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AN OPTIMAL STRATEGY FOR SHAPE OPTIMIZATION OF EXTRUSION DIES

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The rather unintuitive and nonlinear behavior of plastics melts is a well known obstacle in the design and manufacturing cycle of profile extrusion dies. This is reflected, for example, in the so-called running-in experiments, in which the already manufactured die is modified up to 15 times [1] until the final product, shaped by the die, matches the quality requirements. In addition to the goal of a homogeneous outflow velocity and thus homogeneous material distribution, die swell complicates the reworking of the manufactured die [2].

As part of the Cluster of Excellence Integrative Production Technologies for High-Wage Countries at the RWTH Aachen University, an effort is made to shorten the manual running-in process by the means of numerical shape optimization, making this process significantly less costly and more automatic. The optimization is performed with the in-house flow solver XNS, which uses the finite element method with Galerkin/Least-Squares stabilization, can utilize various parallel machines (IBM Blue Gene, etc.), and is able to exploit the common communication interfaces for distributed-memory systems (SHMEM and MPI). Recently, XNS has been coupled with a nonlinear optimization library [3] in an optimization framework with a T-Spline based geometry kernel [4].

Using the numerical shape optimization framework described above, a set of optimization strategies using global optimizers, local optimizers and memoization is evaluated with the goal to reach best results with a minimal number of steps. Furthermore, it is investigated how modelling and parameters of the optimization problem itself, e.g., dimensionality of parameter space or coupling of design parameters, both influence an optimal strategy of the shape optimization of parameterized extrusion dies.

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