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DATA-DRIVEN MODELS FOR SHRINKAGE POROSITY PREDICTION IN ALUMINIUM CASTING

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ABSTRACT

Casting is a widely used process in material forming. It can be operated to form various metals such as aluminum alloys. Different defects might affect a casting part and contribute on crack initialization such as porosity. Thus, several rounds of numerical simulation should be performed in order to operate on a selection of parameters and come with an optimized porosity distribution that fits the user's application. In the present work, a new methodology is proposed to allow the prediction of porosity distribution using supervised learning.After defining a casting study case, a preparation step consists of analysing the considered casting part and identifying the parameters to be varied in the Design Of Experiment (DOE). The learning dataset is built from few casting simulations performed on Procast software with the different parameters combinations previously defined in the DOE. The extracted dataset from the casting simulations is composed mainly of the nodal thermal history and the corresponding porosity value. A modal representation combined with model reduction (Singular Value Decomposition) are implemented in order to interpolate the nodal thermal history for new combinations in the parameter space. The dataset is enriched by gradients and Laplacians of temperature computed in 4 critical times that define the active feeding mechanism in the mushy zone. This dataset is evaluated and optimized using the minimum Redundancy Maximum Relevance (mRMR) method. The resulting dataset is used to train and test different decision trees algorithms. The adopted strategy is to train a classifier to localize porosity and then a regressor to predict the porosity value. By comparing the predicted values of local porosity to the simulated results, it was demonstrated that the proposed model is efficient and can open perspectives in the casting process optimization.