FAKULTÄT FÜR !NFORMATIK
Faculty of Informatics

Diplomarbeitspräsentation

Realistic Local Lighting in Dynamic Height Fields

Masterstudium:
Computergraphik & Digitale Bildverarbeitung

Aaron Meier-Stauffer

Technische Universität Wien
Institut für Computergraphik und Algorithmen
Arbeitsbereich: Computergraphik
BetreuerIn: Associate Prof. Dipl.-Ing. Dipl.-Ing. Dr.techn. Michael Wimmer
Betreuender Assistent: Univ. Ass. Dipl.-Ing. Paul Guerrero

Problem Statement

In real-time applications, soft shadows have to be computed very efficiently. In scenes with dynamic geometry or moving light sources, this is a significant challenge and an area of ongoing research. Using global illumination methods for general geometry would be either too slow or too inaccurate to solve this problem. In the special case of height field geometry, simplifying assumptions can be made that result in increased efficiency to allow real-time soft shadows from dynamic height field geometry.

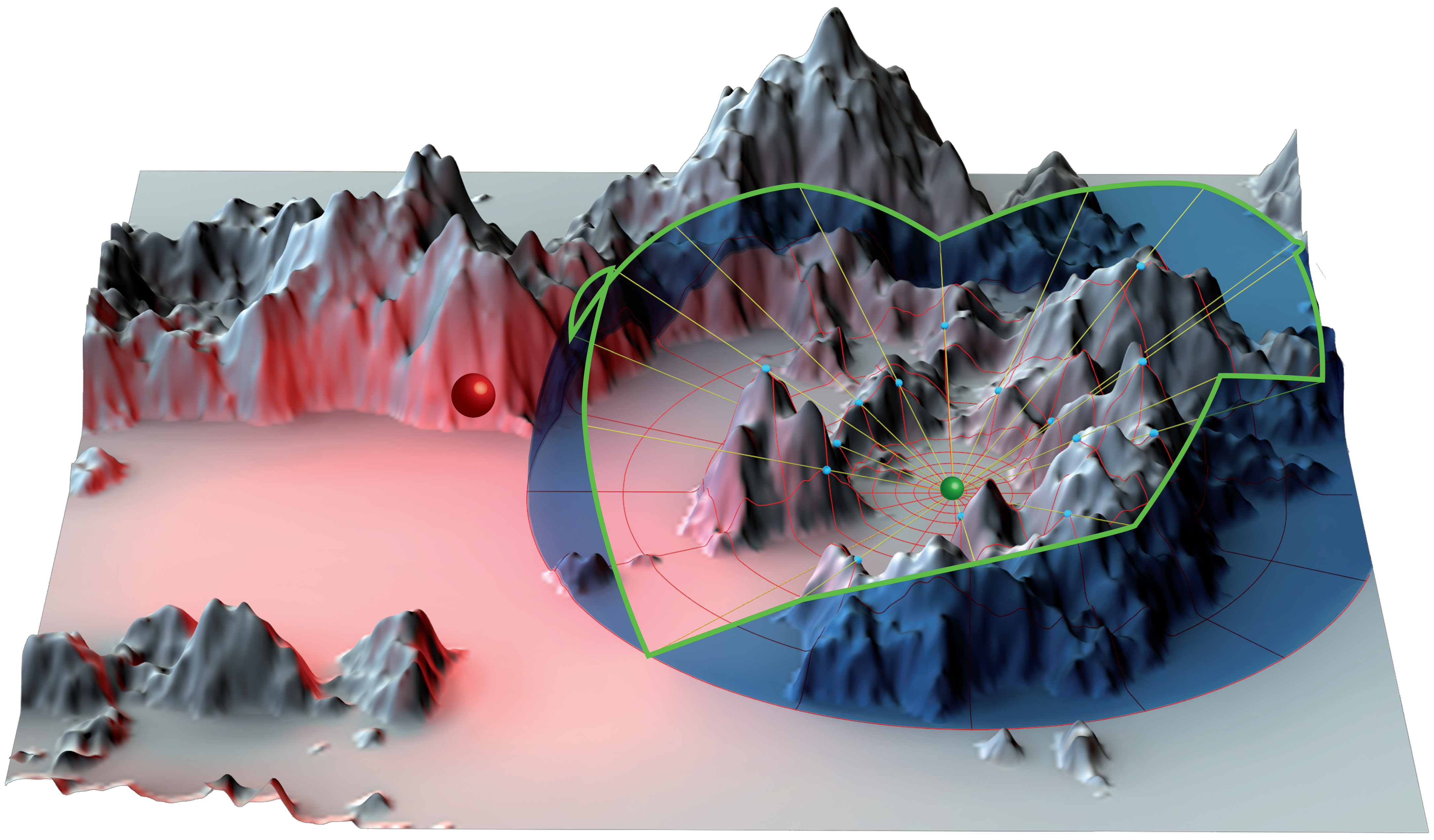
Contributions

Our methods extends an existing method by Snyder et al. [SN08] for soft shadows in height fields from **environment lighting** with two main contributions:

