

## Mapping of geometrical errors of a five-axis machine tool under varying thermal conditions

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### Abstract

A significant part of the overall geometrical errors of machined work-pieces is induced by the effects of temperature. Thermo-mechanical errors of a machine tool are caused on the one hand by environmental influences like the shop floor temperature and on the other hand by internal influences such as heat generated by the machining process. To investigate in particular the overall deformation of a machine tool's structure due to different environmental temperatures a portable climate simulation chamber has been designed. The chamber provides space for a medium-size machine tool. Within a few days the chamber can be assembled and disassembled wherever it is required and where the conditions so allow. The temperature within the chamber can be controlled between +15°C and +45°C.

In a first step we use the chamber to identify changes in a machine tool's structure, in our case a 5-axis dual-spindle machining centre, due to varying environmental temperatures under no load (inactive spindle and no work-piece machining). We apply volumetric error mapping in a wide range of temperatures between +15°C and +30°C. All kinematic errors of location and orientation of the three linear and the two rotational axes (one rotary table and one swivel axis) according to the standard ISO-230 are mapped via sequential multi-lateration using a tracking laser interferometer. Finally, temperature-dependent volumetric error compensations are applied to the axes at certain temperature levels to reduce the effect of ambient temperature and to increase the overall accuracy of the machine tool. The presentation will report on first results and give an outlook on future activities.