SFB 1120

Annual report 2018

Subproject B2

Title

Numerical modelling and compensation of shrinkage and warpage behaviour in injection moulding processes

Project management/-processing

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Task definition

The subproject deals with the compensation of form errors or geometry deviations in plastic injection molded parts. When hot polymer melt is filled into the injection molding cavity, it cools down and loses volume. At the same time, the cooling causes solidification or crystallization, which in turn causes a change in volume. Since the entire change in volume is not homogeneous, this leads to changes in the shape of the component. In order to avoid deviations from the desired component shape, the cavity shape is to be optimized in this subproject based on a simulation. While the focus in the past years was strongly on the structure of the underlying simulation, the optimization methods should now be addressed.

Procedure

In order to be able to carry out the shape optimization of the cavity with common mathematical optimization methods, various prerequisites must be created. In order to guarantee the efficiency of the optimization procedure, among other things, a low dimensionality of the search space must be ensured. This means that a possibility has to be found and implemented which allows to completely describe complex cavity shapes by only a few parameters.
Furthermore, mathematical optimization methods are based on objective functions which describe the quality of the current parameters by a scalar measure. In this case this means that a measure has to be found which can quantize the deviations between a calculated component shape and the desired shape. When these components are implemented, an optimizer must

also be connected and a suitable method for optimization must be selected.

Results

In 2018, significant progress was made, particularly with regard to the topic of target functionalities. For this purpose, a program library was created which enables the handling of different geometry representations and can compare them. First steps were also made in the economical representation of cavity geometry. For this purpose, splines were selected which allow the representation of curved geometries using only a few control points. A software enables the processing of such geometries to build simulation meshes.

Summary and Conclusion

The development of the software components required for the optimisation is well advanced in 2018. If the resulting methods are now combined with the existing simulation, the goal of optimizing cavity geometries can be tackled quickly.

Publication

F. Zwicke, T. Schneppe, C. Hopmann und S. Elgeti, *Numerical Design for Primary Shaping Manufacturing Processes*, Proceedings in Applied Mathematics and Mechanics, 2018.