Advances in Sphere Tracing

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Regardless of the higher-level representation such as parametric, implicit, and subdivision surfaces, the final representation to be rendered is a list of triangles in most applications. Even though rendering triangles is extremely fast and well understood, the original geometry needs to be converted to that representation efficiently. Instead, this talk focuses on singed distance functions, which is an implicit representation that can be rendered directly in real-time with a technique known as sphere tracing [1]. Bypassing the intermediate memory-heavy triangle representation makes sphere tracing ideal for real-time fractal visualization which spearheaded the field.

Nowadays, the sphere tracing technique is used in a variety of applications [4] and was enriched with novel techniques, for example world-space ambient occlusion [3], soft-shadow algorithms [9], and anti-aliasing to enrich the visuals rendered with it. The sphere tracing algorithm imagined by Hart was accelerated with a variety of techniques that rely on smoothness [7], surface convexity, multiple resolutions [7], or clever heuristics [2]. Generalizations of sphere tracing, such as cone tracing, and their applications are also discussed.

Finally, we showcase how the representation is constructed for various shapes [6], and briefly review the theoretical background of signed distance function estimates [5, 8].

References

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