A reduced self-calibrating method for detecting geometric errors of rotary tables

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For gear measurements on a gear measuring machine or on a coordinate measuring machine, a rotary table is typically included in the measurement cycle. In order to get highly precise measurement results, the geometric errors of the rotary table must be known and corrected. If the geometric errors cannot be corrected, they must contribute to the measurement uncertainties of the measured gear parameters, e.g., by the means of a Monte-Carlo simulation.

In this talk, a reduced error separation method based on the complete three-rosette method for the calibration of rotary tables on coordinate measuring machines in all 6 degrees of freedom will be presented. The method is also applicable on machine tools equipped with a tactile measuring device. The procedure uses an uncalibrated ball disk and can be applied on machines with uncorrected linear axis.

The balls on the ball disk are distributed on a circle in an equidistant angular grid. The step size of the grid determines the angular increments in which the geometric deviations of the rotary table can be determined. However, in contrast to the complete three-rosette method, some grid positions can be omitted, reducing the number of necessary balls. This allows to measure the geometric errors with a higher angular resolution, with only a slight increase in measurement effort compared to the complete method. For example, the deviations can be measured in 5° increments, requiring only 8 balls instead of 72. This allows a fast and easy to use detection of rotary table errors, where only the ball disc as additional equipment is needed.

As an experimental verification, some measurement examples comparing the complete and the reduced method will be presented. We will give an outlook on how we plan to apply the procedure in a joint research project together with University of Newcastle and other partners in order to determine the geometric errors of a rotary table of a CNC machining platform for gear manufacture.