
Shaders
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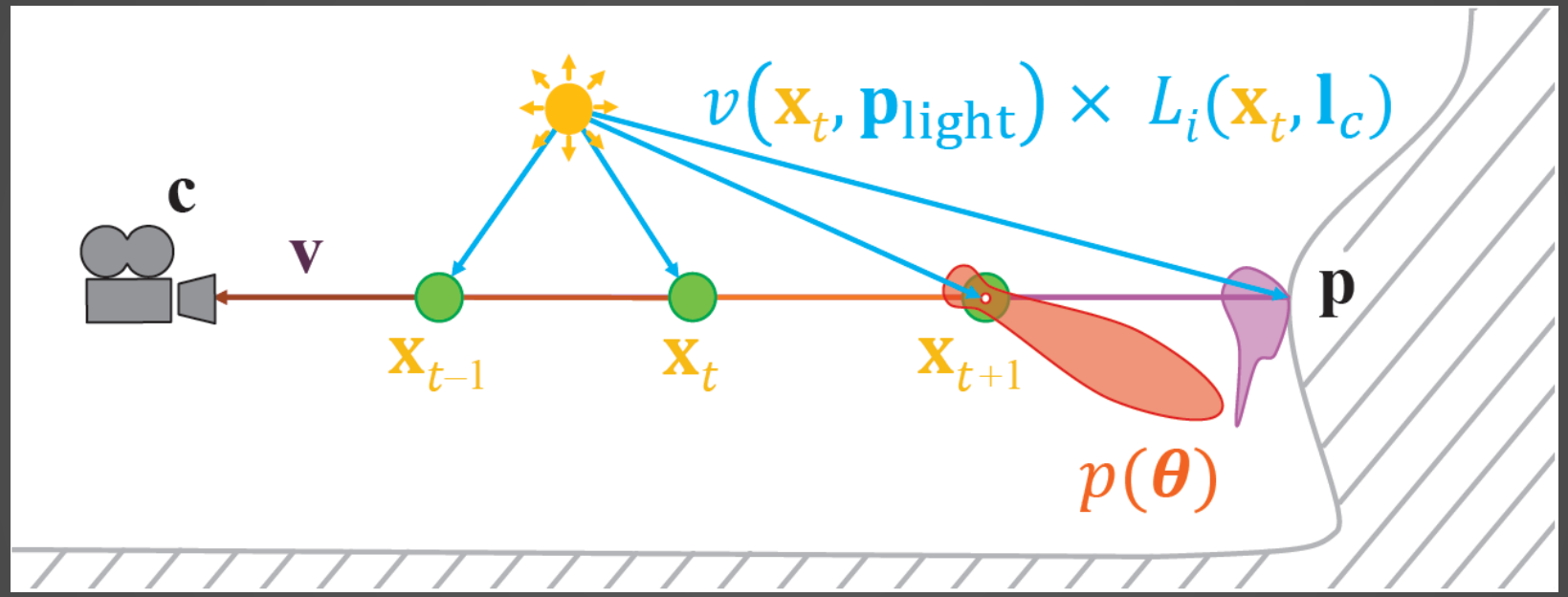
