

Introduction

Ray-tracing has long been used as tool for generating realistic images, and has accumulated a number of different benchmarks over the years, primarily focusing on generating high-quality images. However, we are now moving into the era of real-time *animated* ray-tracing, thus, some old benchmarks that, at the time, did not garner much attention, can be a good starting point for trialing techniques that target animated content. Thus, in this work we take a look back at the *Benchmark for Animated Ray Tracing* [1] (BART) and adapts it to a world of real-time path-tracing with the help of the Spatiotemporal Variance-Guided Filtering (SVGF) [2].

A Single Shader Pipeline

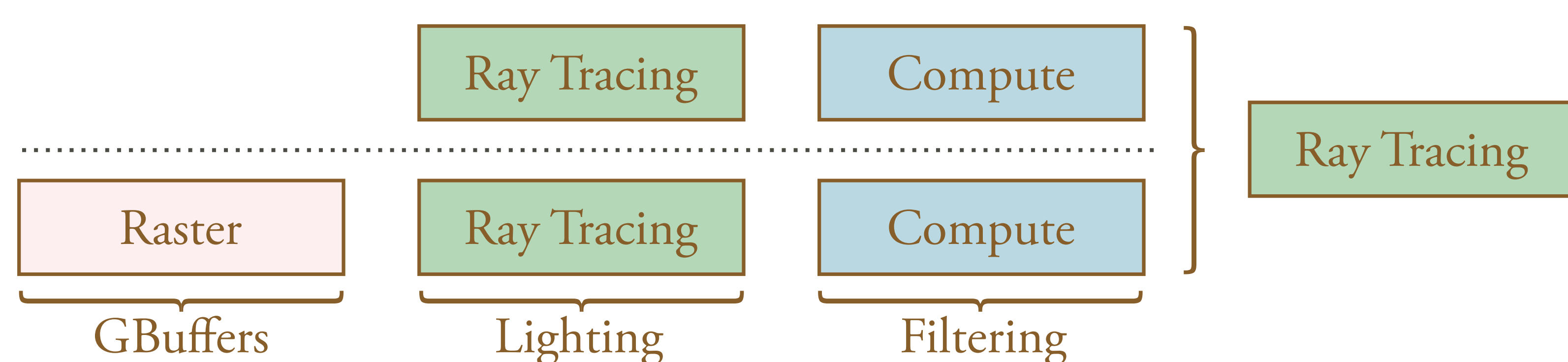


Figure 1: SVGF is typically used with multiple shader stages at once: Either with the rasterization, ray-tracing, and compute pipelines, or just the ray-tracing and compute pipelines. For this work, I wanted to see if I could do *everything* in the ray-tracing pipeline by (ab-)using the shader binding-table and potentially avoid pipeline flushes and related performance issues.

Feature Summary

- A simple, but feature-complete implementation of the paper version of the SVGF [2] filter, with focus on clarity rather than performance.
- A novel (?) way of structuring the filter as a part of the SBT.
- Trowbridge-Reitz (GGX) surface shading model.
- Simple path-tracer for specular reflections, refractions and GI.
- Alternative rendering and filtering of e.g. ambient occlusion.

