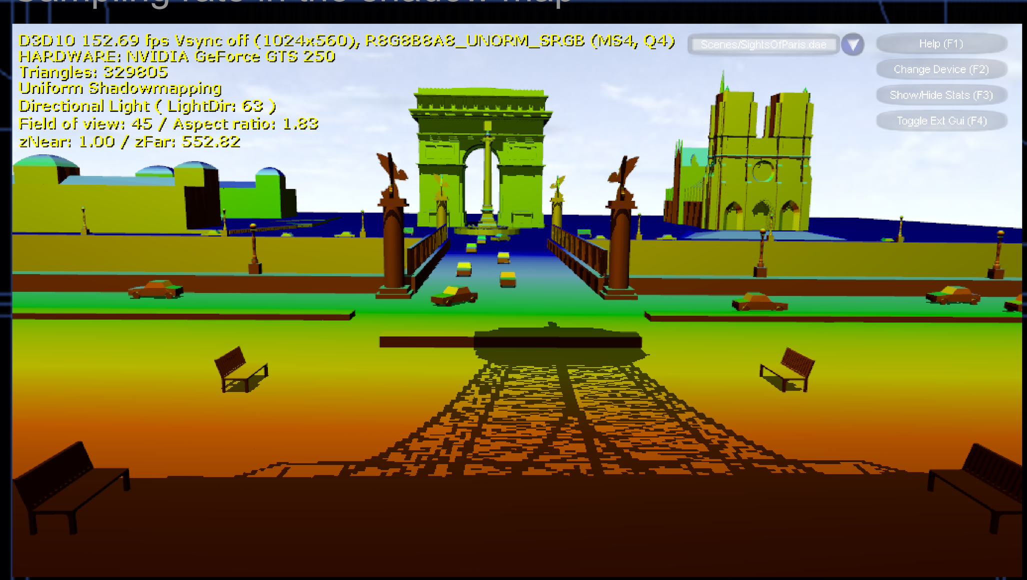
Improvements to existing techniques:

- Optimized calculation of the projection center of the perspective transform for warping to improve robustness

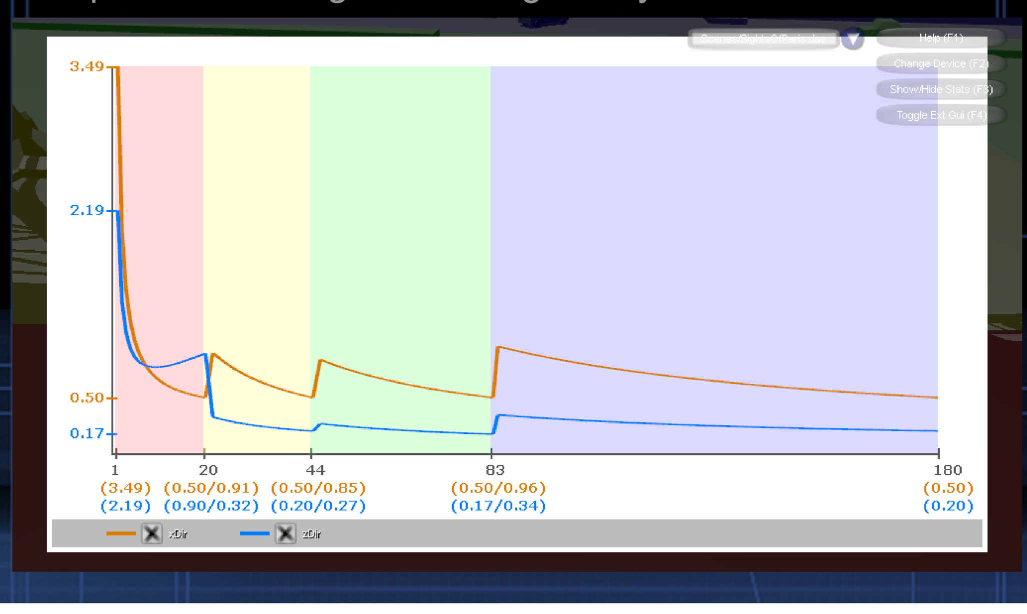
- Automatically adjusted near plane distance for the eye view frustum to improve the shadow quality of some specific methods

