New 3D Adaptive Remeshing Techniques Applied to Piercing, Trimming and Binding Simulations

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ABSTRACT

The so-called 'kill element' strategy is often used to incorporate piercing or trimming functionality in manufacturing process simulation packages. A 'Damage' function is evaluated at every node/element of the FEM mesh and when this value reaches a given trigger value, then the affected element is deleted.

The main advantage of such strategy is its flexibility. Users can easily access to a list of 'damage models' as well as to the trigger value. It also gives the possibility to effectively trim a workpiece in two separate parts which is difficult to achieve within the frame of continuous mechanics without the help of dedicated models.

As usual, everything comes at a price and several drawbacks associated with this simplicity can be identified:

- Element deletion creates numerical material loss
- Topologies in the remaining mesh are often intricate and may be difficult to manage
- Surface after piercing/trimming shows a rugosity corresponding to the local edge element size

To overcome these difficulties, Transvalor has developed specialized techniques to improve the mesh in case of elements deletion.

- Automatic adaptive mesh refinement in the 'killing zone' to control the volume loss. Thanks to FORGE® ability to efficiently manage large meshes as locally the element size may be significantly decreased and then mesh size increased.
- Specific work is done to only create good topologies, giving therefore the opportunity for the remeshing algorithms to work on elements shape factor.
- A dedicated smoothing algorithm is applied to obtain a good shape and a mesh usable to simulate subsequent forming stages.

These new capabilities will be demonstrated on various industrial applications including piercing, trimming and a new binding example used to fasten individual metal sheets together by a process called FDS® for Flow Drill Screw.

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