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MADALGO seminar by Thomas Mølhave, Aarhus University

I/O-Efficient Algorithms for Computing Contour Lines on a Terrain

Abstract:

A terrain S is the graph of a bivariate function. We assume that S is represented as a triangulated surface with n vertices. *A contour* of S is a connected component of a level set of S. Generically, each contour is a closed polygonal curve; at *critical* levels these curves may touch each other. We present I/O-efficient algorithms for the following two problems related to computing contours of S:

Given two real parameters h and $d > 0$, we present an I/O-optimal algorithm that report all contours of S at heights $h + kd$, for every positive integer k, using $O(\text{Sort}(N)+T/B)$ I/Os, where T is the total number edges in the output contours, B is the *block size*, and $\text{Sort}(N)$ is the number of I/Os needed to sort N elements. The algorithm uses $O(N/B)$ disk blocks. Each contour is generated individually with its composing segments sorted in clockwise order.

We can preprocess S, using $O(\text{Sort}(N))$ I/Os, into a linear-size data structure so that all contours at a given height can be reported using $O(\log_B N + T/B)$ I/Os, where T is the output size. Each contour is generated individually with its composing segments sorted in clockwise order.

Joint work with:

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