

R-Imager

Inline roughness inspection

Optical roughness measurement in the production line – fast, across large surfaces and in motion

The R-Imager inline inspection system calculates surface roughness not from the topography, but from two speckle patterns that are generated on the surface by laser light.

Surface roughness plays a central role in many production processes and must therefore often be monitored during production. With established measurement methods, the inspection process takes several seconds to minutes. The novel inline inspection system R-Imager inspects surface roughness spatially resolved in just a few milliseconds – even across large and moving surfaces in challenging environments.

Inline roughness inspection

Inline inspection of surface roughness is important in many industrial applications: Roughness is often a key parameter that significantly influences both the quality and the efficiency of a production process. Random measurements with stylus instruments, that are commonly used for roughness control, do not allow for fast and large-area measurement. Optical measurement methods are faster, but typically have a very small measurement area. They also require exact environmental conditions that are usually impossible to achieve in the production line. A novel solution for inline roughness inspection is the R-Imager. It characterizes the roughness of a surface directly in the production line – on large surfaces and in real time. In this way,

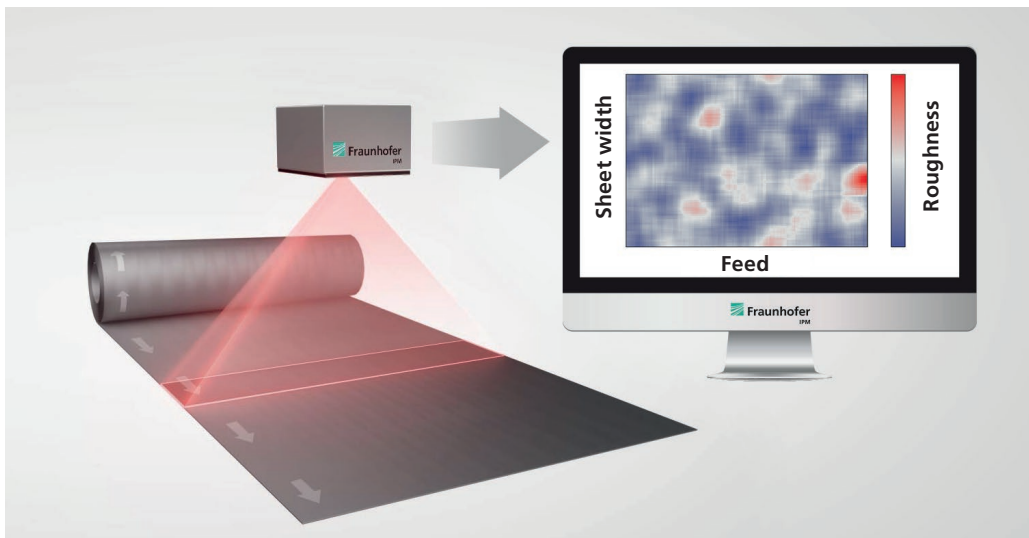
the R-Imager ensures consistent product quality while simultaneously increasing production efficiency.

Spectral speckle correlation

Relying on a laser-based optical measurement method, the R-Imager can measure surface roughness quickly, across a large area and without contact. Based on spectral speckle correlation (SSC) the R-Imager analyzes speckle patterns that are created whenever coherent laser light hits a rough surface and is scattered. For each measurement field, the system records two of these speckle patterns at different wavelengths – in a few milliseconds and in a single camera image. The inspection system then calculates the surface roughness from

Advantages at a glance

- Fast inline roughness measurement on moving surfaces at typ. 2 m/s (or more)
- Measuring surfaces in the range of 10 cm²
- Spatial resolution in the range of 1 mm
- Measuring range from 0.6 μm to 2 μm Sa
- Contactless measurement
- Insensitive to working distance: e.g. 400 mm ± 5 mm



The R-Imager inline inspection system can be easily integrated into existing production processes thanks to its large working distance.

the information contained in the image. To do this, it uses the small differences between the resulting speckle patterns that arise due to the different wavelengths. The rougher the surface and the greater the difference between the wavelengths, the more distinct the speckle patterns. Accordingly, the choice of wavelengths ultimately also determines the measuring range: this can be set, for example, between $0.6 \mu\text{m Sa}$ and $2 \mu\text{m Sa}$, depending on the application.

Large-scale measurement – spatially resolved

Thanks to its innovative measuring method, the R-Imager inline inspection system can measure relatively large areas in real time while conventional measuring principles are generally limited to smaller areas. The R-Imager analyzes a measuring area of many square centimeters in just a few milliseconds, providing very comprehensive roughness information. And although the method does not directly measure the surface topography, it still allows the spatial roughness distribution to be determined. To do this, the R-Imager analyzes the recorded speckle patterns at precise positions.

Roughness measurement in the production line

The R-Imager allows the determination of roughness at a relatively large working distance, which makes the inline inspection system much easier to integrate, even in challenging production environments. Even when using standard laser light sources, measurement times are in the millisecond range, enabling measurements on moving surfaces – at belt speeds of around 2 m/s; specially adapted systems also work at higher speeds.

Continuous real-time monitoring

The innovative measuring method of the R-Imager excels over other roughness measuring methods when roughness is a critical production parameter and continuous monitoring is desired. In many cases, the R-Imager is the only system available to measure roughness in real time in the production line, thus ensuring production quality and enabling a quick response to changes in the production process.

The R-Imager inline inspection system provides continuous, real-time monitoring of surface roughness, ensuring product quality and production efficiency.

Contact

Dr. Alexander Bertz
Group Manager Geometrical Inline Measurement Systems
Phone +49 761 8857-362
alexander.bertz@ipm.fraunhofer.de

Patrick Laux
Project Manager Geometrical Inline Measurement Systems
Phone +49 761 8857-346
patrick.laux@ipm.fraunhofer.de

Fraunhofer Institute for Physical Measurement Techniques IPM
Georges-Köhler-Allee 301
79110 Freiburg, Germany
www.ipm.fraunhofer.de/en

