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# Contact area measurements
on structured surfaces

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In connection with the use of brass specimens featuring structured surfaces in a tribology test, an algorithm was developed for automatic measurement of the contact area by optical means.

The contact area of the specimen after deformation is visible on a digital photograph as 10 parallel bands in adequate contrast to the background.
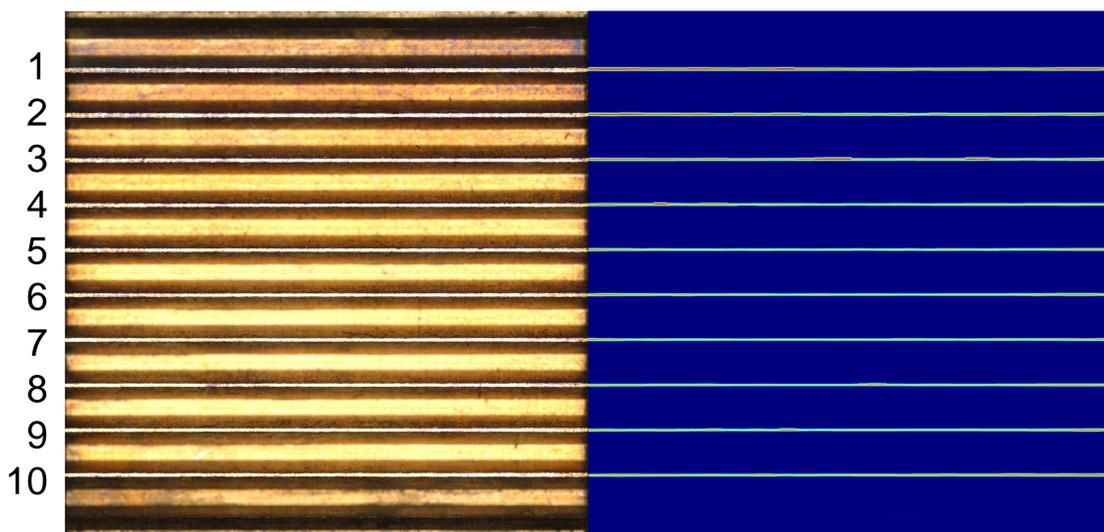
An approach was developed that automatically performs a pixel segmentation based on local image gradient extrema, leading to an accurate band-edge segmentation. For each band, a fine-grained line width is estimated through the distance transform in conjunction with non-max suppression, which can be used to estimate the desired area statistics.

During this study, the traceability of the method was established through an optical standard from NPL. Measuring line-widths in the range 10-100 µm, errors less than 0.4µm were obtained.
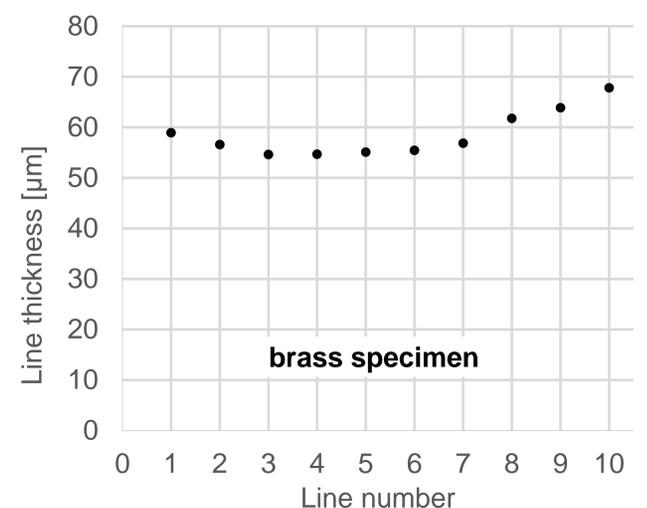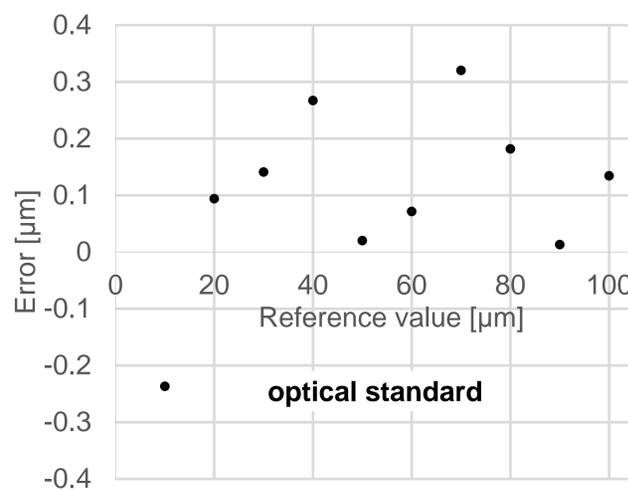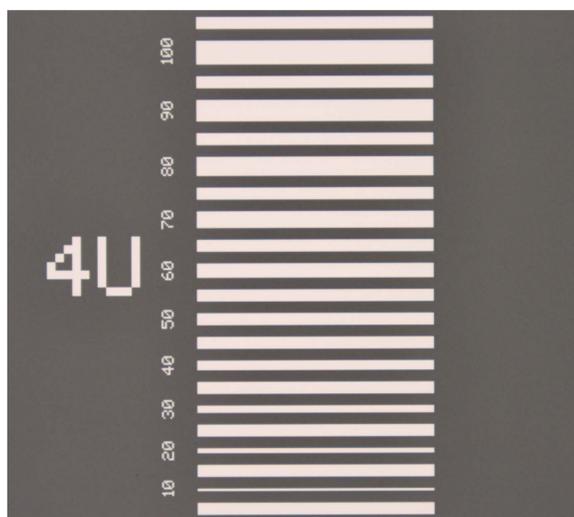
The measurement uncertainty for a single band is calculated as

$$U = k \cdot \sqrt{u^2_{ref} + u^2_{rep} + u^2_p + u^2_e}$$ where

u_{ref} : reference uncertainty
u_{rep} : uncertainty from repeatability of the measurements on the reference
u_p : specimen line-width uncertainty
u_e : uncertainty coming from the coefficient of thermal expansion

A general expanded uncertainty (k=2) of 0.5µm was estimated for single band measurement on the brass specimen.

The method was applied to quantify the single bands' width and it was observed on the specific item that the bands are slightly wider at the edges, indicating a higher deformation.

Based on the study, it is concluded that the method for automatic measurement of contact areas provides traceable measurements for the investigated dimensional range.

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