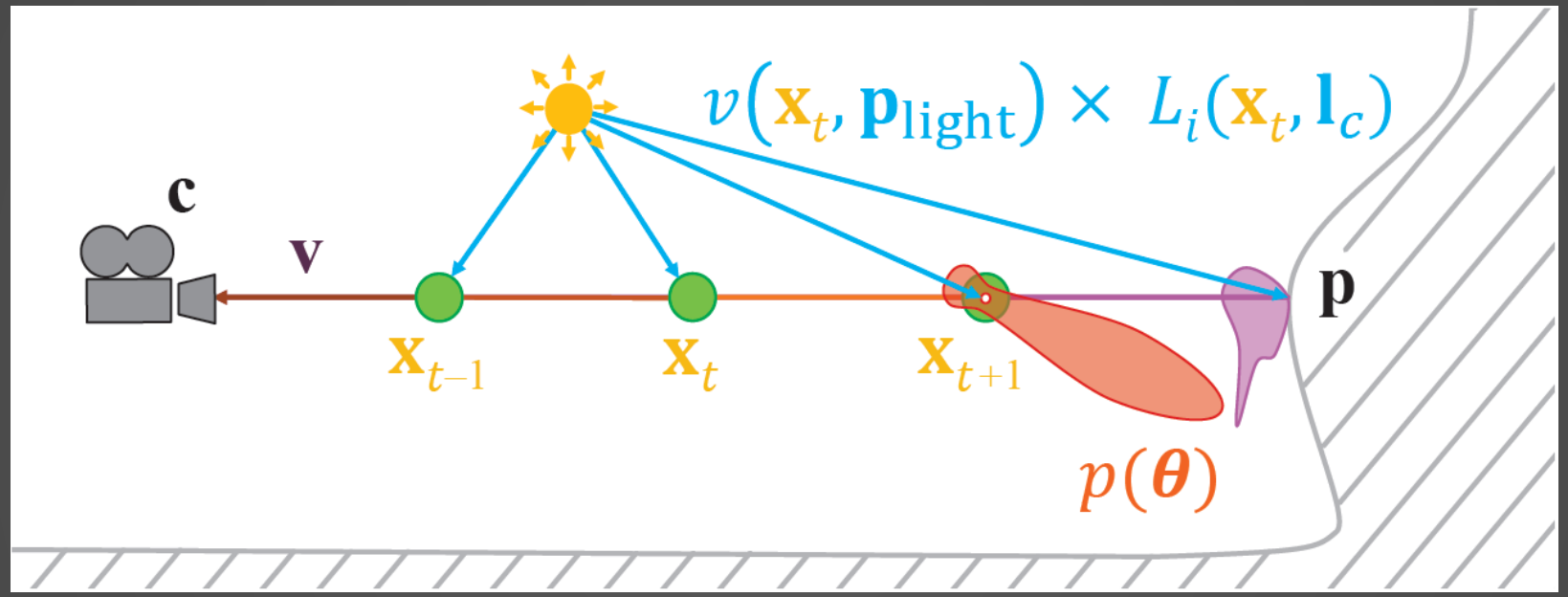
Demo:
Physically Based Volumetric Fog
and Atmosphere

