Special Interest Group Meeting on Thermal Issues
ETH, Zurich, Switzerland, March 2022
www.euspen.eu

Thermal model update strategy using subspace clustering

Nemwel Ariaga[1], Andrew Longstaff[1], Simon Fletcher[1]

[1]*Centre for Precision Technologies, University of Huddersfield,*

Nemwel.Ariaga@hud.ac.uk

Abstract
Thermal errors present a significant source of dimensional errors in machined components. Many error compensation models have been found capable of mitigating thermally induced errors using temperature sensor measurements. However, the robustness in prediction performance of these models under changing operating conditions has also been recognised. One strategy for improving robustness has been updating the model parameters periodically using process-intermittent probing to identify any changes in positional error. One challenge with implementation of this approach is the reduction in machine productivity, since the machining cycle can be unnecessarily interrupted during probing. This paper introduces an approach for informing the model update scheme by making use of proper orthogonal decomposition (POD) to perform subspace clustering of temperature measurement data.

Temperature measurements from key points of the machine tool contain a lot of information on the thermal state of the machine tool and by extension the dynamics of the thermally induced errors. This data can be obtained with little impact on the machining process. However, due to the limitations of the model training process, most of the collected temperature data is never used, with most approaches down-selecting and rejecting sensor data to avoid multicollinearity of model inputs. Using POD clusters in the temperature data are used to identify the machine operation conditions. Probing cycles for updating the model are then performed if the observed clusters significantly differ from those observed in the training data. Preliminary results indicate that the approach can detect changes in spindle speed and machining cycles.

Compensation; Decomposition method; Modelling; Thermal error