

Bent Normals and Cones in Screen Space

Oliver Klehm

1. Motivation

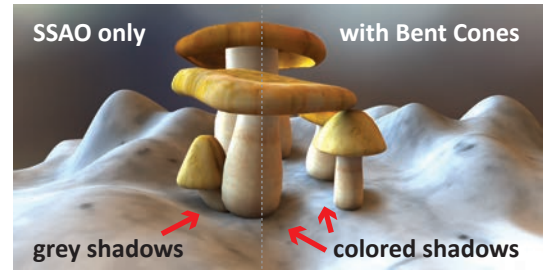
Ambient occlusion (AO) is a fast, approximate technique for uniform environmental lighting. Surface points compute an average occlusion caused by nearby objects.

Ambient occlusion properties:

- visually improved lighting
- fast to compute
- real-time approximation possible (SSAO; standard in modern game engines)
- ignores directionality of lighting by decoupling occlusion and shading

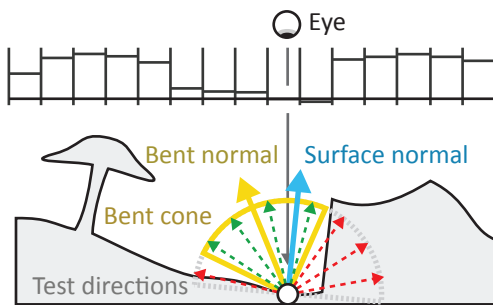
++
++
++

—

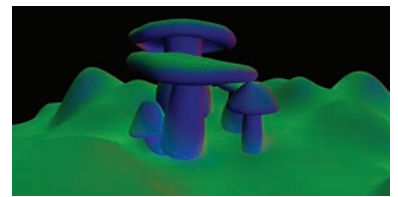


→ Our approach: Use statistics to derive unoccluded directions and estimate contribution of the visible environment.

2. From Ambient Occlusion to Bent Normals



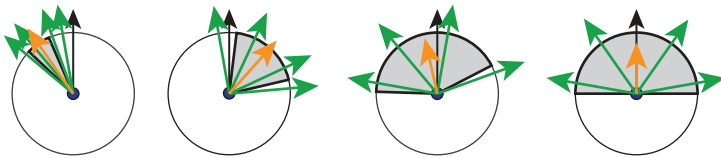
Ambient occlusion:
Percentage of unoccluded directions



Bent normal:
Average of unoccluded directions

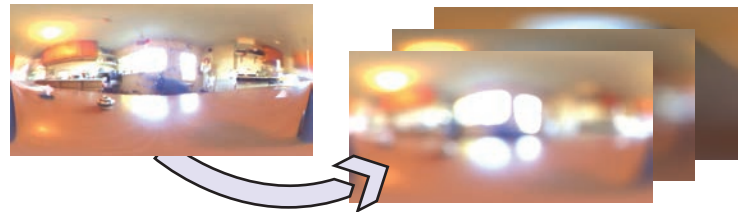
Compute ambient occlusion and bent normals in screen space by testing random directions for occlusion

3. Bent Cones



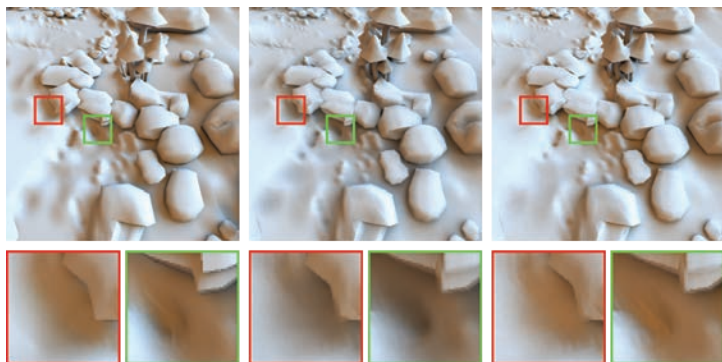
Map variance of unoccluded directions to cone angle

4. Environmental Lighting



Query pre-convolved environment map with bent normal

5. Results

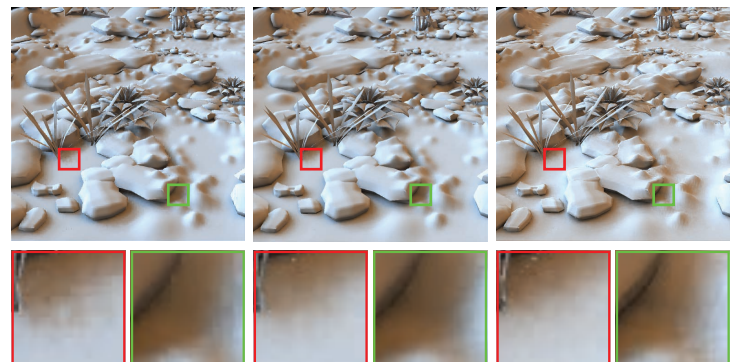


Ray traced
environmental lighting

Bent Normals /
SSAO

Bent Cones /
SSAO

6. Performance



Importance Sampling
32 directions, 18.8 ms

SS Directional Occlusion
16 directions, 12.5 ms

Bent Cones
8 directions, 6.0 ms
speed-up 3x

Bent Normals and Cones in Screen-space. 16th International Workshop on Vision, Modeling and Visualization (VMV 2011, Berlin).

Screen-space Bent Cones: A Practical Approach. GPU Pro 3. Oliver Klehm, Tobias Ritschel, Elmar Eisemann, Hans-Peter Seidel