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Anisotropic mesh adaptivity for FSI applications with large deformations

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Recent works ([2]) have shown that local mesh adaptation techniques can generate anisotropic meshes which are suitable to capture boundary layers in fluid computations with low Reynolds numbers. Compared to the approach that consists in extruding a surface mesh to obtain semi-structured meshes, this technique has the advantage of being automatic regarding the geometry of the domain. In addition, the usual advantages of the method based on local mesh modifications are preserved: easily parallelizable and local projections of the solution only.

Additionally, the approach can be extended with the developments that enable large domain deformations [1, 2]. The resulting technique allows to produce adaptive meshes with boundary layer regions for laminar computations in which the domain undergoes large deformations like for computing blood flows in human arteries (see Figure 1).

A particular attention has to be paid to the quality of the elements in order to obtain a well-conditioned system and to limit the interpolation error. It is now commonly admitted that large angles propagate a large interpolation error, and that small and large angles are responsible for weaknesses in the conditioning of the system. We show here results obtained with meshes for which different quality criterions have been used, including criterions over dihedral angles, and we compare the convergence and accuracy of the resulting computations.

A particularity of this work is that all the mesh adaptation techniques presented are available in an open source software, MAdLib (Mesh Adaptation Library) [3].

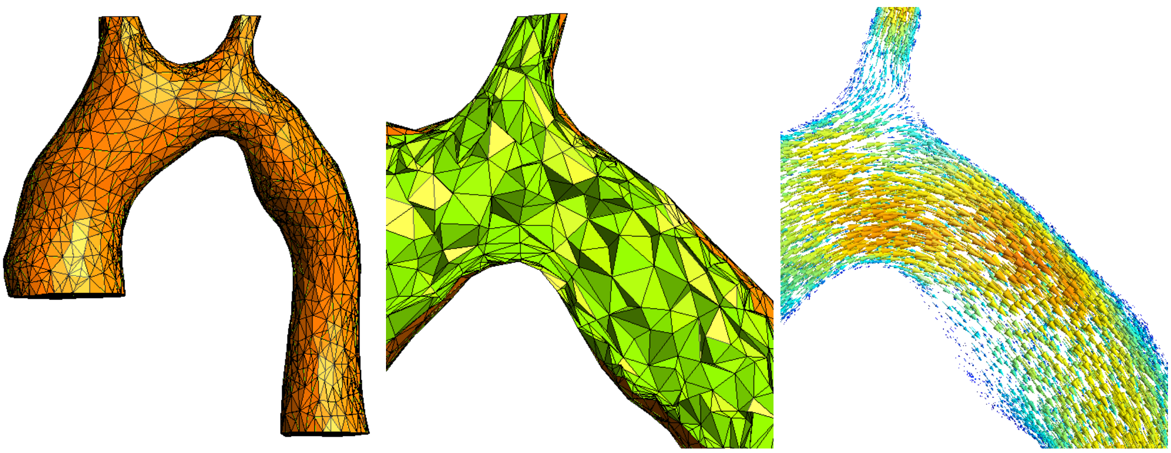

Figure 1: Human aorta: surface mesh (left), cut in the volume mesh with anisotropic elements (center), and velocity obtained with a fluid solver (right).

References

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