

Real-time Volumetric Fog Simulation

Project Defense

Lucia Tódová

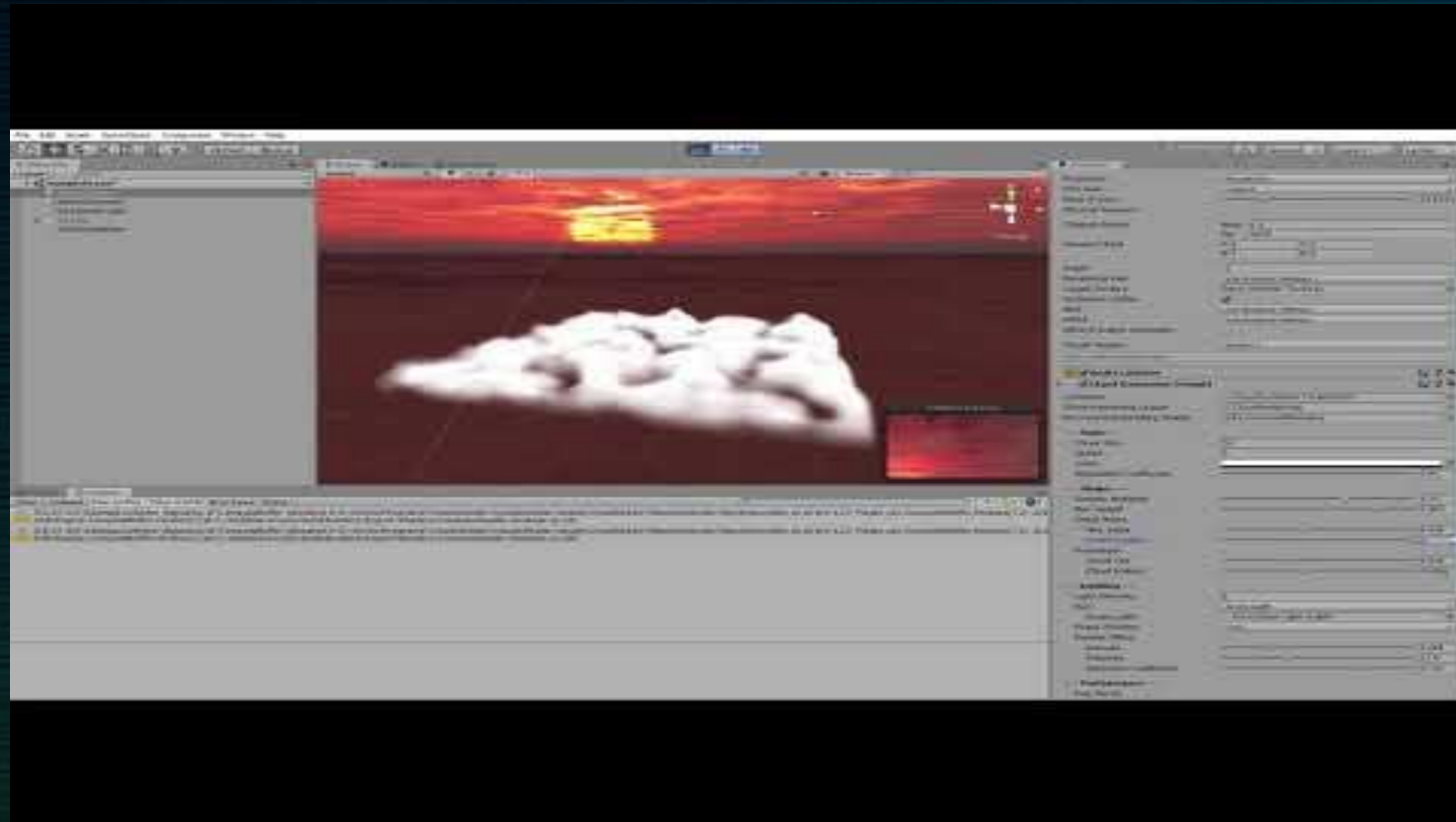
<https://github.com/todoval/CloudsShader>

23.05.2020

Volumetric Fog and Clouds

- Procedural real-time generation
- Different types of clouds
 - Cloud height
 - Cloud coverage
 - Stratus, cumulus...
- Lighting
 - Beer-Lambert's law
 - Powder effect
 - Phase function
- Optimizations

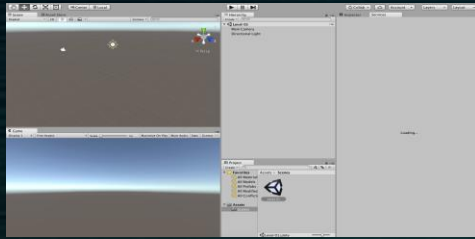




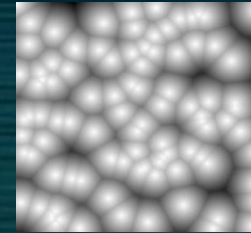
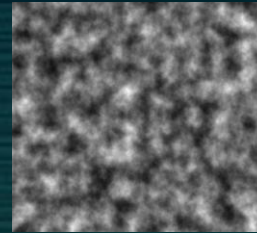
[Link to video](#)