Light Scattering Theory



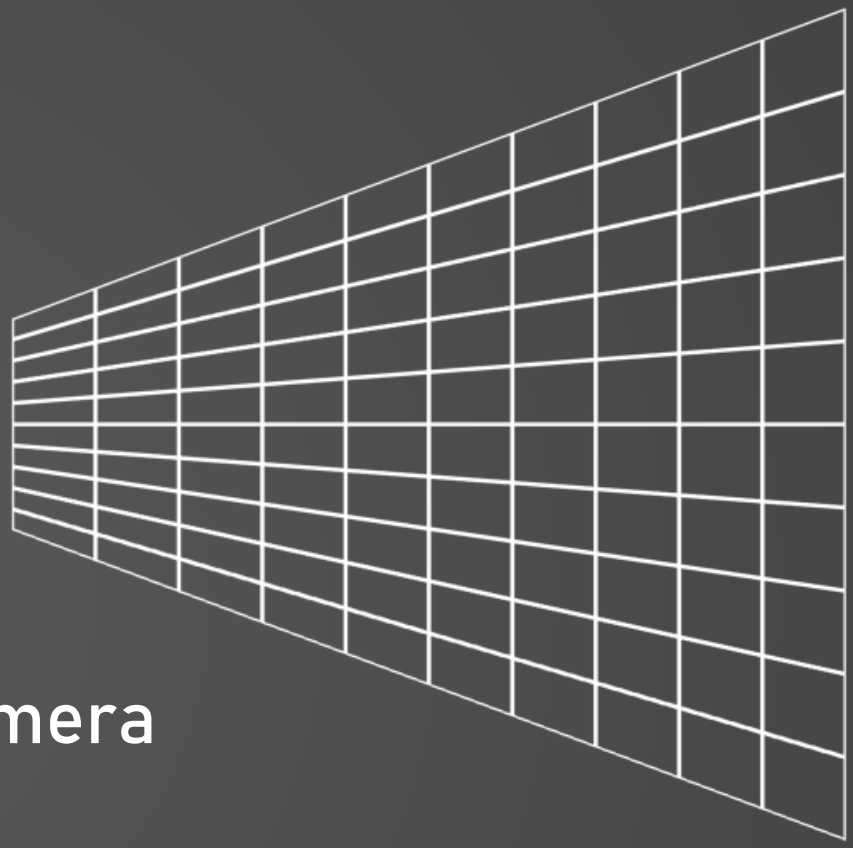
Light Scattering Theory



$$L_i(c, -v) = T_r(c, p)L_o(p, v) + \int_{t=0}^{\|p-c\|} T_r(c, c - vt)L_{scat}(c - vt, v)\sigma \, dt$$

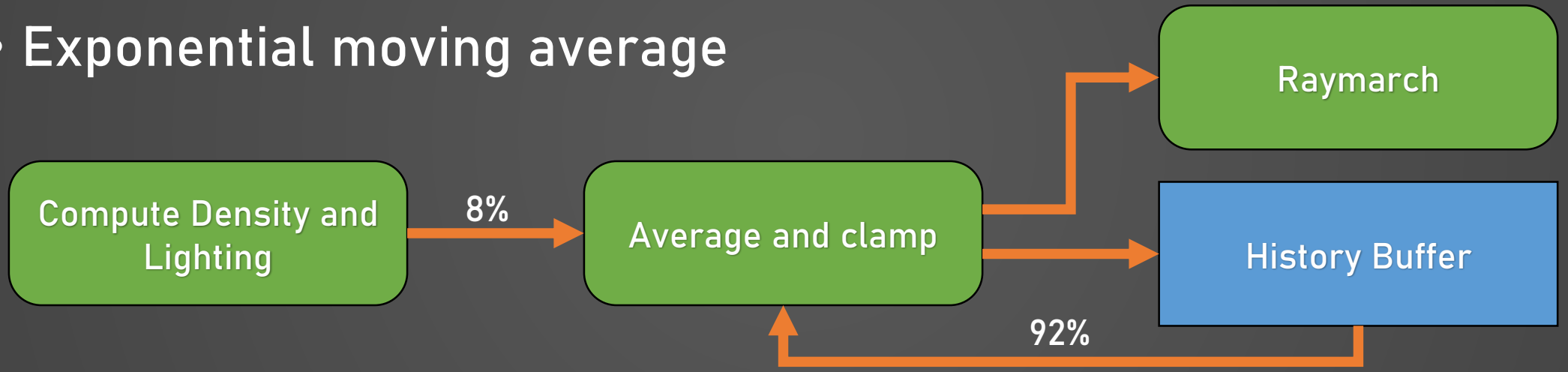
Implementation

- Frustum oriented volume
  - 240x135x96
  - In-scattering in RGB
  - Scattering coefficient in Alpha
- Exponential depth distribution
- Covers scene up to 900 units from camera
- 3 passes:
  - Compute density and lighting at each sample position (Compute Shader)
  - Raymarch (Compute Shader)
  - Apply to scene (Pixel Shader)



