Realtime Vulkan Hair: Milestone 3

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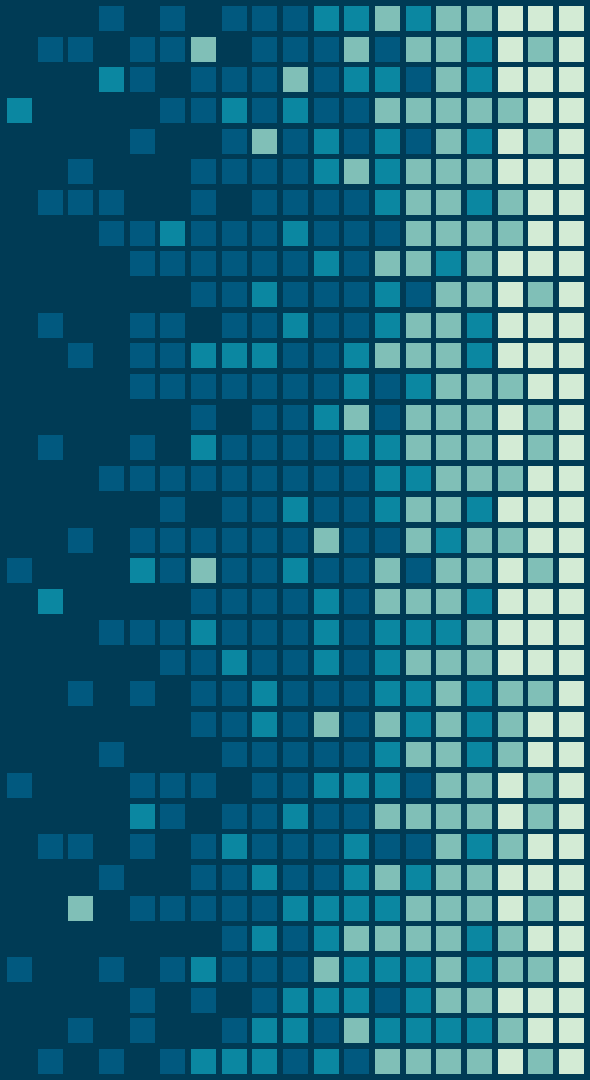


Project Overview

- Interactive realtime hair simulation in Vulkan
- Realistic sim should have ~1,000,000 hairs that interact with each other and objects

An Artist Friendly Hair Shading System (2010)

Milestone 3

- Expanded isolines into triangles with geometry shader
- Started single scattering
- Moveable collision objects

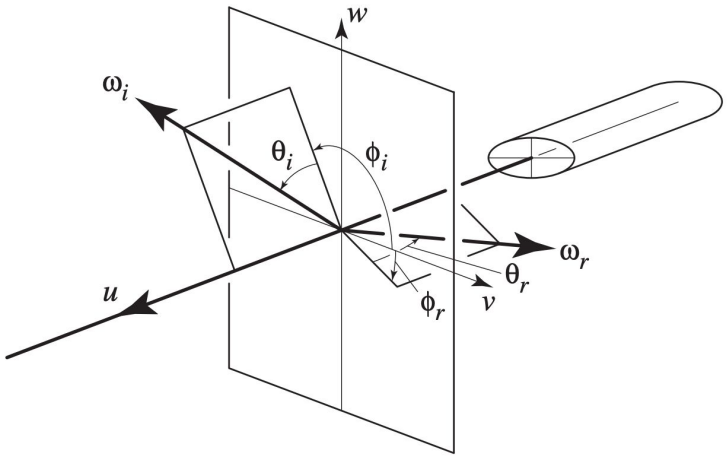
Live Demo

Geometry Shader

- Occurs between tessellation evaluation and fragment shader
- Expands isolines in triangles

Rendering: Single Scattering

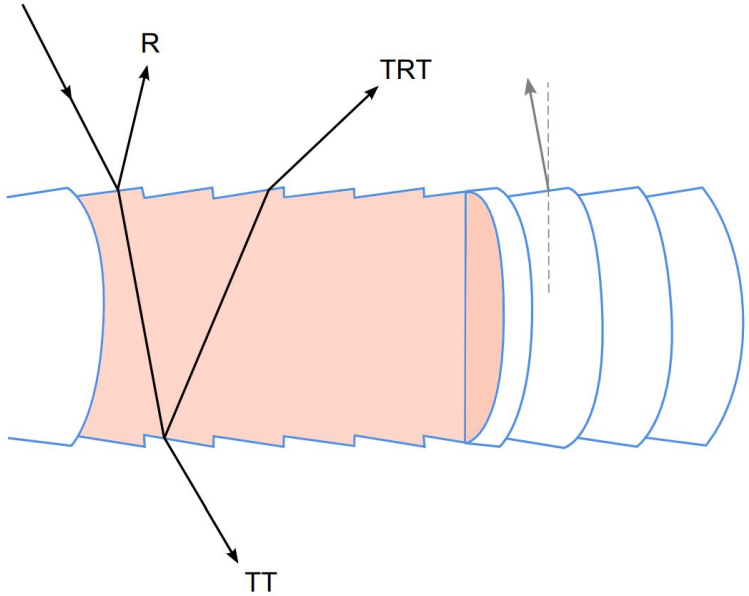
- **Marschner Shading Model** (with approximations)
- Basically a BSDF for a curve/line
- **$S(\theta_i, \theta_o, \varphi_i, \varphi_o)$** can be factored into product of two functions: **longitudinal scattering $M(\theta_i, \theta_o)$** and **azimuthal scattering $N(\theta_d, \varphi_d)$**



Light Scattering from Human Hair Fibers (2003)

Rendering: Single Scattering

- **Focus on 3 paths:**
- **R:** light hits surface and is immediately reflected
- **TT**: transmitted inside hair, then transmitted back out
- **TRT**: transmitted inside the hair, reflected at backside of hair, then transmitted again



Light Scattering from Human Hair Fibers (2003)

Rendering: Single Scattering

R

TRT

Full

Full with eccentricity

Light Scattering from Human Hair Fibers (2003)

Current Issues

- The same as last week
- Setting up and connecting a second compute shader in Vulkan needed for hair-hair collisions
- Multi-strand tessellation, plus combining it with single strand
- Imperfect collisions
- General Vulkan hijinks

Next Steps

Final

- Finish rendering
- Refine tessellation
- Hair-hair collisions
- User interaction
- Polish demo

References

- Fast Simulation of Inextensible Hair and Fur
- Advanced Techniques in Real-time Hair Rendering and Simulation
- Strand-based Hair Rendering in Frostbite
- Physically Based Hair Shading in Unreal
- Light Scattering from Human Hair Fibers

Questions?