3DP-MESH : 3D prismatic meshes for toroidal geometry

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Considering a simulation tool solving the MHD equations in 2D axisymmetric geometry on unstructured triangular finite element meshes, the goal of the project is to extend this simulation tool to solve the MHD system for three dimensional toroidal geometry. The principle of this extension is to construct from the 2D finite element triangular mesh, a 3D mesh composed of curved prismatic elements obtained by sweeping out the 2D element in the toroidal direction. In this way, one obtain an unstructured mesh in the poloidal plane combined with a structured mesh in the toroidal direction. An important point to notice is that the 3D computational mesh is only virtual and do not need to be effectively constructed (and stored).

A first part of the project consist to design the 3D code architecture and the data structure implementation in order to minimize the data storage while maintaining fast access to the new computational structures.

The second part of the project will see the computation of the geometric data corresponding to the 3D elements : volumes, faces, segments etc of the (curved) elements.

Finally, in a third part, these tools will be used to implement and compare two numerical techniques to discretize the MHD equations in 3D toroidal geometry, a standard finite volume method and a stabilized finite element one.

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