Compensation of in-line metrology of polymer parts based on 3D thermomechanical analyses

The growing demands for quality and flexibility and at the same time production speed challenges conventional metrology. The future tendency is that metrology is an integrated part of the production line and thus is placed in a production environment. This is a challenge since dimensional metrology in a production environment might lead to higher uncertainties due to dynamic variations both in the conditions of the environment and in the conditions of the produced parts. However, many of these effects can be treated as systematic errors if the physical phenomena leading to the deviations can be described. Today, it is very common to compensate for the variations in temperature in a classical 1D manner. However, when temperature gradients and very complex part geometries exist the deformation pattern might not at all follow a linear path. Instead, more advanced three-dimensional thermomechanical numerical models should be applied taking the inherent build-up of residual stresses and warpage into account.