Shader Binding Table

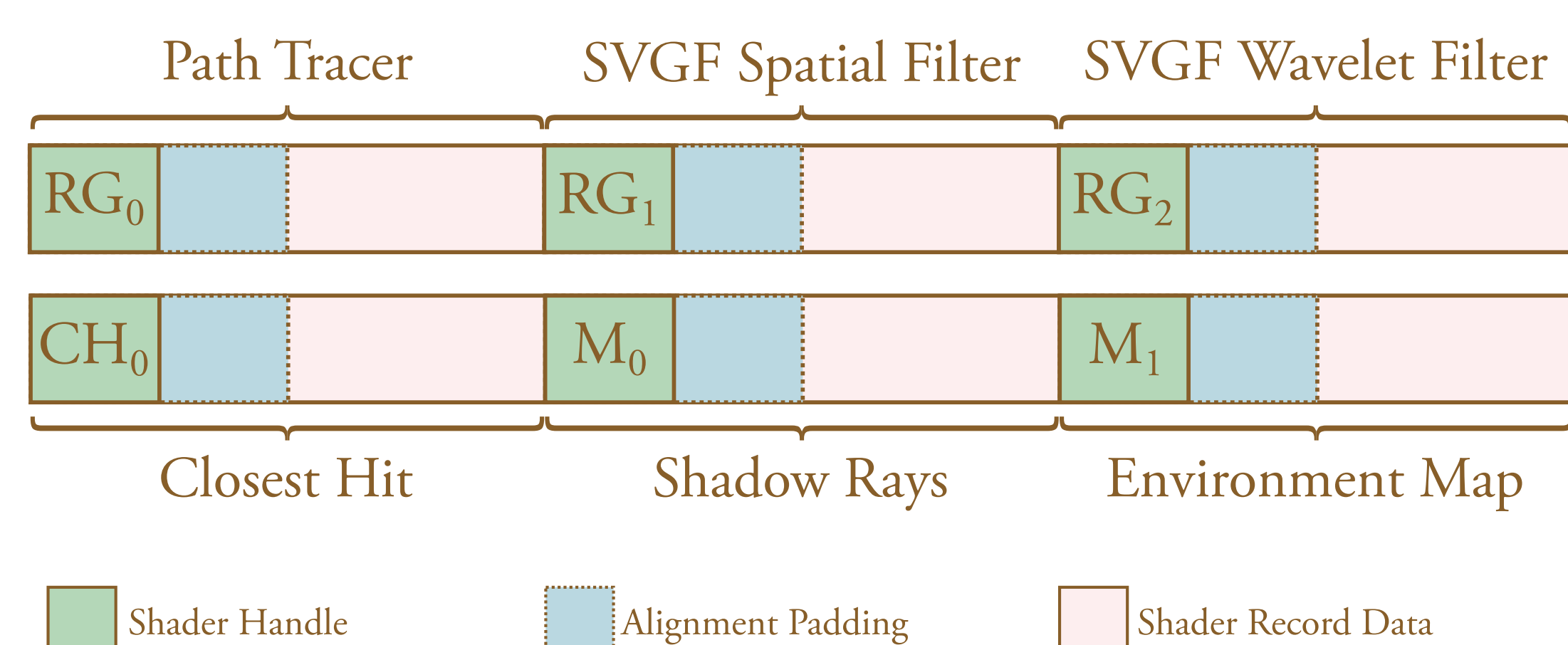


Figure 2: The Shader Binding Table (SBT) control both the rendering and filtering: The first RayGen-shader performs the primary rendering, and optionally, the temporal filtering, whereas the remainder perform the actual SVGF passes; the spatial and à trous wavelet filters.

