FOURIER PTYCHOGRAPHY FOR FAR-FIELD MICROSCOPY

Task

Process monitoring is becoming an increasingly relevant topic in almost all industrial processes in the Fourth Industrial Revolution. In metal processing, for example, light microscopy is often used for this purpose: to detect and analyze surface defects. However, the microscopes used are expensive and the complete scan of a macroscopic object is extremely time-consuming.

Method

The Chair for Technology of Optical Systems TOS is developing an optical setup based on Fourier ptychography, which, with a laser and a CCD camera, can generate algorithm-based images at a higher resolution than those generated conventionally by optical methods. This is achieved by mechanically moving an aperture to different positions and taking a low-resolution image after each shift. From the sum of these images, a single, higher-resolution image can now be recalculated using an optimization process. Thus, with inexpensive components and a working distance of about 50 cm, the setup can generate wide-angle images whose resolution can compete with that of conventional light microscopes.

Result

TOS has successfully implemented an optimization algorithm to generate the high-resolution image. Furthermore, it has set up an experimental system that has increased image resolution. Future developments include further increases in resolution by adapting the measurement method and algorithm.

Applications

The process can be applied to all industrial systems that use optical methods for process monitoring. It is particularly useful in those processes that benefit from microscopic imaging, but that cannot be used with the small working distance of conventional microscopes.

Contact

Paul Buske M. Sc., Ext.: -359
paul.buske@tos.rwth-aachen.de

Dr. Annika Völl, Ext.: -8369
annika.voell@tos.rwth-aachen.de

3 Resolution enhancement by iterative algorithm.

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