An Inverse Shape Design Method Considering Polymeric Solidification

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ABSTRACT

In primary shaping manufacturing processes, parts of desired shapes are produced from molten material by using a mold or die. Subsequent to the shaping step, solidification is spontaneously initiated by cooling the material; the part is then usable under standard environmental conditions. The commercially most relevant primary manufacturing process in plastics engineering is injection molding; it will, therefore, serve as our illustration example. A fundamental characteristic of injection molding is the non-linear material and flow behavior that eventually manifests in inhomogeneous solidification of the product. This inhomogeneity in shrinkage and warpage leads not only to deviations from the desired shape but also to residual stresses [1]. One remedy is a mold that anticipates those deviations and is designed in such a way that the desired shape is reached after shrinkage and warpage have taken place. The design of such a shape exceeds the intuition of a design engineer. Instead, an inverse shape design method can be used to optimize the mold as well as the manufacturing process as a whole [2].

Our focus will be on such an application-oriented and numerical inverse shape design method and the corresponding model. In addition, its extendibility to injection molding of semi-crystalline polymers will be discussed.

REFERENCES

[1] Zwicke, F., Behr, M., and Elgeti, S. "Predicting Shrinkage and Warpage in Injection Molding: Towards Automatized Mold Design", *AIP Conference Proceedings*, Vol. **1896**, (2017).

[2] Zwicke, F. and Elgeti, S. "Inverse Design with Nonlinear Thermoelastic Materials for Shape Optimization in Injection Molding", submitted to *Finite Elements in Analysis and Design*.