Ray Tracing Pipeline

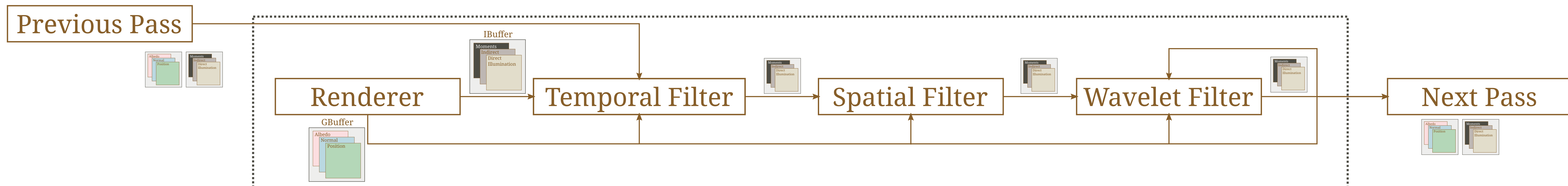
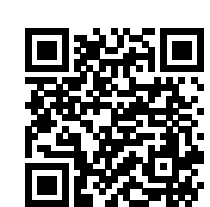
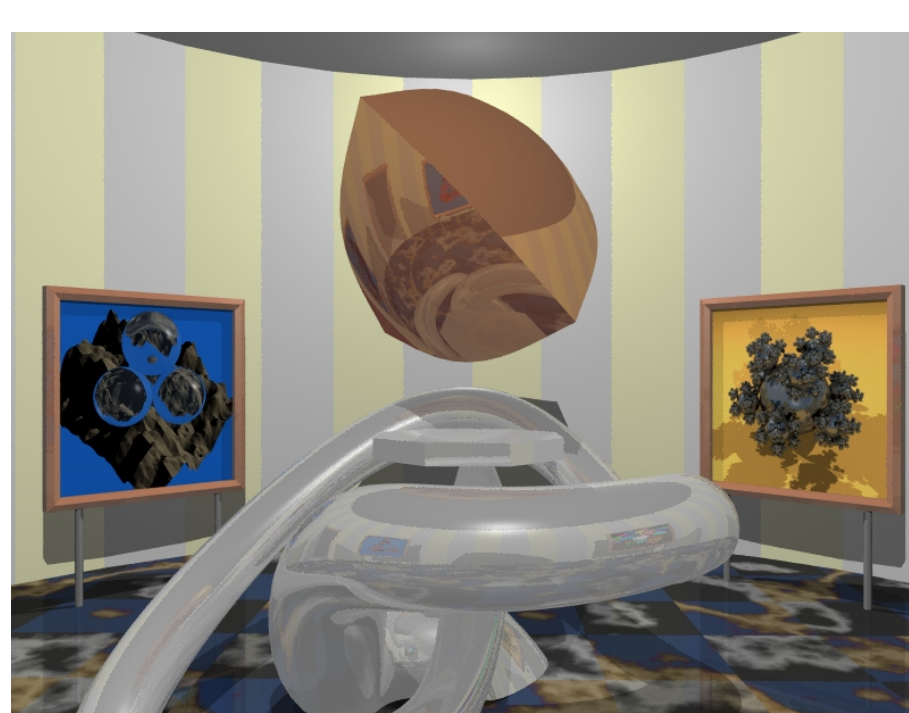
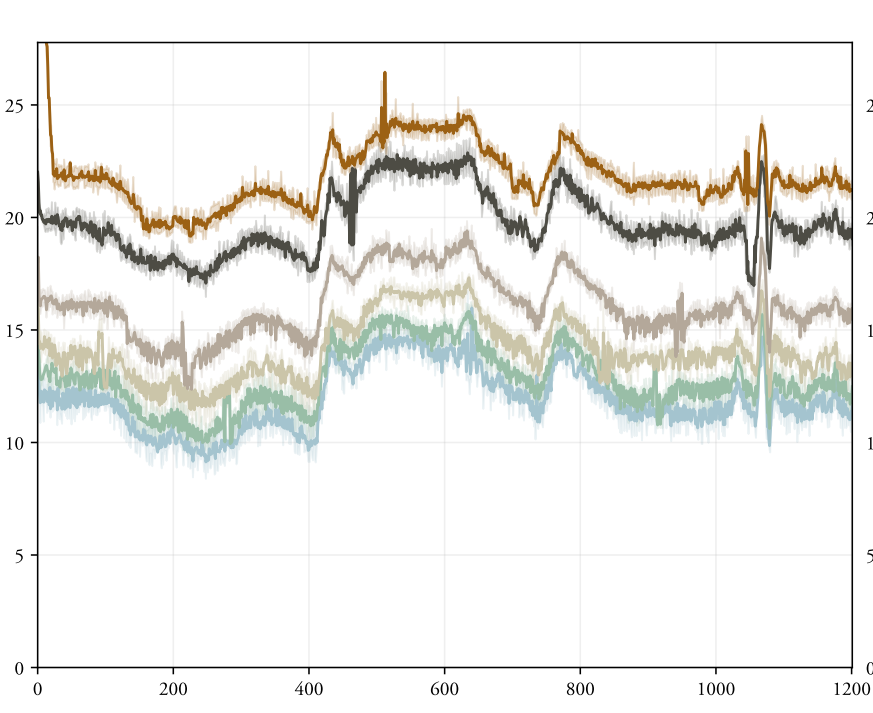


Figure 3: High-level overview of the ray-tracing and filtering pipeline: The renderer generates a Geometry Buffer (GBuffer) and Illumination Buffer (IBuffer) that is then filtered in the respective SVGF filter components.

