Numerical Design for Warpage Compensation in Injection Molding

Florian Zwicke* and Stefanie Elgeti†

* Institute of Lightweight Design and Structural Biomechanics (ILSB)
  Vienna University of Technology
  Vienna, Austria
  e-mail: zwicke@ilsb.tuwien.ac.at

† Institute of Lightweight Design and Structural Biomechanics (ILSB)
  Vienna University of Technology
  Vienna, Austria
  e-mail: elgeti@ilsb.tuwien.ac.at

Key Words: inverse design, shape optimization, injection molding, finite element method

ABSTRACT

We present a method for the inverse design of cavity shapes that can be used with injection molding processes. When a plastics part is created by injection molding, its shape is mostly determined by the shape of the mold cavity, where the liquid polymer is injected. However, some physical phenomena that occur during the injection molding process can cause deviations between the cavity and part shapes. These are, for instance, inhomogeneous cooling of the liquid melt, as well as stresses that are caused by the solidification of the polymer.

In order to ensure that the part shape meets the specifications, the cavity shape can be adjusted to compensate for the deviations that occur during the process. The problem of finding such an adjusted cavity shape can be formulated as a shape optimization problem. In this case, a suitable parameterization needs to be found for the cavity shape description. Furthermore, the quality of the part shape, i.e., the degree of its correspondence to the specifications, needs to be formulated as an objective function.

Alternatively, simulation models for the injection molding process can be transformed into an inverse formulation [1]. This makes it possible to prescribe certain results of the forward problem and determine missing initial or boundary conditions. We will discuss such methods and present some examples to showcase their applications.

REFERENCES