Realtime Vulkan Hair: Milestone 1

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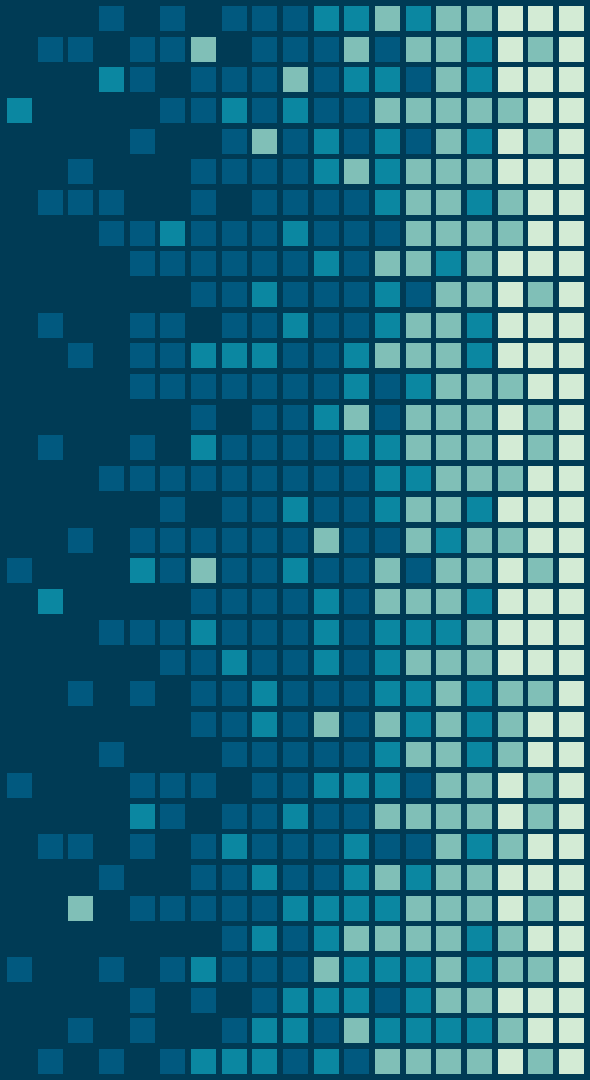


Project Overview

- Interactive realtime hair simulation in Vulkan
- Realistic sim should have ~1,000,000 hairs!

Milestone 1

- Set up project base (based on HW4)
- Follicle placement from sampling mesh
- Physics sim in compute shader
- Bezier interpolation within a strand (tessellation shaders)

