

Fun with Restricted Delaunay Triangulations

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Abstract

The restricted Delaunay triangulation is a subcomplex of the three-dimensional Delaunay triangulation that serves as a triangulation of a smooth surface embedded in three-dimensional space. It has proven itself as a mathematically powerful tool for surface meshing and surface reconstruction. I discuss two fascinating mathematical twists on these structures. First, I address a question of Bruno Levy: can we constrain them to include specified edges—that is, can we define mathematically well-behaved constrained Delaunay triangulations on smooth surfaces? Second, the restricted Delaunay triangulation can be conceived as an operator that takes as input a smooth surface and a set of points sampled from that surface, and produces as output a triangulation of the surface. What happens if we feed that triangulation back into the operator, replacing the original surface, while retaining the same sample points? Interestingly, the answer leads us to a method for reconstructing 2-manifolds embedded in high-dimensional spaces.

(This work is done jointly with Marc Khoury, Bruno Levy, and Marc van Kreveld.)