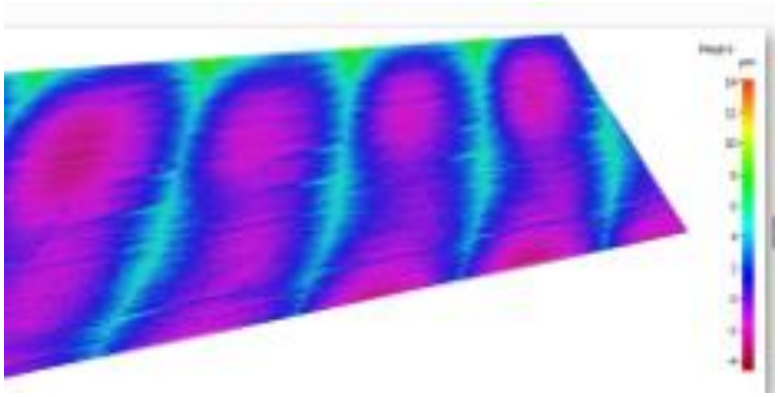
Optical Metrology User Case Study:

Optimizing surface parameters on gear flanks



Bruker alicona

Bruker Alicona is a leading global supplier of optical metrology solutions based on the principle of Focus Variation.

Focus Variation works on the basis of moving a focal plane over a surface and collecting robust 3D data which can then be used to measure geometric form and surface finish from a single optical sensor.

Measurement processes can be fully automated and provide GD&T measurement capabilities across all industrial & medical sectors.

The systems are in use in Industry, Industrial Research, Universities and production facilities globally.

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To help prevent expensive postprocessing, Lund University developed a simulation to identify the ideal machine parameters for a form milling cutter that would ensure the tool could produce tooth flanks with optimum surface quality. The research team used an Alicona InfiniteFocus system at Sandvik Coromant to validate the mathematical models and verify their suitability for practical use. The long working distance of the InfiniteFocus allowed access to the tooth flanks that was previously not accessible by conventional techniques.

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 finish of the tooth flanks.

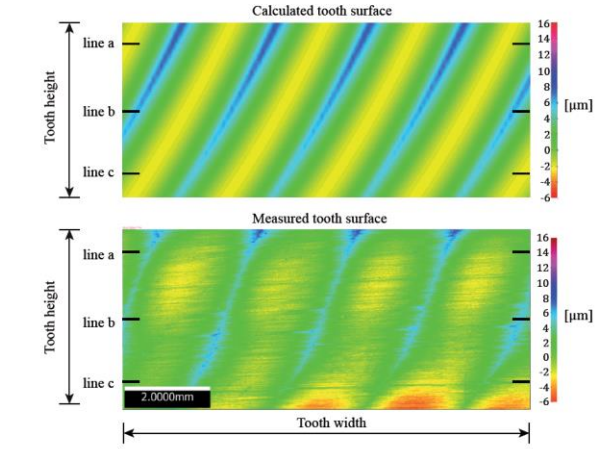
This process could be minimized if it were possible to produce virtually perfect gears with optimum surface quality that need little to no post-processing.

To make this a reality and 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. Roughness is chiefly determined by feed and cutting speed.

These parameters also have an effect on gears' service life, fatigue, uniform transmission of motion and noise. It is therefore of great economical interest to predict which roughness values result from different machine parameters.

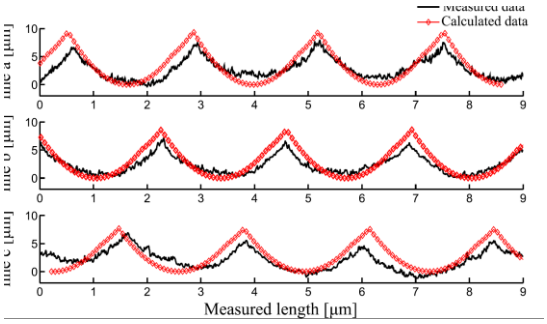
For this reason, Lund University (Sweden) initiated a research project to investigate this exact question by way of a simulation. The research team created a mathematical model to calculate the machine parameters for the production of gears with optimum surface quality. This was accomplished in cooperation with the Swedish tool manufacturer Sandvik Coromant who were planning on launching a new form milling cutter.

Alicona systems were used to verify whether the roughness values calculated in the model could actually be produced in a real-world situation, this required areal based surface measurement which is available with InfiniteFocus.



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.

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.



Roughness and form measurement

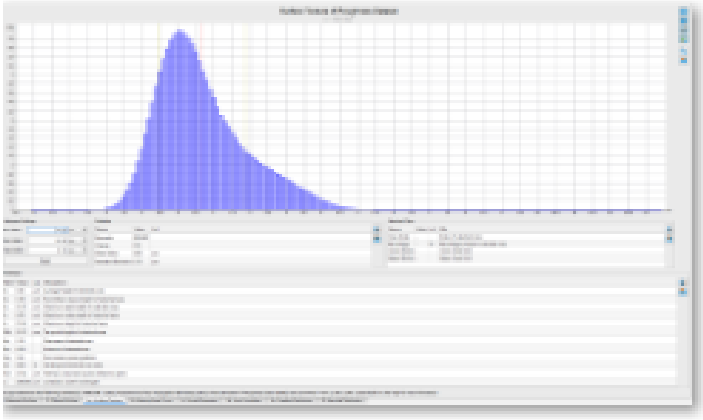
The quality of a tooth flank is determined by both its roughness and its geometry. The roughness of the tooth flank plays an important role in several ways. For example, it directly affects noise generation. The rougher the surface, the noisier the gear. Uniform transmission of motion, on the other hand, 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. Understanding that tactile profile-based roughness measurement would only provide a partial result depending on the direction of the profile meaning that the resulting measurement values are simply not useful for creating and validating the calculation model, the group therefore used an Alicona optical metrology system.

This, in contrast to a profile-based measurement, makes it possible to map the roughness of the entire surface, even of the tooth flanks—quickly, repeatably, and at high resolution. The surface texture parameters Sa, Sq, and Sz allow precise assessment of the surface quality.

Surface Texture_Area Selection



Surface Texture_Parameters

Also 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, the group 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.

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.

"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 InfiniteFocus 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. The high precision and speed of the measurements immediately convinced us to purchase our own InfiniteFocus system," lead researcher Mattias Svahn explained.

We would like to thank Mattias Svahn, Lars Vedmar & Carin Andersson for their help in preparing this application

Summary:

It can be clearly seen that Optical 3D metrology can offer a versatile tool in the pharmaceutical packaging industry.

In a simple to use package, and not requiring any metrology knowledge to operate users can easily scan a surface and measure the features required.

Equipment Available

These measurements can be made using the Bruker Alicona InfiniteFocusG5 plus which will measure up to 200 x 200mm samples

InfiniteFocusG5 plus system with 200 x 200mm XY stage and fitted with rotation device. Info at https://bit.ly/2TF9ctH