MADALGO
CENTER FOR MASSIVE DATA ALGORITHMICS

TerraSTREAM: Terrain Processing Pipeline

What

TerraSTREAM is a collection of software modules for computation on very large digital terrain models.

Problem

Modern sampling techniques yield datasets in the order of hundreds of gigabytes, which cannot be processed by standard software.

Solution

Use provable efficient algorithms specifically tailored to terrains much larger than the size of the memory. These algorithms tries to minimize the number of disk accesses.

Properties

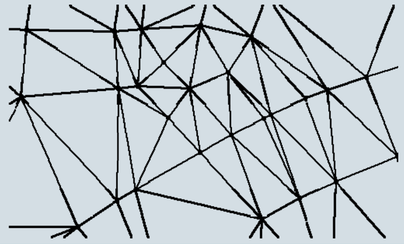
- Where it makes sense, all modules work on both grid and triangulated terrains.
- Works on GNU/Linux, Mac OS X and Windows.
- Many of the modules export several different parameters that can be tweaked by the user for maximum flexibility.
- Supports reading and writing grid mosaics and LAS files.

Usage

The modules presented on this poster are designed independently of any frontend. Frontends designed for:

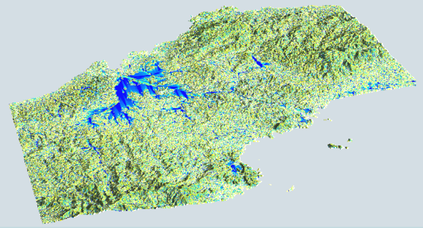
Model Construction

Constructs a terrain model (a raster grid or a triangulation) from the points representing the terrain.



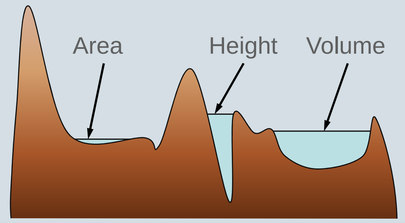
Flood Simulation

Computes exactly what part of a grid or TIN DEM will be flooded if the oceans raise a certain given amount, or computes for each part of the DEM how high the ocean needs to rise before that part is flooded.



Topological Simplification

Removes insignificant sinks from a terrain model. Significance is user defined in terms of the height, area and volume of the sinks. Sinks that are judged insignificant are “flooded”.

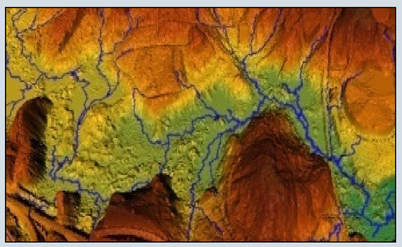


Flow Routing

Determines how water flows locally at each point of the terrain model. Supports several different flow models and can easily be extended with new ones. The input model is usually prepared for flow computation using the conditioning module.

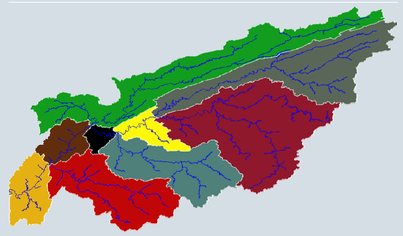
Flow Accumulation

Computes area upstream of each point in a terrain model. Water is routed along the flow paths computed by the routing module. The module can optionally use an auxiliary input model defining the initial flow and compute arbitrary functions at each point.



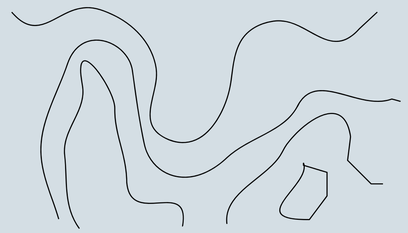
Pfafstetter Labeling

Decomposes a river network into a hierarchy of watersheds. The pfafstetter labels define a certain hierarchy, which is easy for humans to visualize.



Contour Maps

Constructs contour maps of the entire terrain. The contours generated from high resolution terrain models tend to be very jagged and visually unpleasing. Using conditioning with careful definitions of which sinks are insignificant, the generated contours are improved.



Quality Metric

Computes the distance from each cell in grid terrain to nearest original input points. Gives a numerical value that can be interpreted as the quality of individual grid cells. When overlayed with orthophotos the effects of the classification algorithms are clearly seen.

Fitting Everything Together

The modules can be combined to form a pipeline.
This figure shows the typical order in which the modules are invoked