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## Minimizing refining steps for gears

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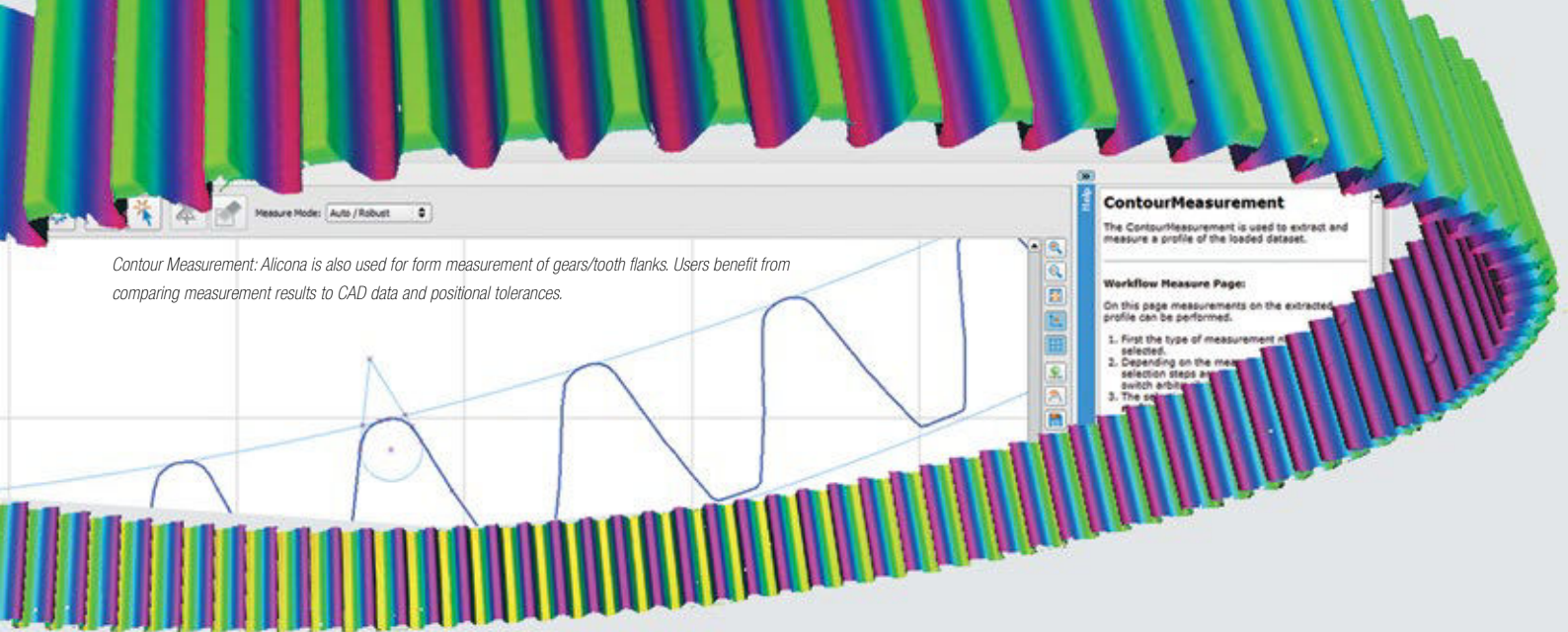
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Contour Measurement: Alicona is also used for form measurement of gears/tooth flanks. Users benefit from comparing measurement results to CAD data and positional tolerances.

