WebGPU Pathtracer + NPR + Cloth Sim

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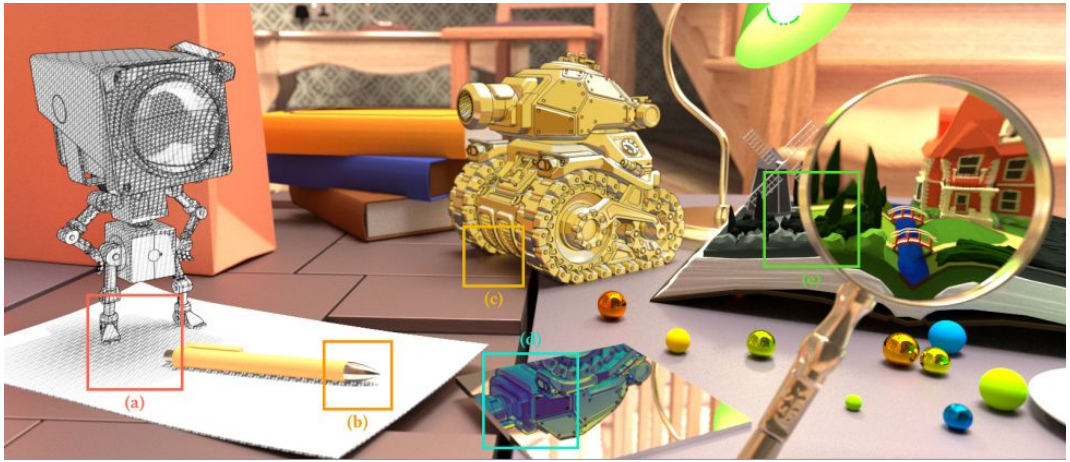
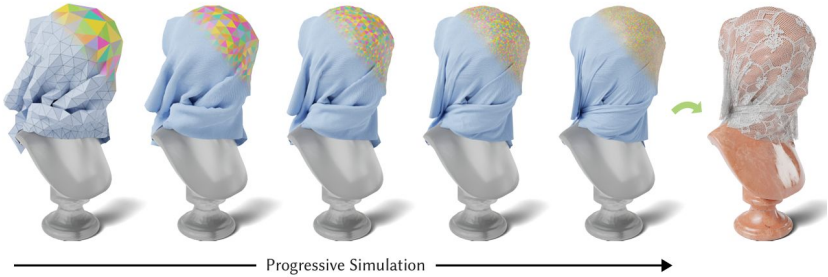
Objectives and Goals

Goal: Explore WebGPU as a platform for artists' exploration of stylization and simulation

- WebGPU-based pathtracer with keyframable object motion (produces a sequence of renders)
- Stylized Rendering as a Function of Expectation on the rendering equation
- Progressive Dynamics for Cloth Animation



Application of GPU Programming & Significance of Topic



- **Pathtracer & NPR** - Path continuation/termination using Stream Compaction, shading kernels as compute/fragment shader passes
- **Cloth simulation** - Compute shader passes per frame accounting for various forces and interactions

- WebGPU pathtracer is still an active area of research. Specialized web-based rendering engine for NPR allows artists to explore and share various stylizations in a platform-agnostic manner free of cost online.
- Progressive cloth simulation allows for consistent behavior of cloth simulation across all LODs of a model, with fast prototyping capabilities provided by coarse granularity that fits well with the nature of WebGPU.

Milestone Schedule

Milestone 1

- Implement WebGPU-based pathtracer with custom mesh and texture loading, acceleration structure, and keyframing of object motion

Milestone 2

- Integrate NPR stylization technique as a part of shading kernel stage and explore parameterization schemes and biased/unbiased estimators for various desired visual effects
- Implement progressive dynamics cloth simulation

Milestone 3

- Explore other post-processing stylization techniques and additional compute shader passes on the framebuffer content

Final

- Complete remaining tasks and additional features to be explored
- Perform comprehensive analysis on various performance and qualitative observations

Technologies & References

- WebGPU, Typescript

- https://github.com/CIS5650-Fall-2024/Project3-CUDA-Path-Tracer
- https://github.com/CIS5650-Fall-2024/Project4-WebGPU-Forward-Plus-and-Clustered-Deferred
- Stylized Rendering as a Function of Expectation (2024) http://cv.rexwe.st/pdf/srfoe.pdf
- Progressive Simulation for Cloth Quasistatics (2023) https://pcs-sim.github.io/pcs-main.pdf
- Progressive Dynamics for Cloth and Shell Animation (2024) https://pcs-sim.github.io/pd/progressive-dynamics-main.pdf