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Model Predictive Control Applied to Thermal Regulation of Thermoforming Process Based on the Armax Linear Model and a Quadratic Criterion Formulation

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Abstract : Energy consumption efficiency is a major concern for the material processing industry such as thermoforming process and molding. Indeed, these systems should deliver the right amount of energy at the right time to the processed material. Recent technical development, as well as the particularities of the heating system dynamics, made the Model Predictive Control (MPC) one of the best candidates for thermal control of several production processes like molding and composite thermoforming to name a few. The main principle of this technique is to use a dynamic model of the process inside the controller in real time in order to anticipate the future behavior of the process which allows the current timeslot to be optimized while taking future timeslots into account. This study presents a procedure based on a predictive control that brings balance between optimality, simplicity, and flexibility of its implementation. The development of this approach is progressive starting from the case of a single zone before its extension to the multizone and/or multisource case, taking thus into account the thermal couplings between the adjacent zones. After a quadratic formulation of the MPC criterion to ensure the thermal control, the linear expression is retained in order to reduce calculation time thanks to the use of the ARMAX linear decomposition methods. The effectiveness of this approach is illustrated by experiment and simulation.

Keywords : energy efficiency, linear decomposition methods, model predictive control, mold heating systems
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