Methods of procedural generation and visualization of clouds in training simulation systems

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Abstract: This article describes a method of procedural cloud generation with the use of Perlin noise function and billboards. Perlin noise can be used to generate various effects with natural qualities, such as clouds, landscapes, and patterned textures like marble. Process of creating noise textures that are used during cloudscape generation is depicted. Clouds are made of a large number of billboards and sorting is required in order to correctly draw a number of semi-transparent surfaces. Sorting large number of billboards on CPU is a resource-heavy operation, therefore it is desirable to move sorting process to GPU. But traditional methods of sorting are not performing well on GPU architecture, therefore, there is a need for special algorithms that can use the processing powers of GPU effectively. One type of sorting that is suitable for GPU architecture is called bitonic sorting. Bitonic sort is a comparison-based sorting algorithm that can be run in parallel. It focuses on converting a random sequence of numbers into a bitonic sequence, one that monotonically increases, then decreases. The algorithm consists of two parts. First, the unsorted sequence is built into a bitonic sequence; then, the series is split multiple times into smaller sequences until the input is in sorted order. In order to implement bitonic sorting compute shaders can be used that allow solving a number of computing tasks, which could only be done on CPU before, on GPU. A number of additional approaches to increase the performance of visualization system during cloud rendering are presented.

Key words: training simulation systems, rendering, cloud visualization, Perlin noise, bitonic sort, billboards, GPGPU, OpenGL.

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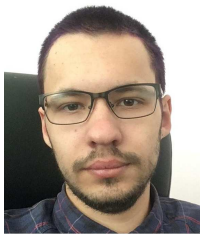

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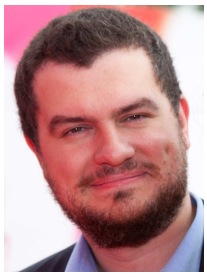

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The paper has been received on 12.11.2018.