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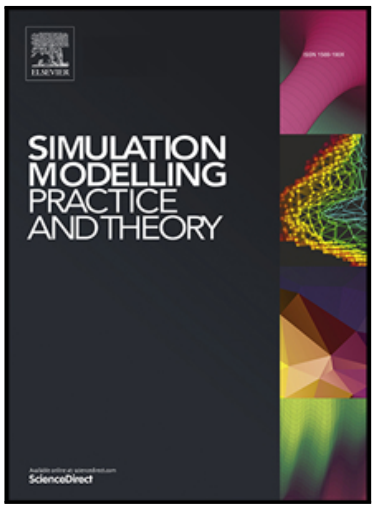

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Numerical and experimental investigation of process parameters optimization in plastic injection molding using multi-criteria decision making

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Abstract

In plastic injection molding (PIM), the process parameters such as packing pressure, melt temperature, and cooling time should be adjusted and optimized for high product quality and high productivity. Warpage is one of the major defects in the PIM and should be minimized for high quality. Cycle time should be minimized for the high productivity. In addition to the warpage and the cycle time, clamping force affects the product both the quality and the productivity. Therefore, for the high product quality and the high productivity, it is important to minimize the warpage, the cycle time and the clamping force simultaneously. In this paper, a multi-objective optimization of process parameters in PIM for minimizing three objectives is performed. Numerical simulation in the PIM is generally so intensive that a sequential approximate optimization using radial basis function network is adopted to determine the optimal process parameters. The radar chart is used to perform the trade-off analysis among three objective functions. In addition, the better and worse solution are newly introduced for the trade-off analysis. It is found through the trade-off analysis that all objective functions of the conformal cooling channel are well improved in comparison with the ones of the conventional cooling channel. Therefore, 43% warpage reduction, 1,7% clamping force reduction, and 47% cycle time reduction can successfully be achieved using the conformal cooling channel. Based on the numerical result, the experiment using PIM machine (GL30-LP, Sodick) is carried out. The conformal cooling channel is developed by the metal 3D printer (OPM250L, Sodick). Through the numerical and experimental result, the validity of the proposed approach is examined.

Keywords: Plastic Injection Molding, Process Parameters Optimization, Multi-objective Optimization, Sequential Approximate Optimization, Trade-off Analysis

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