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Metamodels of Residual Stress Buildup for Machining Process Modeling

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ABSTRACT

In the process of machining materials, stresses, called residual stresses, accumulate in the workpiece being machined that remain after the process is completed. These residual stresses can affect the properties of the material or cause part distortion, and it is important that they be calculated to prevent complications from arising due to the residual stresses. However, these calculations can be incredibly computationally intensive, and thus other methods are needed to predict the residual stresses in materials for quick decision-making during machining. By using metamodels - a method of representing data where few data points exist - we can achieve an accurate prediction of the residual stresses without the need for computationally intensive calculations for each process. This involves running a series of simulations and creating a response surface from this data using the Kriging Method, which smooths out the surface such that small changes in inputs result in small changes in outputs. This achieves the result of a model for predicting the relative stresses in materials after the machining processes, and allows computationally expensive simulations to be bypassed in situations where the inputs do not vary large amounts outside of the initial simulations ran. This can allow better tracking of residual stresses, and thus lead to better control of the complications that can arise from residual stress buildup.

KEYWORDS

Simulation, Machining Processes, Metamodels, Residual Stress