# Additive Manufacturing of Multi-Material Molding Tool using Artificial Intelligence

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**ABSTRACT** – The manufacturing process of injection molding places high demands on the quality of the components produced. This highly depends on the temperature management system's ability to achieve high cooling rates of the polymer melt at homogeneous temperatures within the cavity. By dissipating heat as efficiently as possible, the necessary cycle time can be reduced, which is a decisive factor for the economical production of large quantities. A thermally optimized injection molding tool core using a combination of multi-material (MM) of X45NiCrMo4 and CuAl10Fe1 with conformal cooling, additively manufactured by laser-based Directed Energy Deposition utilizing metal powder feedstock (DED-LB/M) is presented. Its manufacturing demands high effort on process parameter development to avoid errors. These are identified regarding their pattern of occurrence and possible optimization approaches applying AI-supported evaluation algorithms are shown. They are based on in-process data acquisition and monitoring using existing, and such cost-efficient sensor technology. Thus, detection of process instabilities and their minimization gets feasible. This contains a high potential for reducing the number of time-consuming iterative optimization loops significantly. During additive manufacturing of thermally optimized multi-material molding tools. This may support cost efficient identification of suitable process parameter sets, ensuring production with sufficient material properties and geometric accuracy. As a result, the performance of the presented thermally optimized molding tool core has been proven on a use case from injection molding industry. A significant reduction of the cycle time by 51% without any loss in part quality was achieved.