# Minimizing refining steps for gears

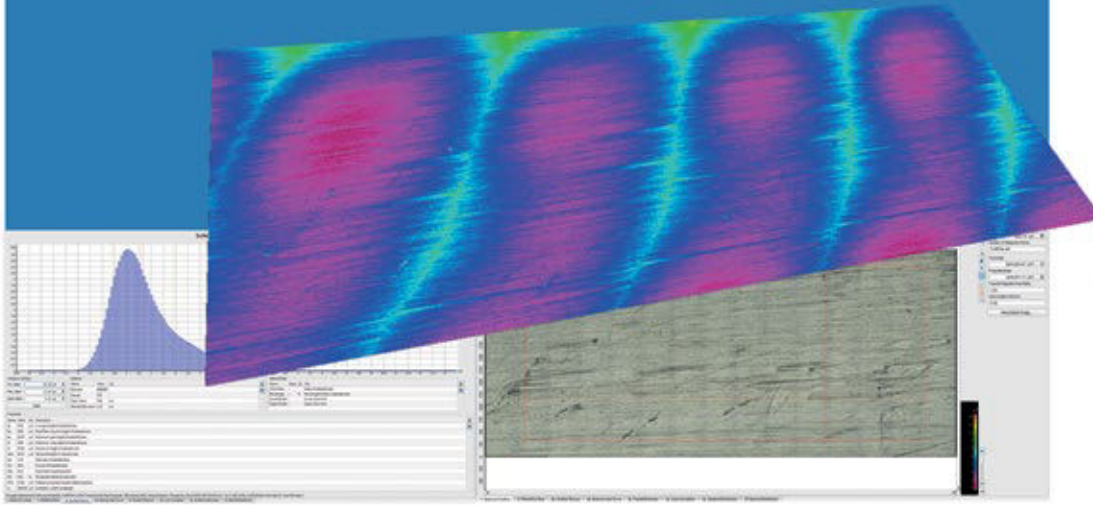
To help prevent cost-intensive postprocessing, Lund University developed a simulation model to calculate the ideal machine parameters for a form milling cutter. This was to ensure the tool would produce tooth flanks with optimum surface quality. The research team used Alicona systems at Sandvik Coromant to validate the mathematical models and verify their suitability for practical use. “Thanks to the high working distance, we were able to measure the roughness of tooth flanks that were previously inaccessible to us,” Mattias Svahn confirms.

Due to global competition, cost pressure is constantly on the rise. This makes it necessary to increase the efficiency of processes in the manufacture of gears. One of the major cost factors is post-processing, including refining steps such as grinding and honing to ensure the correct roughness of tooth flanks. This process could be minimized if it were possible to produce virtually perfect gears with optimum surface quality that need little to no post-processing. To make this a reality and to ensure gears are produced with the desired roughness, it is critical to calculate the correct machine parameters for the tool used, e.g. for a form milling cutter. The roughness has an effect on gears' service life, fatigue and uniform transmission of motion and is chiefly determined by the feed rate, possible errors connected to the tool and the machining process. It is therefore of great economical interest to predict which roughness values result from different machine parameters, and how possible error sources in milling affect the cut surface. For this reason, Lund University (Sweden) initiated a research

project to investigate this exact question by way of a simulation. The research team developed a mathematical model in order to investigate how machine parameters and possible error sources, isolated or combined, find their impact on the cut surface roughness. This was accomplished in cooperation with Sandvik Coromant, a renowned Swedish tool manufacturer that recently launched a new series of form milling cutters. Alicona systems were used to verify whether the roughness values calculated in the model could actually be produced in reality, and thereby identify error sources in the milling process. Areal roughness measurement enabled Lund University to validate the model at the required level of quality. „We carried out the areal roughness measurement on-site at Sandvik Coromant and got to know Alicona in the process. The high precision and speed of the measurements immediately convinced us to purchase our own InfiniteFocus system,“ professor Carin Andersson explains.

## Roughness and positional tolerance

The quality of a tooth flank is determined by both its roughness and its profile accuracy. The roughness of the tooth flank plays an important role in several ways. For example, it directly affects noise generation. The rougher the surface, the noisier the gear. Uniform transmission of motion, on the other hand, mainly depends on the form and positional tolerances of the tooth flank. It is therefore vital to measure both roughness and form to ensure proper quality assurance of gears. When measuring roughness, it is important to consider the dominant surface structure of gears and choose the appropriate measurement technology for this purpose. Mattias Svahn used an Alicona system, as he knew that mere profile-based roughness measurement would not deliver useful results. „Profile-based measurement allows me to map the surface only partially. A lot of important information is lost by only a few line measurements along the tooth height and the tooth width.



