

Representation of Terrain Data by Drilling Process

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We present a new representation of terrain data based on a mathematical operator that mimics the physical process of drilling the terrain. Popular terrain representations, specifically Digital Elevation Models (DEMs) do not allow for surface discontinuities such as caves and cliff faces. Also, data gathering for DEMs is often imprecise and results in local minima (pits) where none actually exist. More advanced representations, such as layered height fields and TINs, can represent more complicated topology, but still lack a deep mathematical connection to the physical world. The drill operator is encoded with two parameters: the location of the drill p , and the shape of the drill blade, S . The blade is placed and spun, allowing the drill bit to carve out the terrain around p in the shape S . The operator is powerful in its simplicity and versatility. Since S can be any shape, cliff faces and caves can be formed using rectangular and spherical blades, respectively. Useful constraints, such as requiring a lack of local minima, can be enforced by careful choices for p , such as a defining a monotonically decreasing trajectory to the edge of the terrain. In accuracy trials, we chose S to be parabolic, represented by a quadratic polynomial, and the drill locations p were chosen to be along the drainage network of the terrain. Parameters to the system include the threshold for drainage network extraction, the size of the drill, and the size of the area used to determine drill shape. The drill shape is determined by finding the union of terrain cross sections at each p . The optimized drill representation generated a terrain within 2.5% RMSE of the original, and required 40% the storage. Future work includes extending the set of operators, as well as possible drill shapes, to improve accuracy and storage results.

Keywords:

Terrain representation, data representation, terrain generation

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