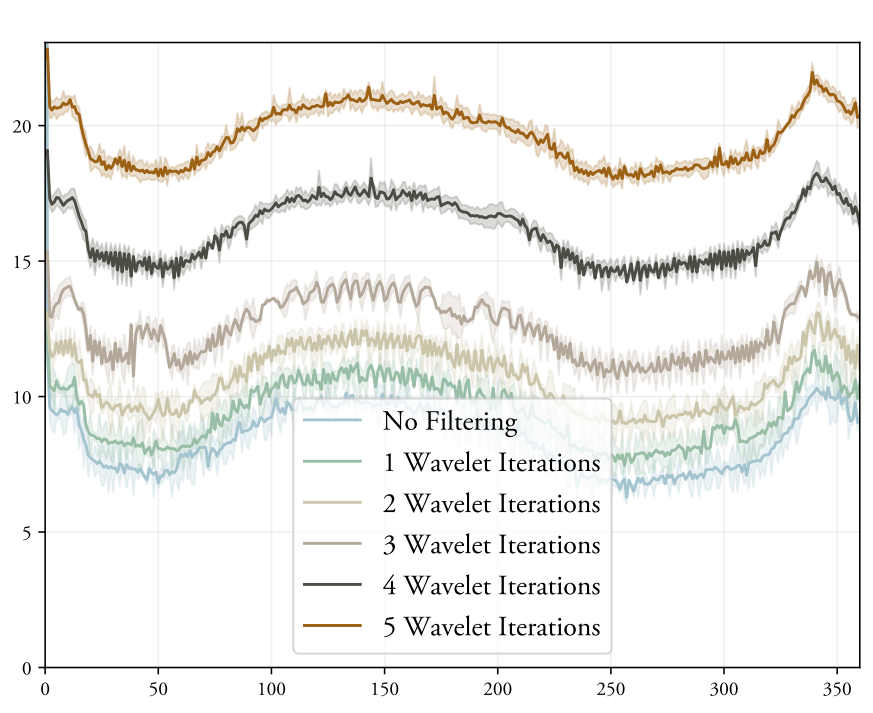
Scenes and Performance Results



Kitchen



Museum



Robots