Temporal Supersampling

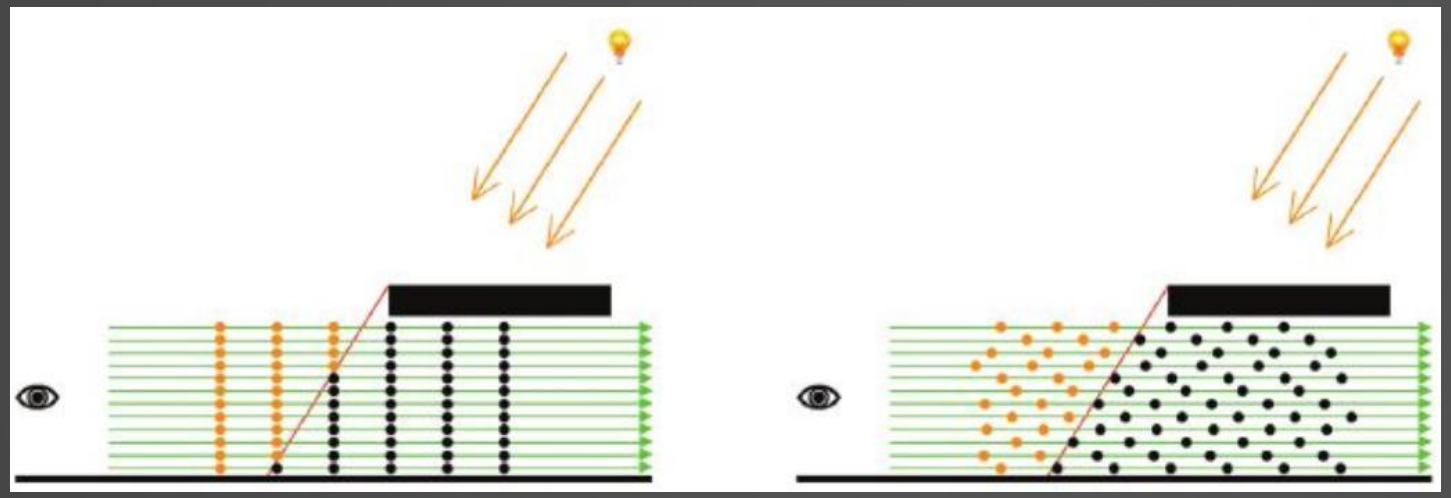
- Use previous frames to increase sample count
- Jitter sample positions using Halton sequence
- Exponential moving average

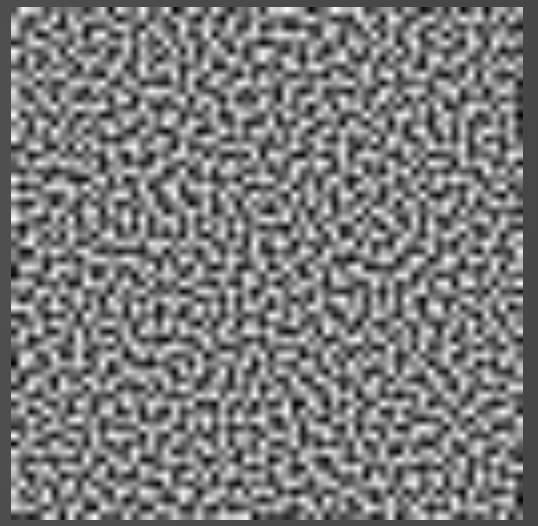


- Need to compute position in history buffer if camera moves
- Neighborhood clamping to avoid ghosting on moving lights

Dithering

- Offset sample depth using blue noise
  - ➔ Better sample distribution





- Dithered sampling ➔ smoothed by TAA

Grass Shader – Live Demo

Vegetation

Grass Shader – General

- Generate grass geometry in tessellation and geomety stage
  - Allow artist to pass properties such as height, color distribution and wind displacement

- Collide grass blades with player and other specified objects

Grass Shader – Tessellation

- Create additional ground verticies for geometry shader to work on, effectively increasing grass density

- Optimizations: Tessellation fractors decrease with distance to player, and input verticies are frustum culled

