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Oswin Aichholzer, Wolfgang Aigner, Franz Aurenhammer, Thomas Hackl, Bert Juettler, Margot Rabl and Elisabeth Pilgerstorfer

Divide-and-Conquer for Voronoi Diagrams Revisited

We show how to divide the edge graph of a Voronoi diagram into a tree that corresponds to the medial axis of a (modified) planar domain. Division into base cases is then possible, which, in the bottom-up phase, can be merged by trivial concatenation. The resulting construction algorithm - similar to Delaunay triangulation methods - is not bisector-based and merely computes dual links between the sites, its atomic steps being inclusion tests for sites in circles. This guarantees computational simplicity and numerical stability. Moreover, no part of the Voronoi diagram, once constructed, has to be discarded again. The algorithm works for polygonal and curved objects as sites and, in particular, for circular arcs which allows its extension to general free-form objects by stability-preserving and data saving biarc approximations. The algorithm is randomized, with expected runtime $O(n \log n)$ under certain assumptions on the input data. Experiments substantiate an efficient behavior even when these assumptions are not met. Applications to offset computations and motion planning for general objects are described.