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MADALGO seminar by Herman Haverkort, Eindhoven University of Technology (TU/e)

I/O-efficient flow modeling on fat-triangulated surfaces

We study the flow of water on *fat terrains*, that is, triangulated surfaces where the minimum angle of any triangle is bounded from below by a positive constant. We show that the worst-case complexity of any path of steepest descent on a fat terrain of n triangles is $\Theta(n)$, and that the worst-case complexity of the river network on such terrains is $\Theta(n^2)$. This improves the corresponding bounds for arbitrary terrains by a linear factor.
We prove that in general similar bounds cannot be proven for Delaunay triangulations: these can have river networks of complexity $\Theta(n^3)$.

Moreover, we present an acyclic graph, the descent graph that enables us to trace flow paths on triangulated surfaces I/O-efficiently. We use the descent graph to obtain I/O-efficient algorithms for computing river networks and watershed-area maps of fat terrains in $O(\mathrm{sort}(r + n))$ I/O's, where r is the complexity of the river network. We also describe a data structure for reporting the boundary of the watershed of a query point q (or the flow path from q) in $O(l + k)$ I/O's, where 1 is the number of I/O's used for planar point location and k is the size of the reported output.