

NUMERICAL ANALYSIS AND SCIENTIFIC COMPUTING
SIAM STUDENT CHAPTER

Centroidal Voronoi tessellations: algorithms and applications

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Abstract: One of the beauties of mathematics is that it can uncover connections between seemingly disparate applications. One of the most fertile grounds for unearthing connections is computational algorithms where one often discovers that an algorithm developed for one application is equally useful in several others. One such algorithm is centroidal Voronoi tessellations (CVTs) which are special Voronoi diagrams for which the generators of the diagrams are also the centers of mass (with respect to a given density function) of the Voronoi cells. CVTs have many uses and applications, a non-exhaustive list of which includes data compression, image segmentation and edge detection, clustering, cell biology, territorial behavior of animals, resource allocation, stippling, grid generation in volumes and on surfaces, meshless computing, hypercube sampling, and reduced-order modeling. We discuss mathematical features of CVTs (that give an indication of why they are so effective) as well as deterministic and probabilistic methods for their construction. Our main focus, however, is on considering as many applications of CVTs as time permits.

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