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GENERATION OF HEX DOMINANT MESHES BASED ON FRAME FIELDS SKELETONS

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The generation of hexahedral meshes is a very hard problem. Among the various attempts to solve it, several approaches have used cross fields (in 2D) and frame fields (in 3D). In 2D, Kowalski et al. [1] have proposed a method that computes a cross field and a skeleton using streamlines of this cross field to partition any planar domain into blocks that can be meshed using structured schemes. While the extension of this method in 3D can provide a partitioning of some simple geometries, in most cases, it is unable to generate a conformal arrangement of blocks covering the whole domain. Promising results were also obtained using cross fields combined to a fully unstructured approach in Remacle et al. [2], although a 3D extension of the method have yet to be showcased.

We propose here a method to generate hex dominant meshes combining the advantages of these two methods, i.e. an efficient domain partitioning and tets recombination algorithm. Our algorithm proceeds in four steps:

1. A smooth frame field is generated over the whole volume and a partial partitioning of the geometry based on this frame field is computed.
2. For each computed surface of the partitioning and for each surface of the boundary of the geometry, we compute a quadrilateral mesh using the Blossom-Quad algorithm [3].
3. Vertices are inserted inside the geometry in a frontal manner, starting from the surfacic vertices created at the previous step and by following the underlying frame field as best as possible. A Delaunay tetrahedral mesh using these vertices is then computed.
4. The tetrahedral elements are recombined into hexahedrals and prisms, using a method proposed by Yamakawa et al. [4].

By doing so, good quality hex-dominant meshes can be obtained even for geometries where previous frame fields based methods failed. Using frame fields also allows to improve the percentage of volume covered by hexahedral elements and the quality of said hexahedral elements compared to other hex-dominant generation approaches.

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