Design and optimization

Bachelor/ Master thesis, student research project

Gating design optimization by means of machine learning

Start of work: As of now

Initial situation
The design of the gating system has a decisive influence on the quality of the final cast component, since the geometric shape of the gating system determines the mold-filling characteristics. An unfavorable mold filling leads, for example, to turbulence during mold filling with associated air entrainments, long flow paths and an unnecessary use of material. When designing the gating system, the designer can rely on simple formulas or advanced tools such as casting process simulation. The casting process simulation allows different casting run geometries to be analyzed and advantageous geometries to be identified. However, this requires a great deal of effort, since either numerous geometries have to be created manually by the designer or a complex parametric model has to be created. In any case, these designs cover only a very small amount in the totality of possible designs, so that the designs based on them are always only the result of local optimization. The machine learning method could help here to identify similarities in "optimal" gating geometries and to apply these to future designs. Thus, on the one hand, the design process could be accelerated, on the other hand, more optimal gating system geometries could result, which in turn could lead to a better casting quality. In principle, it has already been shown that this method can be successfully used for topology optimization, as shown for example in [1].

Step 2: Training the CNN-based encoder and decoder network for predicting a low-resolution near-optimal structure


Task definition
The core objective of this task is to use already developed tools or codes for machine learning for the design of gating systems. The data basis for the optimization is initially created by calculating numerous (>1000) casting runs for a reference part in a casting process simulation program (MAGMASOFT). From this amount of data, the best 10% - 20% of the designs are to be used as a data basis for further optimization. For this purpose, the gating system geometry is to be abstracted and used as input source for machine learning. Using the codes, suggestions are to be made by the algorithms with regard to the gating system geometry. The quality of the proposed geometries is finally to be checked by casting simulation.

For further information please contact the responsible supervisor:

Dr.-Ing. Sebastian Müller
Institut für Füge- und Schweißtechnik | Langer Kamp 8 | 38106 Braunschweig
Tel.: +49 (0)531 391-95521 | E-Mail: sebastian.mueller@tu-braunschweig.de