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INVERSE AND ITERATIVE APPROACHES IN NUMERICAL INJECTION MOLD DESIGN

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Abstract: In order to reduce defects in injection molded parts, as well as to reduce costs and manual work in the mold design process, we develop a numerical approach for the design of injection molding cavities. The idea is to simulate the injection molding process as reliably as possible and to use the predictions yielded by such simulations to automatically determine a suitable mold cavity shape. Our primary goal in this respect is the reduction of geometric faults in the finished part. The quality of the simulation-based design method clearly depends on the quality of the simulation itself. Therefore, the development of an accurate simulation method that uses state-of-the-art as well as newly developed material models is a key component of such a method. While keeping in mind that the simulation must remain suitable for an optimization in terms of, e.g., computational efficiency, we work on models to more accurately describe the material behavior of polymers during their solidification. A special focus is placed on transitional states of amorphous polymers, when they can neither be described as completely liquid nor completely solid. In specific terms, we combine viscoelastic fluid models and nonlinear solid models to be able to simulate both fluid and solid aspects of material behavior simultaneously. For the design of an optimized mold cavity, we follow multiple approaches. While we aim for an efficient inverse design mechanism, we also utilize concepts of mathematical optimization. This requires the formulation of the design process as a minimization problem. A challenge is presented by the suitable representation of geometric deficiencies in a single scalar objective function. Since any iterative procedures will require many runs of the computationally costly molding simulation, we also look for more efficient methods that can aid the iterative process or even replace it completely. We have already been successful in developing an inverse procedure that can be applied to a part of the simulation and will show how this can be used to speed up the optimization process.