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COOLING-CHANNELS DESIGN OPTIMIZATION FOR INJECTION MOLDING, USING EXACT GRADIENTS AND REDUCTION MODEL IN INSTANIONARY CASE

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ABSTRACT

Today, around 30 % of manufactured plastic goods rely on injection moulding. In this moulding process, heat transfer control, during the cooling step, has a great influence on the quality of the final parts that are produced, as well as on the moulding cycle time. Models based on a full 3D finite elements method render unpractical the use of optimization of the design and placement of the moulds cooling-channel. We have extended the use of boundary element method (BEM) to this process. This yields a reduction of the computational space dimension from 3D to 2D, avoiding full 3D remeshing. Only the surface of the cooling channels needs to be remeshed at each evaluation required by optimization algorithm [1] [2]. Moreover, during the optimization, this method permits to compute analytic gradients, thereby avoiding the N direct computations per optimization iteration that are necessary for finite-difference gradient approximation (where N is the number of optimization variables).

We introduce in this paper a practical methodology to optimize the design of cooling channels in injection moulding-processes. First, we propose an implementation of the reduction model (introduced by [3]) in the BEM solver. This reduction permits to reduce by 50 the direct computing time of the instationary heat transfer problem case. Secondly, we present how to couple the reduction model with an optimization algorithm such as SQP (Sequential Quadratic Programming) using analytic computation of cost-function gradients. Thirdly we present encouraging computational results on semi-industrial plastic parts, which show that our optimization methodology is viable.

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