GPU Based Contouring Method On Grid DEM Data

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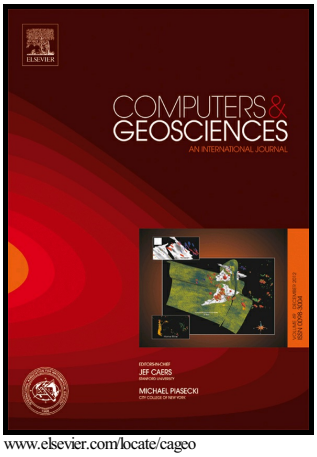

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Abstract

This paper presents a novel method to generate contour lines from grid DEM data based on the programmable GPU pipeline. The previous contouring approaches often use CPU to construct a finite element mesh from the raw DEM data, and then extract contour segments from the elements. They also need a tracing or sorting strategy to generate the final continuous contours. These approaches can be heavily CPU-costing and time-consuming. Meanwhile the generated contours would be unsmooth if the raw data is sparsely distributed. Unlike the CPU approaches, we employ the GPU's vertex shader to generate a triangular mesh with arbitrary user-defined density, in which the height of each vertex is calculated through a third-order Cardinal spline function. Then in the same frame, segments are extracted from the triangles by the geometry shader, and translated to the CPU-side with an internal order in the GPU's transform feedback stage. Finally we propose a "Grid Sorting" algorithm to achieve the continuous contour lines by travelling the segments only once. Our method makes use of multiple stages of GPU pipeline for computation, which can generate smooth contour lines, and is significantly faster than the previous CPU approaches. The algorithm can be easily implemented with OpenGL 3.3 API or higher on consumer-level PCs.

Keywords

Contour - Grid DEM – GPGPU - Geometry Shader - Spatial Interpolation

1. Introduction

Contours, grid DEM and TIN DEM are the three most important forms of terrain expression (Wang and Wu, 2006), each of which has its own characteristics and usages. The