

The effects of smoothing on ray reflections

1. Background

- Ray tracing is useful for games, animation and designing [1]. Although it is very expensive to compute. To combat this we can use height fields[2] to reduce render time.
- Micro-surfaces can have a profound effect on how rays reflect off a surface. This micro-surface is approximated with statistical models in normal ray tracers.
- There exist algorithms that make 3D models look smooth such as normal interpolation and Phong tessellation[1]

2. Research question

what is the effect on the reflection of rays on micro geometry when applying smoothing techniques on a height field?

3. Methodology

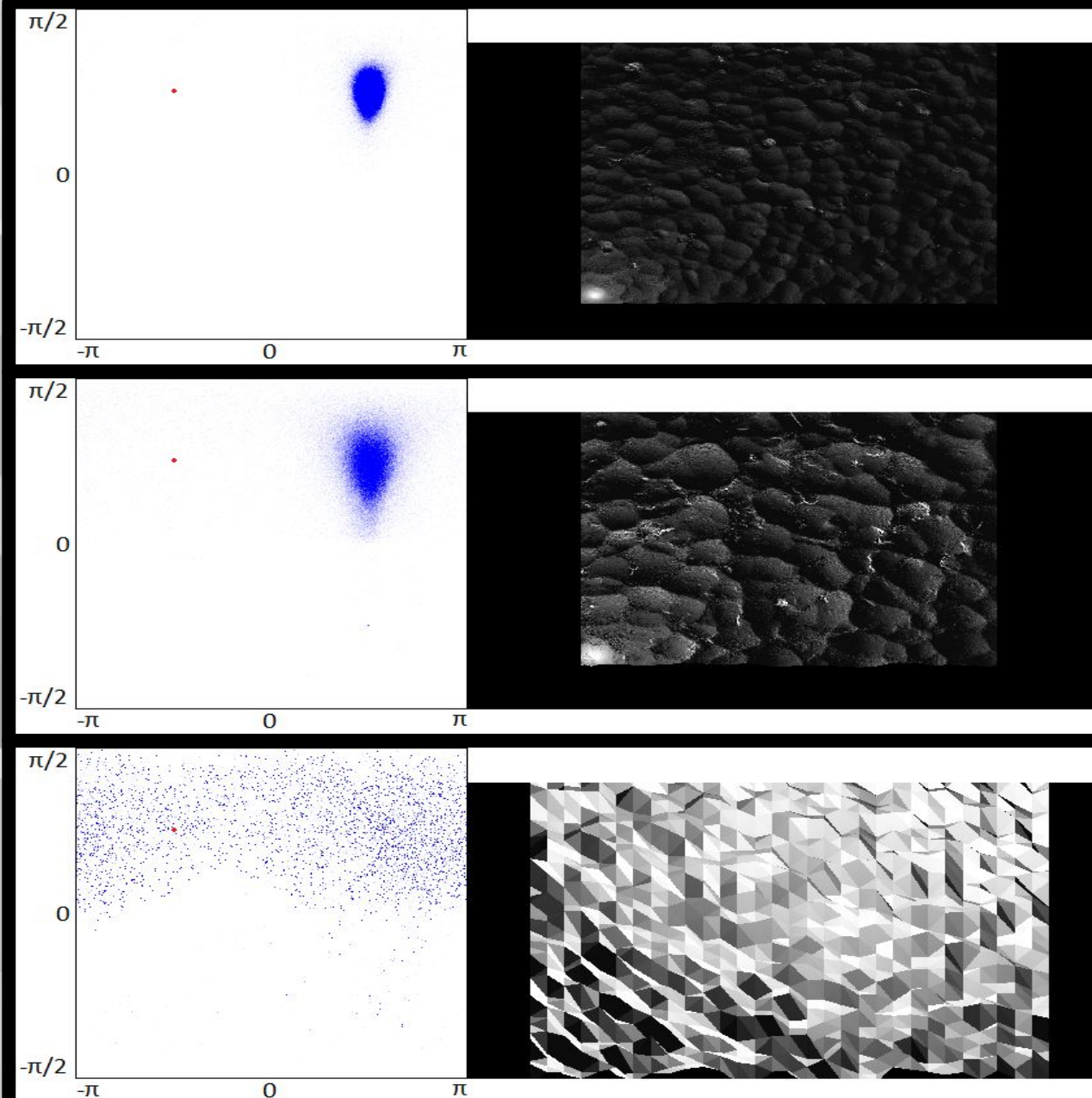
In order to show and compare different micro-surfaces and their reflections, the direction of reflected rays has been put into graph. The direction of rays has been extracted by transforming the coordinate system of the rays into polar form. The two angles in the polar form were then used as the x- and y-axis. A rendered image of the surface will also be provided so that the general roughness and shape can be related to the distribution of the reflected rays.

References

- [1] Boubekur, T., & Alexa, M. (2008). Phong tessellation. ACM Trans. Graph., 27.
- [2] Dübel, S., Haubelt, L. M. C., & Schumann, H. (2015). A flexible architecture for ray tracing terrain heightfields. <https://doi.org/10.1145/1073204.1073305>
- [3] X. Jiang, Y.-H. Chiang, Y. Zhao, and Y. Ji, "Plato: Learning-based adaptive streaming of 360-degree videos," Oct. 2018, pp. 393–400. doi: 10.1109/LCN.2018.8638092.

5. Results

Two aluminium micro-surfaces and one randomly generated surface. The red dot represents the camera direction and the blue cloud are the reflected rays. The randomly generated surface is 30 by 30 and the two aluminium surfaces have a size of 480 by 640



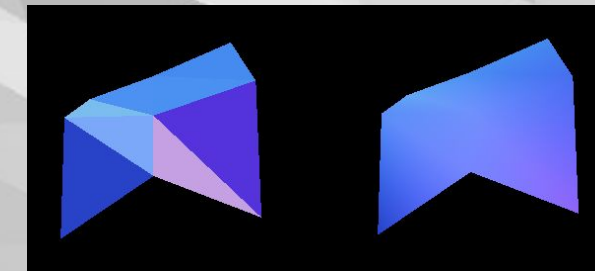
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4. Algorithms

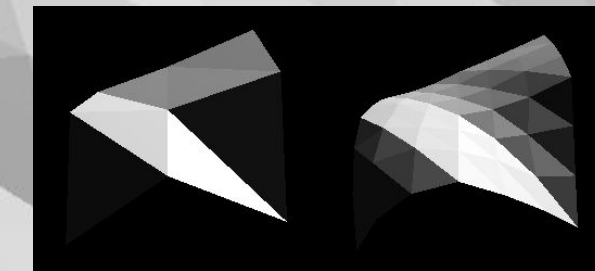
- Normal interpolation

Normal interpolation require us to put 3 normals on each of the vertices of a triangle. When a ray hits a triangle we mix these 3 normals depending on how close they are to each vertex.



- Phong tessellation

Phong tessellation divides triangles and then repositions the newly generated vertices.



- Height field

Height fields are 2D arrays that represent what the height should be at their index. By taking advantage of the structure of the data we can improve the render time.

6. Conclusion

- When the micro-surface has a high triangle density, then the smoothing has very little effect. If the triangle density is low enough then the smoothing does matter
- Rougher surfaces have displayed a more spread out distribution than

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