Crack modeling via minimum-weight surfaces in 3D Voronoi diagrams

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Shortest paths play an important role in mathematical modeling. Applications include robot navigation, telecommunication and image processing. Usually, shortest path problems are formulated on planar (directed) graphs that consist of vertices and weighted arcs. In this context, one is interested in finding a path of minimum weight from a start vertex to an end vertex. The concept of minimum-weight surfaces extends shortest paths to 3D. The minimum-weight surface problem is formulated on a cellular complex with weighted facets. A cycle on the arcs of the complex serves as input and one is interested in finding a surface of minimum weight bounded by that cycle. In practice, minimum-weight surfaces can be used to segment 3D images. Vice versa, it is possible to use them as a modeling tool for geometric structures such as cracks. In this work, we present an approach for using minimum-weight surfaces in bounded Voronoi diagrams to generate synthetic 3D images of cracks.