MTF Measuring Systems for industrial applications

OEG GmbH was founded in 1991 and works since that time in the field of MTF testing. Based on that long experience OEG GmbH provides a comprehensive product line for the computer-controlled fully automatic measurement of the modulation transfer function (MTF) for quality assurance in the optics manufacturing. Depending on specimen parameter, there are different setups available.

A new standard of MTF-measurement

MTF test benches from OEG provide the fully automatic characterization of the imaging quality on the axis and in the field for any azimuths and types of object / image conjugates by measurement of the modulation transfer function. The operational area covers a wide range of optics from VIS to NIR up to 250mm free aperture.

Technical background

The modulation transfer function (MTF) is a recognized control criterion for the optical imaging quality. It characterizes the resolution of optical systems on the axis and in the image field. The MTF describes how the image contrast varies with spatial frequencies. Spatial frequency is expressed in terms of line pairs per millimeter (lp/mm). The MTF combines image resolution and contrast into a common representation. Beside the MTF also other optical parameters can be measured, e.g. focal length (EFL), back focal length (BFL), field curvature, chromatic aberrations, astigmatism or the distortion.
**Reasons for MTF measurement**

Despite the presence of sophisticated design and manufacturing techniques, lenses can still vary considerably in imaging quality because of manufacturing errors. Because of the growing demands in imaging performance of lenses their characterisation by help of the Modulation Transfer Function (MTF) as the premier parameter for objectively evaluating is more and more used. Another feature of an MTF measuring instrument is, that it allows system testing in situations similar to actual applications. Field angle positions, spectral ranges, distances between object- and image plane can be replicated or simulated in the test of an optical system.

MTF measuring instruments are characterised by large versatility, there apart from the MTF numerous further parameters can be derived, e.g. field curvature, chromatic aberrations, effective focal length, back focal length or line spread function. MTF measurement results can be compared with the associated optics calculation.

**Real time MTF-measurement offers new possibilities**

The MTF test benches from OEG uses a CCD-camera as sensor. An image processing software allows the real time display of the test chart image as well as parameters like line- or edge spread function, grey value distribution and MTF. Additionally CCD-cameras provide the advantage, that both directions of MTF (sagital, tangential) can be measured nearly at the same time.

**Measuring principle**

The lens under test provides an image of the test chart. This image is projected by the image analyzer optics on the CCD camera. The MTF evaluation software calculates the MTF and other parameters from the detected grey value distribution.
A meaningful MTF measurement needs both the measurement on the optical axes and in the image field. A powerful software for the control on an automatic measuring sequence is at least of equal importance like the MTF calculation algorithms. Additionally, the optical components of the MTF test bench and the mechanical components must meet high quality demands.

MTF test benches from OEG guarantee the compliance with the demands of a high accurate MTF measurement!

Special requirements require special solutions
Experience has shown that MTF test benches often have to be customized. Therefore, a close cooperation of supplier and customer is necessary, to adapt the MTF bench to the existing measuring demands. Parameters, which must be adapted to the specimen are e.g. the free aperture, measuring wavelength, object-/image- conjugates, image field size, object field angle and EFL of specimen.

OEG GmbH is a proven and competent partner with experience for more than 20 years.

On a view
MTF test benches from OEG provide among others the following features:
- real time representation of MTF, ESF (edge spread function) and LSF (line spread function) on the PC screen;
- fast switching between tangential and sagittal MTF measurement;
- comparison with freely selectable desired MTF-values in the diagram;
- simple change between different measuring wavelengths;
- automatic, software controlled measurement of colour aberrations;
- fast change between measurement on the axis and in the image field
- fully automatic, software controlled measuring sequence for up to 7 automatic axes;
- alternatively manual or automatic azimuth-dependent measurement
- automatic, software controlled symmetry measurement;
- operation and control of the hardware by Joystick, mouse and PC keyboard
- graphic and numeric representation of the measured values;
- automatic production of meaningful metrology records (quick report);
- diagram of the focus curve (contrast for given spatial frequency)
- software controlled or manual focusing;
- automatic focusing with a user selected spatial frequency;
- measuring procedure very easily programmable by operator;
- measurement of focal length (infinity / finite) or magnification (finite / finite);
- evaluation of distortion, image field curvature and astigmatism;
- objective data base;
- measuring template data base assigned to the according objective;

**MTF-Explorer**

**Image evaluation software for measurement of MTF, ESF and LSF**

MTF-Explorer is an image evaluation software for the measurement of modulation transfer function (MTF), Line spread function (LSF) and Edge spread function (ESF). It consists of a Windows-software with interfaces to different image sources. In particular, MTF explorer is perfect suited for the upgrade of existing MTF benches with outworn evaluation units. The old units can be replaced by the MTF Explorer and a CCD camera. The picture shows a special setup for CCD chip adjustment by best MTF. If the MTF does not meet the desired values, they are marked in red, otherwise in green. MTF curves can be stored and printed in diagrams.