- **Self-Visibility**: An efficient method to compute the visibility of the spherical local light sources at each receiver point on the height-field
- **Incident Radiance**: A method to compute the unshadowed incident radiance from **spherical local light sources** at each receiver point on the height-field

Soft Shadows from Local Lights

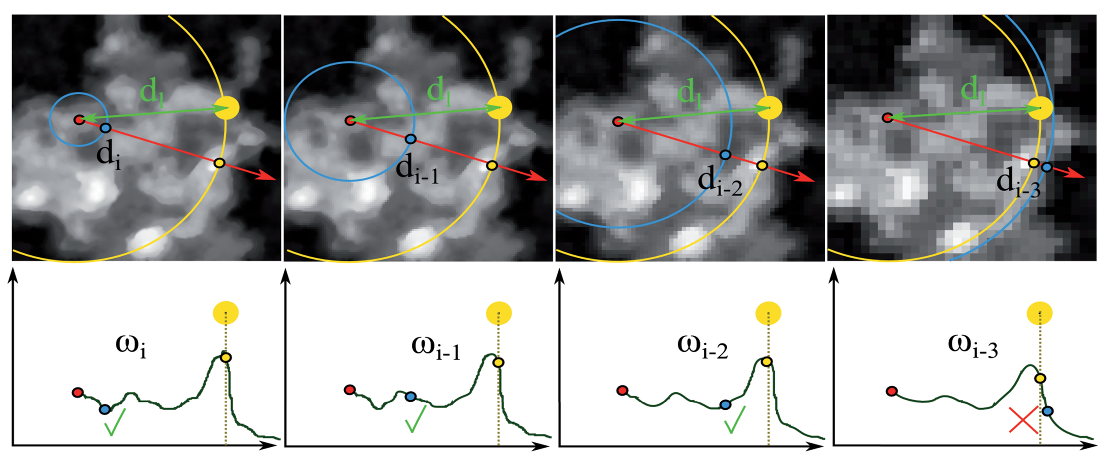
To shade a receiver point we need to integrate the product of three functions over the hemisphere around the receiver point: the **visibility function**, the **BRDF** and the **incident radiance**, each represented in the **Spherical Harmonics (SH)** basis.



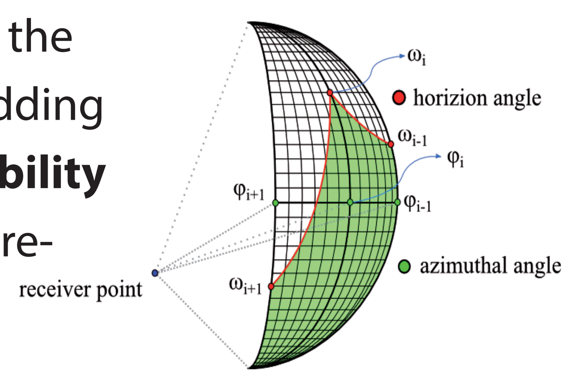
receiver point · radial sample grid · horizion samples · local light source · horizion

Self-Visibility — Contribution 1

The horizion for a receiver point is approximated by sampling height differences between the sample- and the receiver point in a radial grid around the receiver point. Sample density decreases with distance from the receiver point and a **multi-resolution pyramid** of the height field is used to used to sample from pre-filtered versions of the height field where the sample density is lower. Samples with a distance larger than the local light source are discarded..

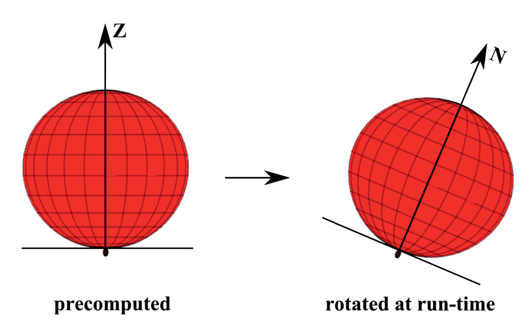


To avoid the costly projection to the Spherical Harmonics (SH) basis, the SH projection of the horizon is composed by adding several precomputed **'visibility wedges'** that have been pre-projected to the SH basis.



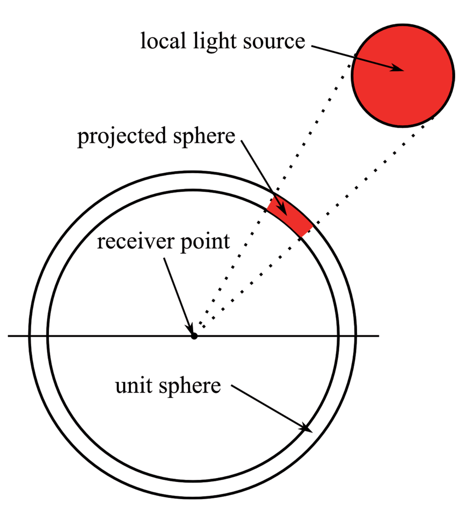
BRDF

The diffuse reflectance at a receiver point is computed using the clamped cosine around the normal. The projection to the SH basis is done through **Zonal Harmonics rotations**.



