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AN IMPRINTING ALGORITHM TO INSERT GEOMETRIC DETAILS INTO HEXAHEDRAL MESHES

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Abstract. In numerous computational engineering applications, such as automobile crash simulations, structural mechanics, neutronics or fluid-structure interactions, hexahedral meshes may be preferred over tetrahedral meshes. Unhappily, the generation of hexahedral meshes is known as a time-consuming stage in the simulation process. Indeed, unlike the generation of tetrahedral meshes, there does not exist any algorithm allowing to automatically generate an hexahedral mesh for any geometric domain. Semi-automatic approaches with a lot of user interactions are then often necessary.

The classical process for designing and optimizing a geometric shape requires parametric studies where the shape is modified and/or enriched by adding geometric details one per one. We have then to "adapt" the initial mesh and not to regenerate it for each new detail taken into account.

In order to perform such studies with hexahedral meshes, we propose an imprinting method allowing us to automatically add geometric details into an existing mesh. This addition is done using geometric projections, sheets (layers of hexahedral elements) insertions and combinatorial algorithms while preserving the hexahedral mesh structure as best as possible. This algorithm can be seen as an extended overlay-grid approach where the grid is replaced by any type of unstructured hexahedral mesh.