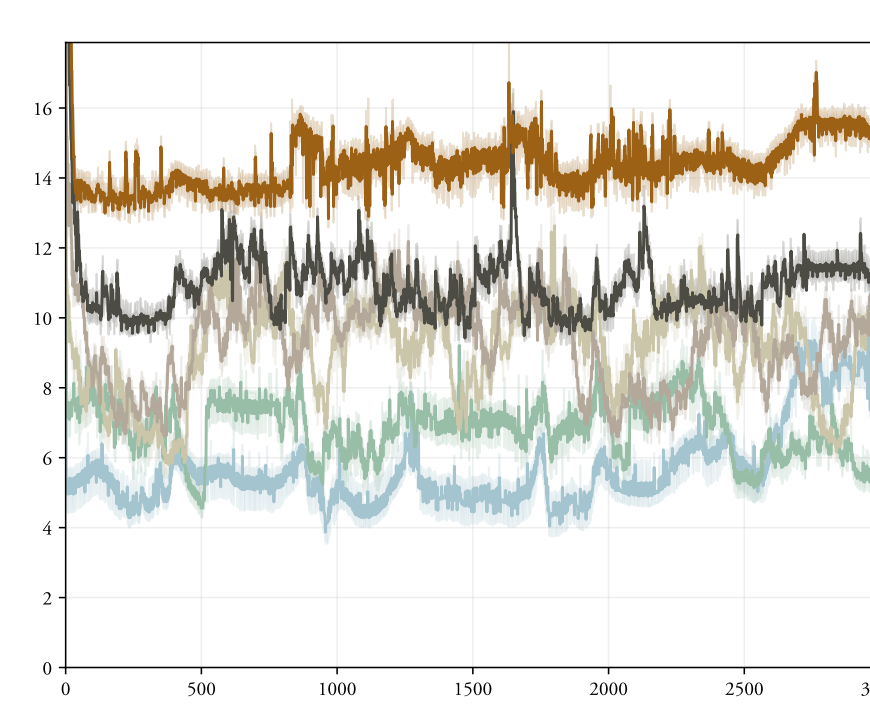
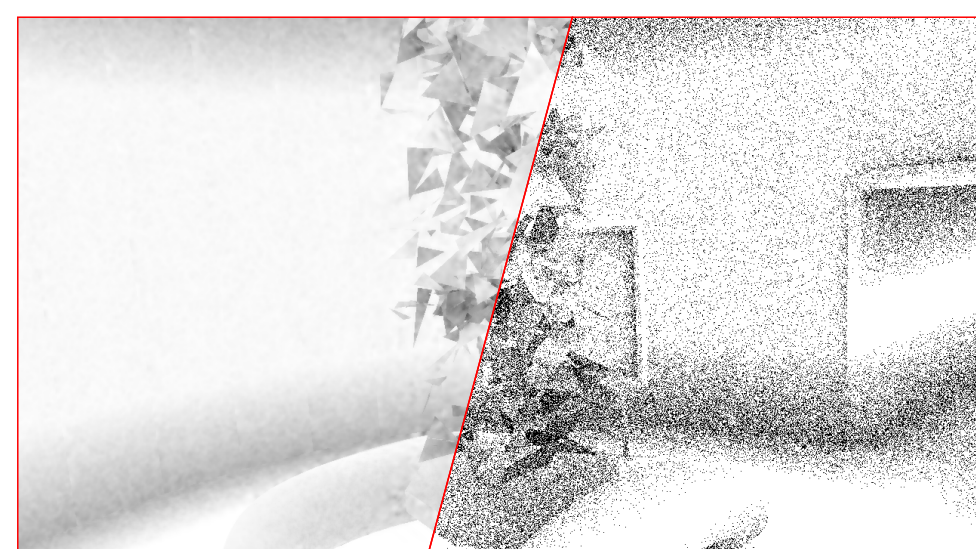
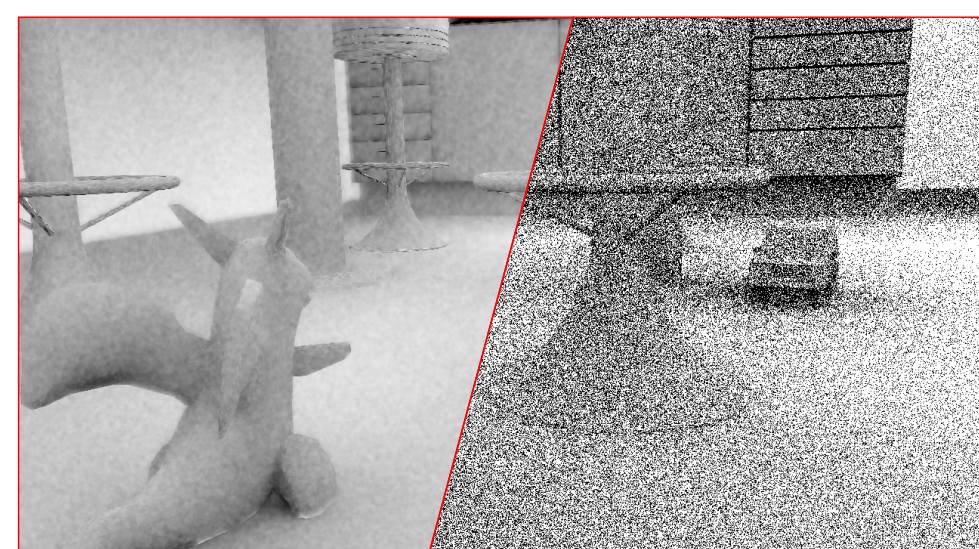


