Modelling of finished surfaces produced by large deformation processes with the Particle Finite-Element Method (PFEM)

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ABSTRACT

Industry needs finished products which fit high precision tolerances and free of residual stresses. An important percentage of the pieces produced in the manufacturing process does not fulfil the required features and a generates a substantial waste in material and energy. In the present work we focus in the subtractive manufacturing, where the final form of the product is reached by cutting and de-attaching a part of the material from a given massive piece.

The purpose is to obtain the characteristics of the finished surface and the residual stresses remaining on the processed material. At the same time, it is important to predict the life of the tools and the energy consumption of the process in order to optimize the manufacture.

In this work we show how the Particle Finite Element Method (PFEM) can be used to get a prediction of the exposed problems via numerical simulation. The PFEM is used in the modelling of cutting processes, where material experience large deformations and segmentation. So, the recognition of the free-surfaces plays an important role that the proposed method has to deal with. The modelling must account for friction and wear of the interacting parts as well for the thermo-mechanical behaviour of the work material.

In order to show the virtues of the method in the modelling of manufacturing processes, several examples of application are presented. The capabilities of the method as well as the accuracy of the solutions are discussed.

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