

Integrated Data-based Process Chain Optimisation in Casting and Machining Production

Motivation

It is often necessary to carry out a series of process steps to manufacture components. Each of these individual processes is subject to a certain degree of uncertainty, which is why tolerance limits are defined as specifications between the processes in order to keep rejects to a minimum. The productivity of individual processes is therefore dependent on the process parameters of the upstream processes. However, the current procedure means that the information from the upstream processes and therefore the cause of uncertainties is not available, which means that the potential for optimizing the process chain is not used. In the present project, the process chain of casting, heat treatment and machining is used as an example to carry out an overall analysis of the process chain with the aim of improving the efficiency, quality and resilience of it.

Approach

The selected example geometry is a stator housing, which is cast in a low-pressure casting process using 3D-printed sand molds. The inner bore of the stator housing is often a cause of rejects due to the large bore diameters, the low wall thickness and high tolerance requirements. In this project, the geometry of the stator housing was specifically adapted to induce residual stresses in the casting process in order to cause deformation during the processes and to increase the influence of process variables. Each individual process is also equipped with sensors, whereby the sensor and control information is made available across the individual processes. The data processing structure is based on the requirements of GAIA-X to ensure secure data exchange.

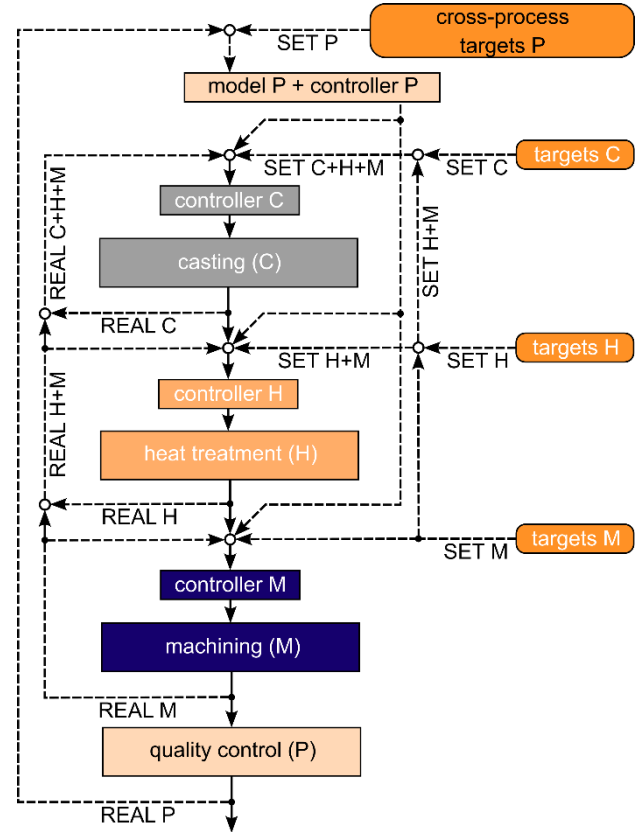


Figure 1: Structure of the cross-process control for the process chain casting, heat treatment, machining

Outlook

In the next step, simple plates are cast in order to test both the process chain and the planned analysis methods on a simplified geometry. The process chain is then used to manufacture and examine the stator housings. Based on the information, a digital overall model of the process chain is created. With the help of the model, a processchain control system is set up by feeding back measurement data and the process chain is optimized.