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Abstract

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Eikonal-based models of random tessellations

In this presentation, we describe a novel, efficient method for computing a random tessellation from its level sets representation at each voxel of a discretized domain. This method solves the Eikonal equation to compute the voxelization, which yields a complexity in $O(N \log N)$, where N corresponds to the number of voxels of the discretized domain. By contrast, evaluating the implicit functions of the level set representation at each voxel location results in a complexity in $O(N^2)$ in the most general case. The method also offers the possibility to generate generalizations of the classical Voronoï or Johnson-Mehl tessellations models exhibiting rough interfaces between cells by simulating the growth of the germs on a domain where the velocity varies locally, as displayed in Figure 1 below.

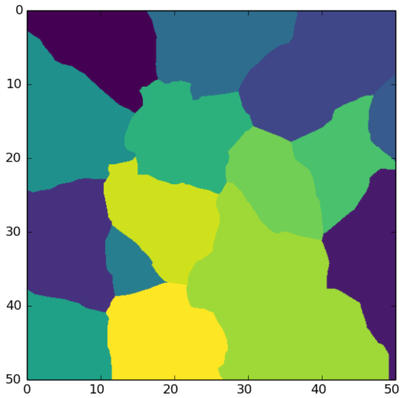

Figure 1: Simulation of a Voronoï tessellation with rough cells on a 50×50 domain.

A final contribution is the development of an algorithm for estimating the multi-scale tortuosity of the boundaries of the tessellation cells. Using convex optimization tools, the algorithm computes the tortuosity of the boundary at several scales by iteratively deforming the boundary until it becomes a straight line. Using this algorithm, we show that it is possible to relate the local velocity model to the roughness amplitude observed at the cells boundaries.