Areal based roughness measurement of a tooth flank. In contrast to profile based roughness measurement, the surface texture parameters Sa, Sq, and Sz allow precise assessment of the surface quality.

The resulting measurement values are simply not useful for validating the calculation model," lead researcher and measurement expert Mattias Svahn explains. By contrast, Alicona's measurement systems make it possible to map the roughness of the entire surface, even of the tooth flanks—fast, repeatably, and at high resolutions. The surface texture parameters Sa, Sq, and Sz allow precise assessment of the surface quality.

Form deviations can be made visible using difference measurement. This is accomplished by comparing measurement results to a CAD dataset and/or form and positional tolerances.

In addition to form and roughness measurement, Lund University also makes use of the visualization of 3D data sets. The large lateral and vertical scanning areas make it possible to map the topography of the entire gear cutting.

*„Thanks to Alicona, we have been able to minimize the time and cost-intensive refining steps of gears. We were blown away by the capabilities of the Infinite-Focus system we got to know at Sandvik Coromant. There is no measurement system we know that is capable of measuring critical form and positional tolerances and roughness of tooth flanks in this way with just one system.“*

Mattias Svahn, Lund University

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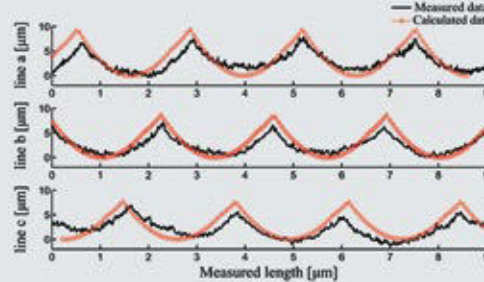
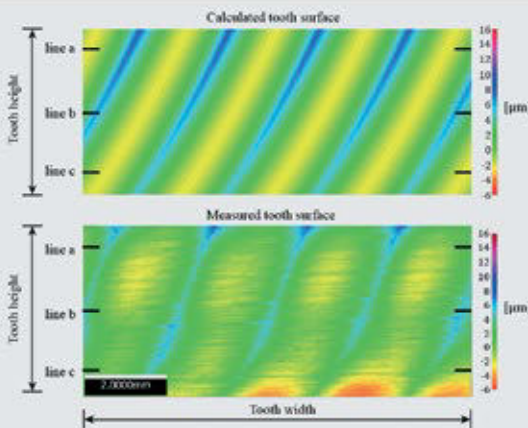
**Mattias Svahn**, Division of Machine Elements: „ We were blown away by the capabilities of InfiniteFocus!“



**Lars Vedmar**, Division of Machine Elements



**Carin Andersson**, Division of Production and Materials: “The high precision and speed of the measurements immediately convinced us to purchase our own InfiniteFocus system.”



Deviations between calculated surface and measured surface. Alicona systems were used to verify whether the roughness values calculated in the model could be produced in reality.

Calculated roughness versus measured roughness: The research team developed a mathematical model in order to investigate how machine parameters and possible error sources find their impact on the cut surface roughness.

### At one glance:

- » Alicona was used to validate a mathematical model to investigate how machine parameters and possible error sources find their impact on the cut surface roughness.
- » In particular, areal roughness measurement helped to validate the model at the required level of quality.
- » Sa, Sq, Sz parameters were measured at tooth flanks that have not been accessible before.
- » The measurement of form deviations to reference geometry was performed by using difference measurement. This is accomplished by comparing measurement results to a CAD dataset and/or form and positional tolerances.



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