

Validating and generating curved unstructured hexahedral meshes

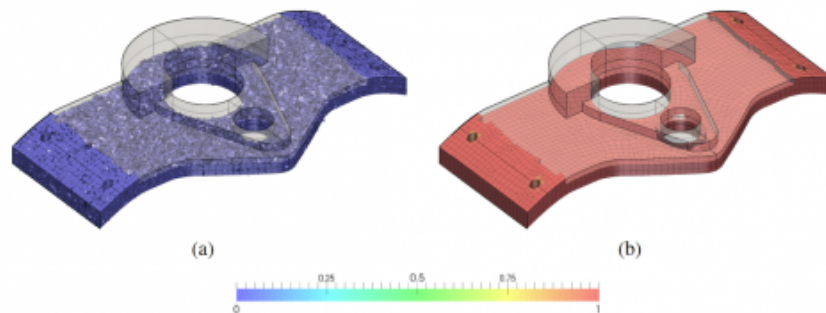
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ABSTRACT

We present a new definition of distortion and quality measures for high-order hexahedral (quadrilateral) elements. This definition leads to two direct applications. First, it can be used to check the validity and quality [1] of a high-order hexahedral (quadrilateral) mesh. Second, it allows the generation of high-order curved meshes [2, 3, 4, 5] composed of valid and high-quality hexahedral (quadrilateral) elements. We describe a method to simultaneously smooth and untangle high-order hexahedral (quadrilateral) meshes by minimizing the proposed mesh distortion [5]. Finally, we analyze the behavior of the proposed distortion measure and we present several results to illustrate the benefits of the mesh generation framework.



References

- [1] A. Gargallo-Peiró, X. Roca, J. Peraire, and J. Sarrate. Distortion and quality measures for validating and generating high-order tetrahedral meshes. *Eng. Comput.*, 31:423–437, 2015.
- [2] S. Sherwin and J. Peiró. Mesh generation in curvilinear domains using high-order elements. *Int. J. Numer. Meth. Eng.*, 53(1):207–223, 2002.
- [3] Z. Xie, R. Sevilla, O. Hassan, and K. Morgan. The generation of arbitrary order curved meshes for 3D finite element analysis. *Comput. Mech.*, 51:361–374, 2012.
- [4] T. Toulorge, C. Geuzaine, J.-F. Remacle, and J. Lambrechts. Robust untangling of curvilinear meshes. *J. Comput. Phys.*, 254:8 – 26, 2013.
- [5] A. Gargallo-Peiró, X. Roca, J. Peraire, and J. Sarrate. Optimization of a regularized distortion measure to generate curved high-order unstructured tetrahedral meshes. *Int. J. Numer. Meth. Eng.*, 103:342–363, 2015.