Figure 4: The BART [1] scenes and associated frametime results in milliseconds (ms) for each frame of the animation with either no filtering, or up to 5 iterations of the à trous wavelet filtering. Additionally, this works includes a g1TF conversion of the original AFF scenes, available through the QR-codes, albeit limited to linear animations for the time being.

Additional Renderers and the History View

Ambient Occlusion



History Length

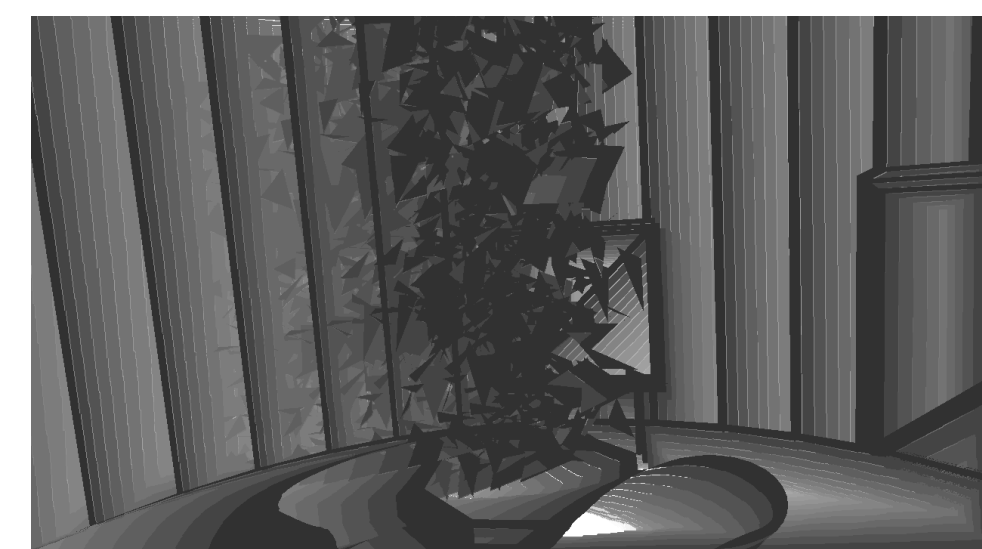
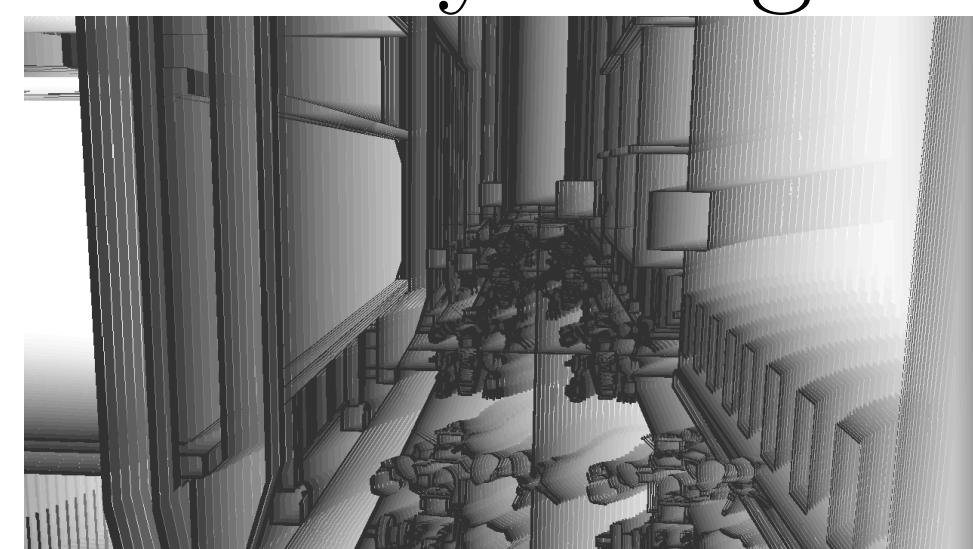
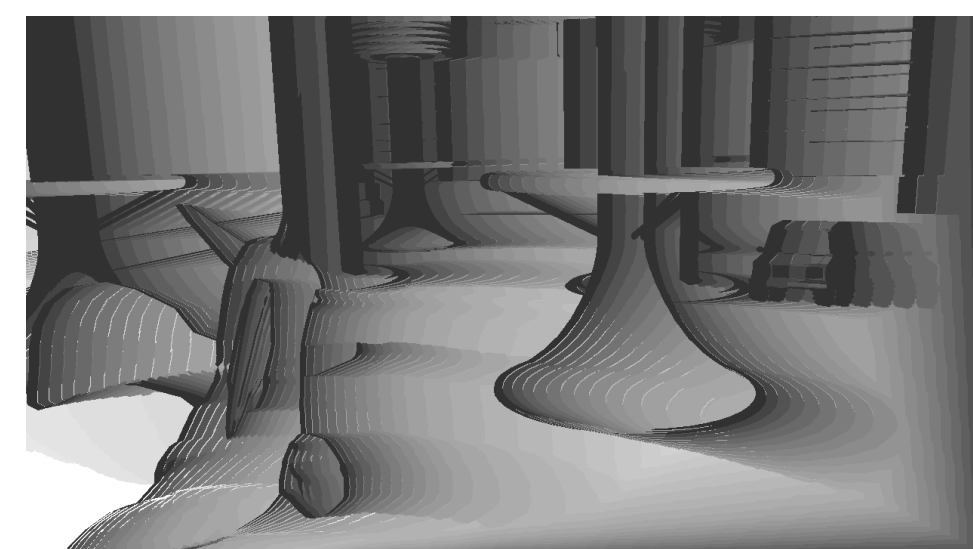


Figure 5: Alternative renderers supported by this framework, such as SVGF filtered Ambient Occlusion with a single sample ray per-pixel (left) and the currently accumulated history length of the SVGF filter (right), the latter of which is a very useful visual milestone while implementing the filter.

References

- [1] J. Lext, U. Assarsson, and T. Moller. "A Benchmark for Animated Ray Tracing". In: *IEEE Computer Graphics and Applications* 21.2 (2001), pp. 22–31. DOI: 10.1109/38.909012.
- [2] Christoph Schied et al. "Spatiotemporal Variance-Guided Filtering: Real-time Reconstruction for Path Traced Global Illumination". In: *ACM/EG Symposium on High Performance Graphics (HPG)*. July 2017, pp. 23–41. DOI: 10.1145/3105762.3105770.

Videos