Project timeline

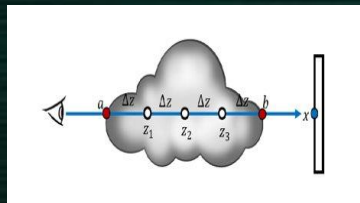
Empty Unity Project



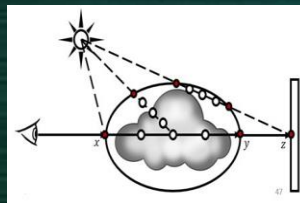
Noise Generation



Visualization



Lighting



Optimizations



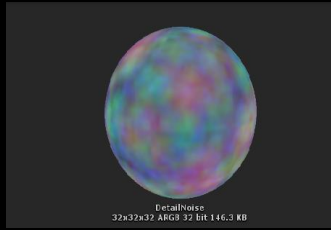
Starting the project

Empty Unity Project

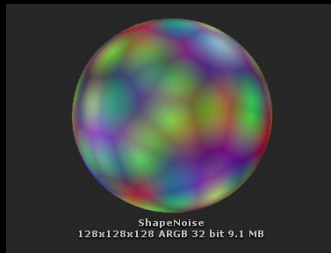
- Architecture setup
 - scripts, shaders, compute shaders, helper functions
- Research
 - Unity ShaderLab language, rendering pipeline...
 - Procedural cloud properties, lighting
- Resources:
 - [Fredrik Haggstrom: Real-time rendering of volumetric clouds](#)
 - [Rurik Hogfeldt: Convincing Cloud Rendering](#)
 - [Dean Babić: Volumetric Atmospheric Rendering](#)
 - [Juraj Páleník: Real-time rendering of volumetric clouds](#)
 - [Horizon Zero Dawn: Real-time Volumetric Cloudscapes](#)



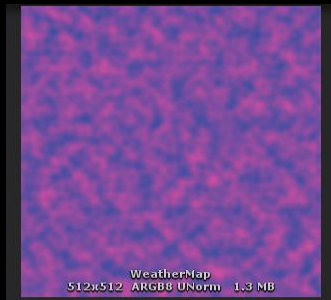
Noise Generation



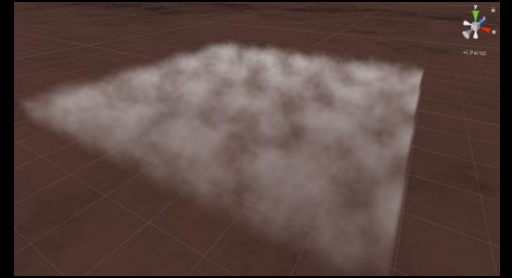
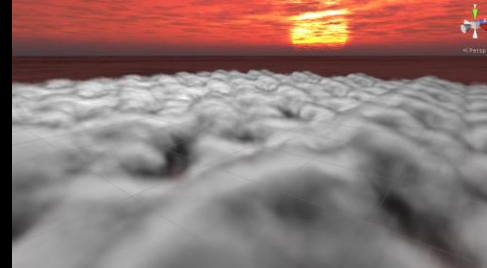
Detail Noise



Shape Noise



Weather Map



Visualization & Lighting

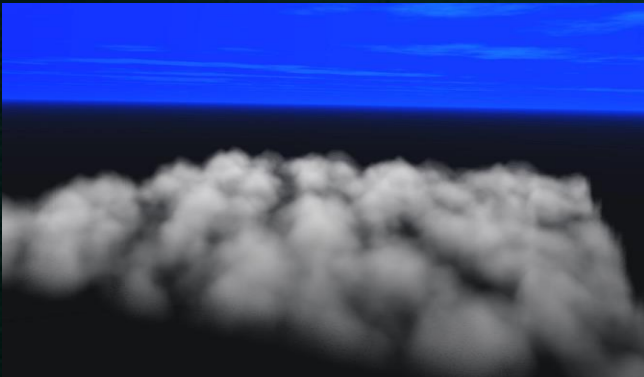
Beer-Lambert's Law



Powder Effect



Henyey-Greenstein
Phase Function



Optimizations

- Raymarch + Lightmarch
 - step size, step decrease
- Blue Noise
- Temporal Upsampling
 - only skyboxes



24 fps



55 fps



11 fps



60 fps



92 fps



132 fps

Main issues:

- Unity ShaderLab language
- Creating 3D textures
- Performance problems
 - Temporal upsampling
- *If it looks good, it works!*



Future work:

- Performance
 - Temporal upsampling check
 - Temporal reprojection
- Nice to have:
 - Random number generation
 - Directional light support
 - User-friendly wind direction

Thank you for your attention!

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