

# High-speed 3D surface scanning by Area Confocal Scanning Microscopy (ACSM)

## Field of application

The new area confocal scanning microscopy (ACMS) is uniquely suited to optical non-contact measurements such as surface inspection and 3D measurement technology. Compared to customary measuring systems the scanning speed is increased by a factor of several hundred with only a slight reduction in resolution.

## State of the art

Conventionally confocal microscopes obtain 3D images by scanning single points of sample successively and then assimilating the detected signals. A sequence of slices supplies a z-stack i.e. depth-data for the 3D image. Currently the two predominant methods to increase scan rates are slit scanning microscopy and programmable array microscopy. Both methods reduce the scanning period by passing the beam over the focal plane in only one direction.

Slit scanning microscopes use a slit illumination source to repeatedly sweep the sample in a bar or line and detect the signals through a slit aperture.

Programmable array microscopes on the other hand use MEMS (micro-electro-mechanical systems) technology to illuminate the object through an array of pinholes that produce illuminated points on the surface of the sample. The object is scanned using this array to collect the necessary data for imaging.

Instead of additional scanning in z-direction (axial direction) either technology can be augmented by chromatic confocal microscopy, which uses the fact, that light with different wavelengths has different focal planes along the z-axis to determine the height of the object.

Unfortunately the mechanical scanning only being one-dimensional adversely influences the speed of the 3D-imaging process in either case.

## Innovation

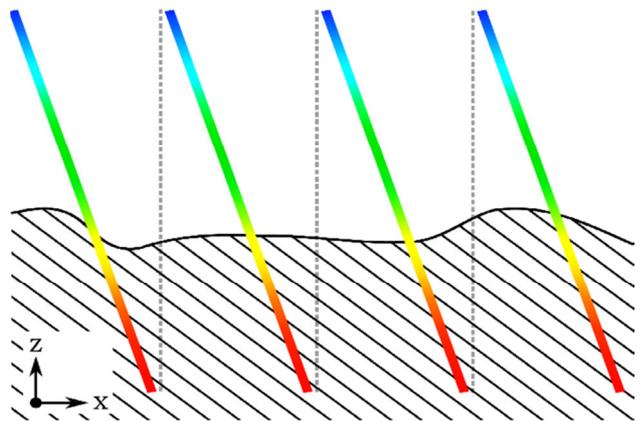
The invention combines the advantages of chromatic confocal microscopy and a new procedure for a 2D surface scan to allow for area scanning.

Using a slit scanning microscope the applied changes are as follows: The focal plane field is tilted by an angle of e.g.  $65^\circ$  to  $85^\circ$  for a microscope with a numerical aperture of 0.33. Thus, measured peak intensity occurs that is several times wider than a conventional confocal peak. Though the resolution is slightly reduced as a consequence, the scanning speed is greatly increased.

A prototype and numerical calculations are available to demonstrate the advantages compared to the state of the art. Since the effect can be simulated, the benefits can be calculated for different microscopy systems.

## Your benefits at a glance

- ✓ Area scan with a modified confocal microscope setup
- ✓ Scanning speed increases by a factor of several hundred
- ✓ The axial uncertainty is only increased by a factor of approximately 2.5
- ✓ The lateral resolution is only slightly reduced



Unlike with a conventional confocal chromatic microscope the beam strikes the focal plane at a specific angle. This tilt makes it possible to obtain a confocal area measurement without sampling.

[Image: Karlsruhe Institute of Technology]

## Technology transfer

TLB GmbH manages inventions until they are marketable and offers companies opportunities for license and collaboration agreements.

## Patent portfolio

A European patent application is pending.

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