Modelling transient thermoelastic states of large components during geometric inspection

M. Ohlenforst[1], R. Schmitt[1]

[1]Laboratory for Machine Tools and Production Engineering (WZL), Germany

M.Ohlenforst@wzl.rwth-aachen.de

Abstract

For dimensional measurements of large and highly accurate components, which are often performed on the shop floor, the knowledge of thermal workpiece expansions is crucial for compensating measurement errors or determining measurement uncertainties. According research is done within the joint research project “Traceable Measurement of drive train components for renewable energy” within the European Metrology Research Programme EMRP. One objective is to develop a solution, which is adaptable for many geometries and works fast and efficiently due to the transience of the part's temperature distribution and the industrial needs.

Basic idea is to simplify the workpiece geometry. This can be done by systematically choosing an according simple geometry, for example a cylinder, a hollow cylinder, a cuboid, a plate, a sphere or parts or combinations of different geometries (Figure 1). In combination with given dimensions, material properties, surface temperatures as initial conditions and environment temperature curves as boundary conditions, the transient temperature distribution and thermo-elastic geometry changes over time can be approximated based on existing, dimensionless solution tables for different geometries. The underlying solutions are based on analytic formulas and look up tables for the transient temperature distribution representing analytic as well as numeric solutions of partial differential equations for transient heat conduction with convection for a set of simple geometries. The validation foresees examining the thermo-elastic behaviour of representative workpieces on the shop floor of partners from industry and in the climate chamber of the WZL.

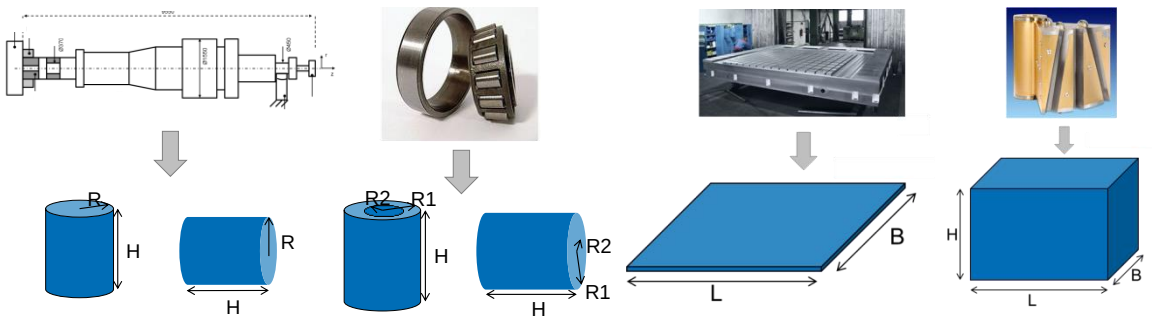

Figure 1: Simplified geometries of a turbine rotor, a rolling bearing, a machine bed and a gear standard