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Generating 3D Anisotropic Centroidal Voronoi Tessellations

Authors : Alexandre Marin, Alexandra Bac, Laurent Astart

Abstract : New numerical methods for PDE resolution (such as Finite Volumes (FV) or Virtual Elements Method (VEM)) open new needs in terms of meshing of domains of interest, and in particular, polyhedral meshes have many advantages. One way to build such meshes consists of constructing Restricted Voronoi Diagrams (RVDs) whose boundaries respect the domain of interest. By minimizing a function defined for RVDs, the shapes of cells can be controlled, e.g., elongated according to user-defined directions or adjusted to comply with given aspect ratios (anisotropy) and density variations. In this paper, our contribution is threefold: First, we introduce a new gradient formula for the Voronoi tessellation energy under a continuous anisotropy field. Second, we describe a meshing algorithm based on the optimisation of this function that we validate against state-of-the-art approaches. Finally, we propose a hierarchical approach to speed up our meshing algorithm.

Keywords : anisotropic Voronoi diagrams, meshes for numerical simulations, optimisation, volumic polyhedral meshing
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