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A Meshing and Remeshing Framework using Implicit Geometries for the Simulation of Rotary Friction Welding

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The contribution is about a novel approach on dealing with the mesh generation and restoration during the simulation of Rotary Friction Welding (RFW). Rather than using conventional explicit methods an Implicit Geometry Meshing (IGM) strategy is applied, in which the geometry description is based on a level set formulation. The main advantages therein consist of a significant robustness and efficiency increase regardless of the complexity of the flash shape and its inclusions, an automatic coarsening of geometric details when element sizes are not sufficient and an inherent handling of self-contact being treated as a weld after the next remeshing instance. The meshing routine is straightforward and easy to understand giving the user full access to the spatial discretization of his problem.
The discussed model utilizes a Carreau Fluid formulation of the plastic deformations being fully coupled to the heat transfer problem, an Augmented Lagrange strategy for keeping the volume constraint, a regularized Coulomb-/fluid friction law and a hybrid time integration strategy. The problem is discretized by 6-noded, triangular finite elements perfectly suiting the described unstructured mesh generation procedure. The focus is particularly set to the automatic distance function generation, constituting the core of the IGM method implementation. The techniques are general and easy to adopt offering the potential of successful transfer to a wide range of other engineering problems.