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UNIVERSAL MESHES: COMPUTING TETRAHEDRALIZATION CONFORMING TO CURVED SURFACES AS BOUNDARIES AND INTERFACES FROM BACKGROUND MESHES.

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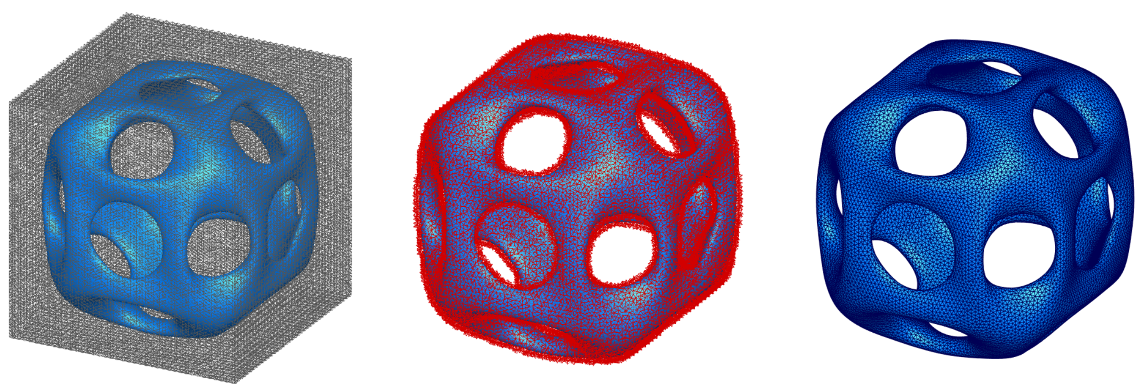

(a) $\mathcal{T}_h$ (b) Γ_h (c) $\mathcal{T}_c^h$

Figure 1: Fig. 1a shows a given high genus surface immersed in the background mesh $\mathcal{T}_h$, in grey wireframe. Fig. 1b shows the union of elements in background mesh,Γ_h, in red wireframe. Fig. 1c shows the conforming tetrahedral volume mesh $\mathcal{T}_c^h$ for the surface given smooth surface.

A large class of computational methods for problems with evolving domains and discontinuities require robust and automatic methods to discretize the changing geometry. We introduce a method to create tetrahedralization that conforms to curved domain boundaries and interfaces by transforming a small collection of tetrahedrons in a background mesh. In the process, no new vertices are introduced and connectivities of tetrahedrons are left unaltered. The method relies on a novel way of parameterizing an immersed boundary over a collection of nearby faces with its closest point projection.To guarantee its robustness, we require that the domain be C^2 -regular, the background mesh be sufficiently rened near the boundary and that specific dihedral and face angles in tetrahedrons near the boundary be strictly acute. Detail analysis of these restriction on the background mesh for the analogous triangular meshes is discussed by Rangarajan et al [1].

The method serves as a quick and simple tool for *meshing* domains with complex boundaries and interfaces. It provides significant algorithmic advantages for simulating problems with evolving domains and in numerical schemes that require iterating over the geometry of domains. With no conformity requirements, the same background mesh can be adopted to tetrahedralize a large family of domains immersed in it, including ones realized over several updates during the course of simulating problems with moving boundaries. We term such a background mesh as a universal mesh for the family of domains it can be used to tetrahedralize. Universal meshes hence facilitate a framework for finite element calculations over evolving domains while using only fixed background meshes. We present demonstrative examples using universal meshes to simulate the interaction of rigid bodies with Stokesian fluids based upon the method presented by Gawlik et al [2].

REFERENCES

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