Results 1: Error visualizations

Sampling rate in the shadow map

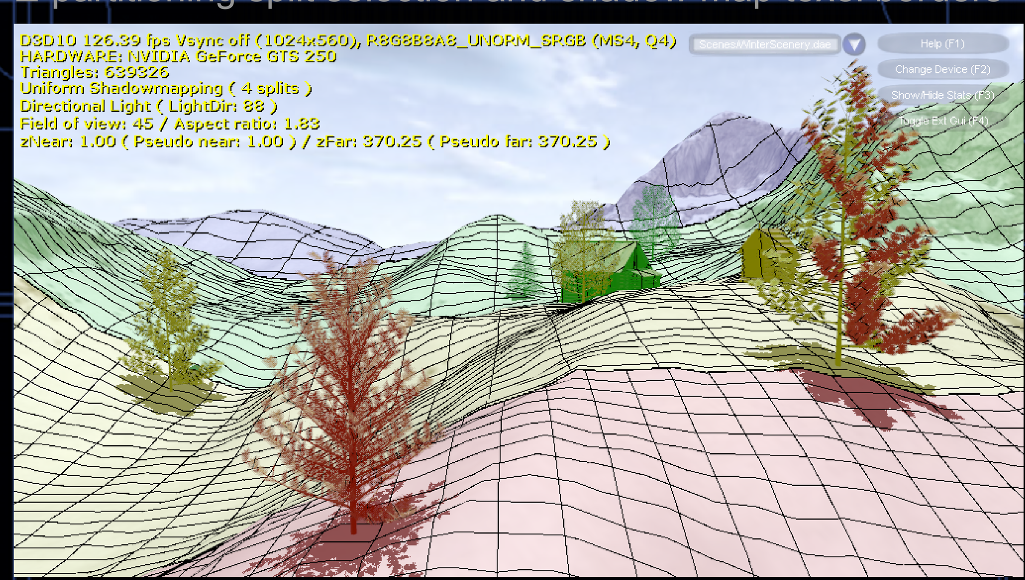


Perspective aliasing error along the eye view frustum

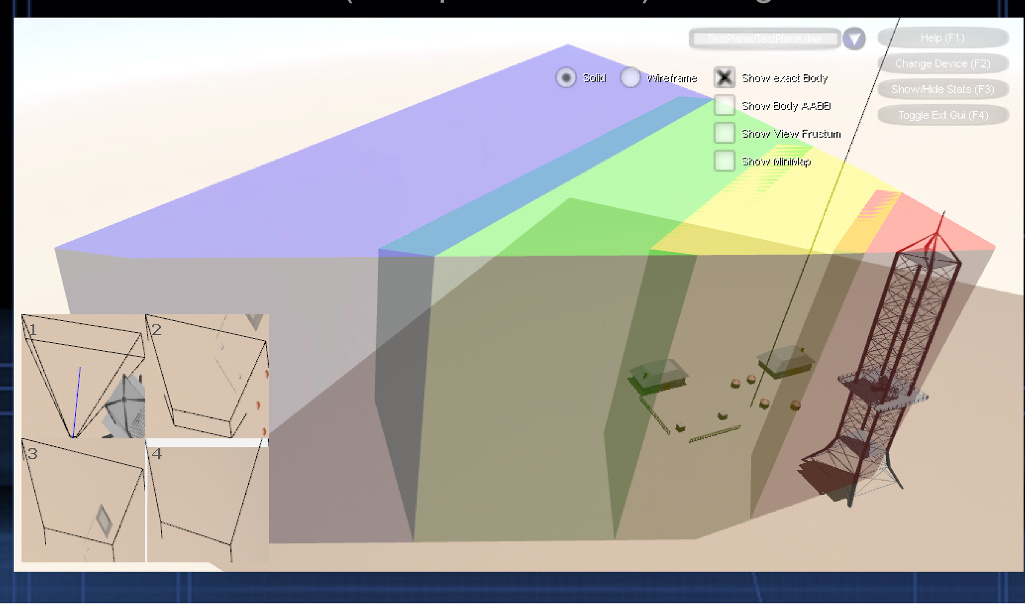


Results 2: Common visualizations

Z-partitioning split selection and shadow map texel borders



Intersection bodies (third person view) and light views



Future work

Improvements to the presented framework:
- Complete elimination of shadow flickering between consecutive frames (e.g. usage of temporal coherence)
- Visualization of sampling rate in the third person view (e.g. computation independent of current screen-space)

Improvements to shadow mapping:
- Complete elimination of shadow map aliasing (e.g. alternative partitioning approach)
- Simulation of physically correct soft shadows (e.g. appropriate sampling of an area light source)

Contact

Martin Stingl (martin.stingl@gmx.at)

Michael Wimmer (wimmer@cg.tuwien.ac.at)