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Development of a filter for the separation of thermal and dynamic influence in the thermal stabilization of machine tools

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Abstract
Up to 75% of workpiece errors are attributable to thermal displacements as shown by Mayr et al in [1]. In order to thermally stabilize the machine tool, the Fraunhofer IPT developed a modeling method which is based on the measurement of the thermally induced length variation of the main machine parts. To measure this, Integral Deformation Sensors (IDS) were developed and placed onto the machine. These sensors consist of a CFRP-rod which shows stable behavior in length despite changing temperatures. As the length variation of the machines part now is known, the resulting Tool Centre Point (TPC) displacement a mathematical model is able to analyze the deformation of the machine and therefore predict the TCP-displacement.

While the machine is in use the moving parts induce dynamic forces onto the structural parts of the machine. This leads to dynamic length changes in said parts, which superimpose with the thermally induced length changes. As the frequency of the dynamical changes is significantly higher than the frequency of the thermally induced changes, the two influences can be separated. In order to do so, this presentation will show how this is done by using a filter. To demonstrate the functional capability of this filter experiments with hydraulic exciter to cause the spindle to vibrate were performed. The results of this shall be shown.

Keywords: thermal deformation; thermo-elastic behavior; filter-development; machine tools; Tool Centre Point; correction; modelling

1. Abstract

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References

[1] Mayr J, Jedrzejewski J, Uhlmann E, Donmez MA, Knapp W, et al., 2012, Thermal issues in machine tools. CIRP Annals - Manufacturing Technology, **61** (2):771-791.

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