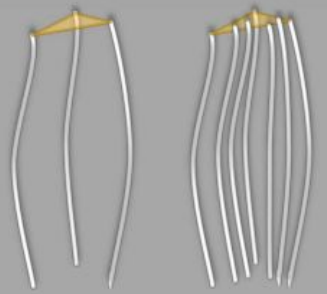
Guide Strand

Simulated/Stored Vertices

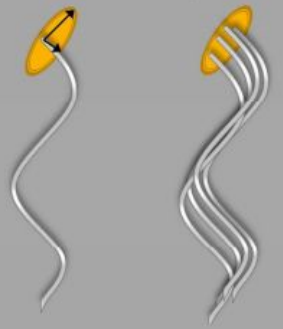
Tessellated Guide Strand

Smoothly Tessellated Hair by creating new vertices

Create New Strands



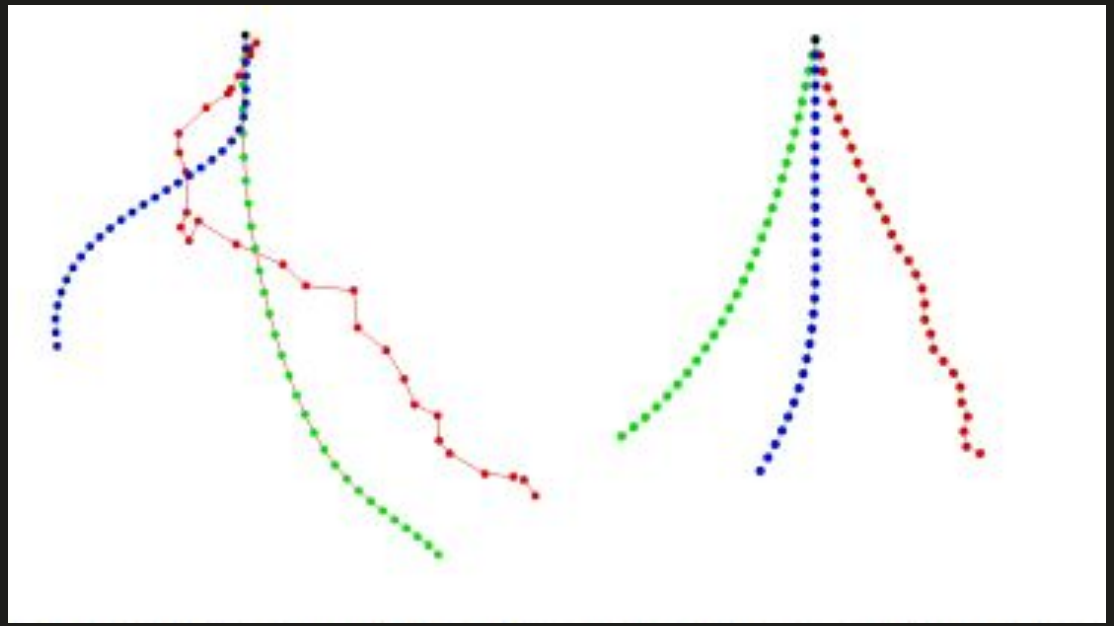
Multi Strand Interpolation



Single Strand Interpolation

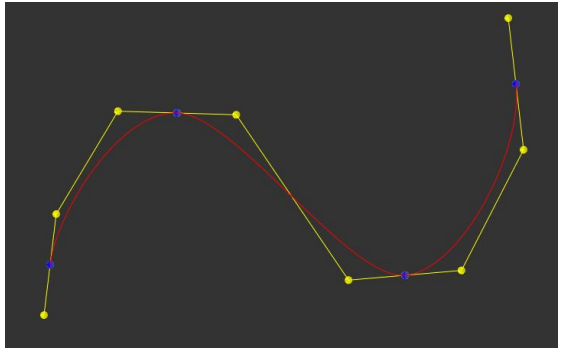
Physics

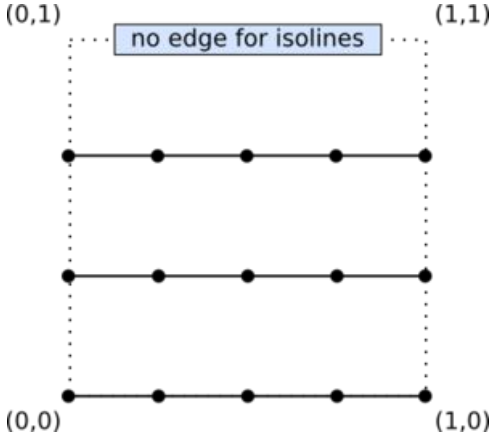
- Performed on control points
- Dynamic follow-the-leader PBD
  - Compute predicted position
  - Appy follow-the-leader as constraint
  - Update velocity based on new position



Tessellation

- Output is isolines rather than triangles or quads
- Bezier interpolation within a strand
- TODO: Interpolation between strands





Next Steps

Milestone 2

- Hair-head collisions
- Hair-hair collisions
- Proper tessellation between strands
- Bring in head model

Milestone 3

- Geometry shader to create triangles
- Start rendering (single scattering, shadows, multiple scattering)

Final

- Finish rendering
- User interaction
- Polish up demo

References

- Fast Simulation of Inextensible Hair and Fur
  - M. Müller, T.Y. Kim, N. Chentanez
- Advanced Techniques in Real-time Hair Rendering and Simulation
  - Cem Yuksel, Sarah Tariq
- Strand-based Hair Rendering in Frostbite
  - Sebastian Tafuri
- Physically Based Hair Shading in Unreal
  - Brian Karis

Questions?