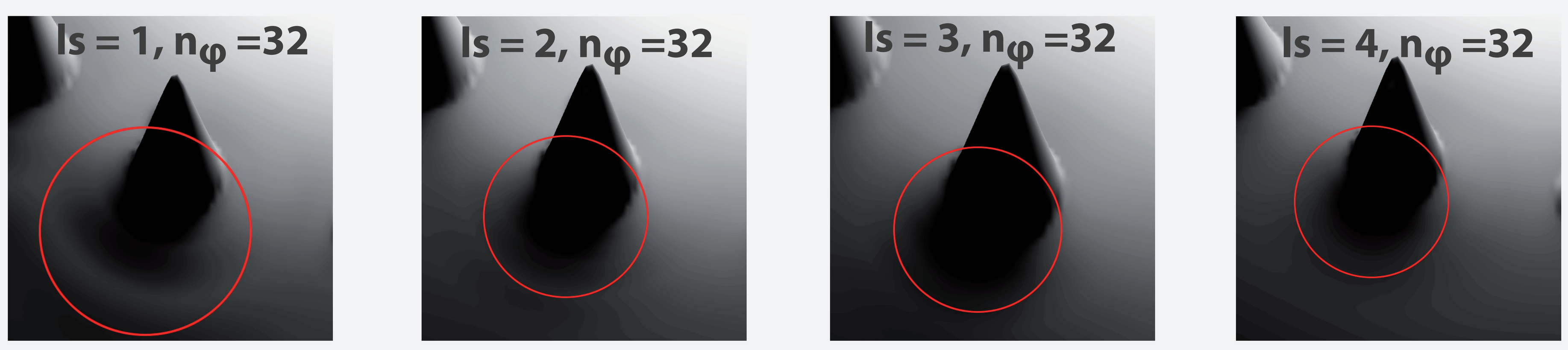
Incident Radiance — Contribution 2

The incident radiance at the receiver point is approximated by projecting the light source onto the unit sphere, centered around the receiver point. Again, the SH projection is done through Zonal Harmonics rotations.

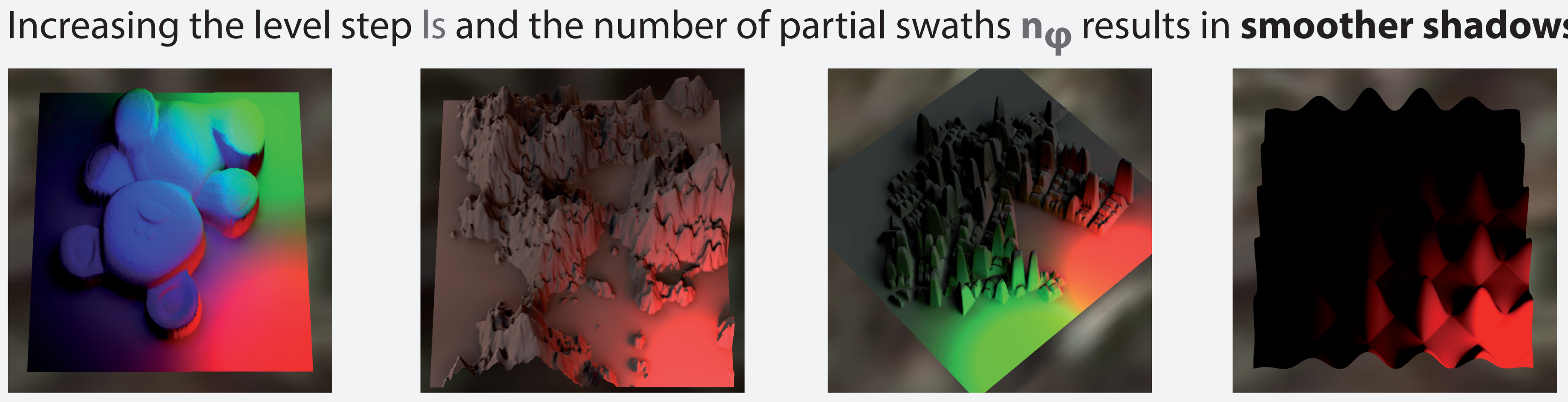


Results & Conclusions

Here we show different scenes and lighting configurations including three local lights and an environment light. The scenes and the lights are fully dynamic. We have two main parameters: level step **ls**, which adds additional levels into the multi-resolution pyramid, and the radial sampling density n_φ, which determines the number of directions in the radial grid. Real-time frame rates for soft shadows from up to three local light sources and an environment light source were achieved on consumer graphics hardware.



Increasing the level step ls and the number of partial swaths n_φ results in **smoother shadows**.



References

[SN08] Fast soft self-shadowing on dynamic height fields. Computer Graphics Forum: Eurographics Symposium on Rendering, June 2008.

Kontakt: aaron.meier-stauffer@gmx.at, paul@cg.tuwien.ac.at, wimmer@cg.tuwien.ac.at