Grass Shader – Geometry

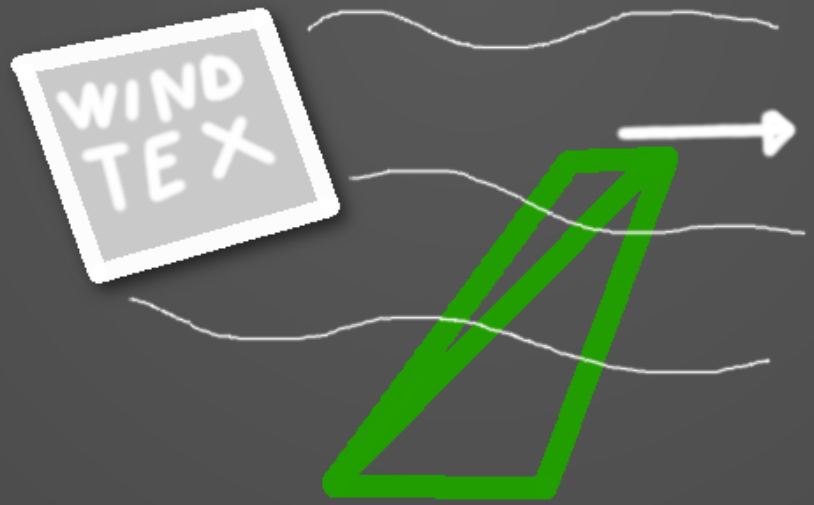
Initially, a single grass blade was added in the centre of the input triangle.
But, a lot of tessellation required for the dense grass look.
==> Add multiple blades for each triangle

Grass Shader – Geometry

Grass blades are constructed out of four verticies, which allows for less pointy looking blades, by pushing down the top verticies.

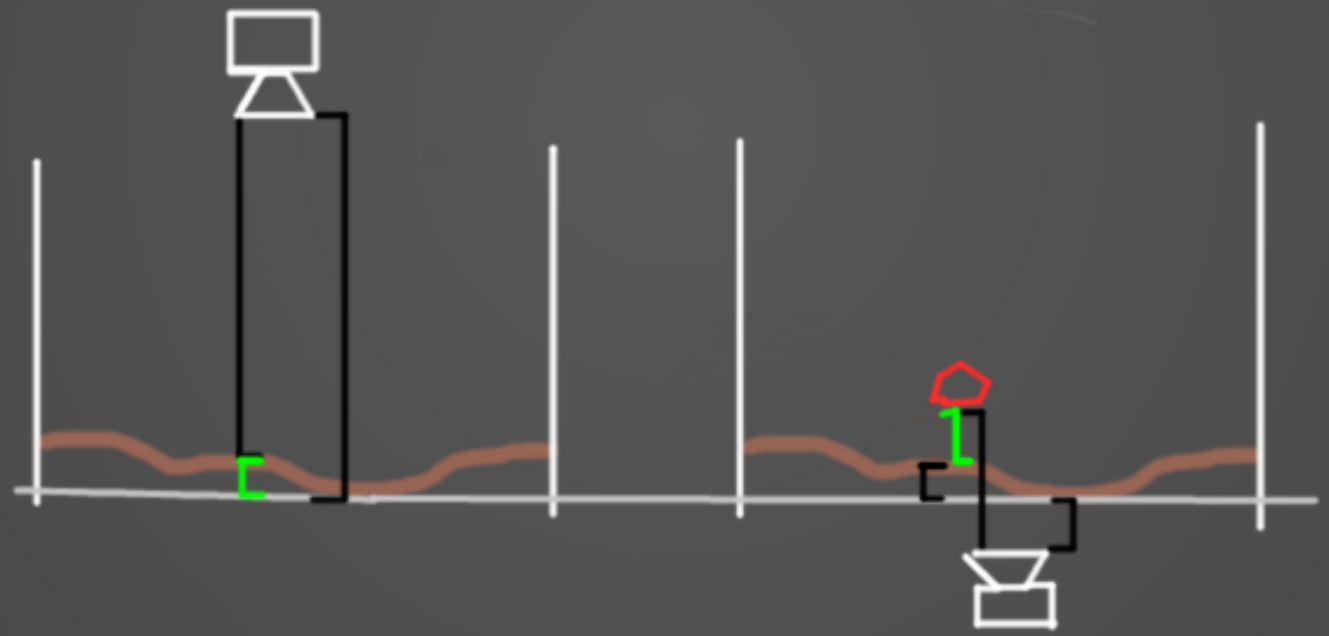
Grass Shader – "External" Influences

Grass Blades are influenced by wind, achieved by a displacement texture applied to the top vertex positions.



Grass Shader – "External" Influences

Additionally grass will collide with players or other objects, and bend away.



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