Optical Systems for the

Measurement of Mesh

Geometries

The
MeshInspector
Series

OSIF
GmbH

Optical **S**ensor Technologies
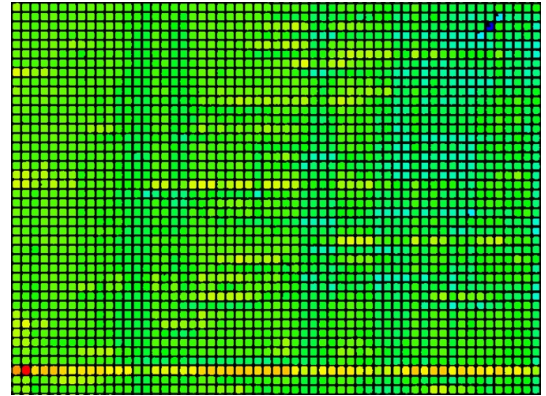for **I**nspection and **F**orm Recognition

MeshInspector -
Application Areas and Key Advantages

The MeshInspector Series is a series of inspection systems for the optical, contact free measurement of the geometries of different meshes such as wire mesh, expanded metal, perforated metal, filter material or meshes for screen printing and other applications. The following characteristics are measured: mesh and knot size (length, height), yarn or wire thickness, mesh angle and the open (unmasked) mesh area.

The MeshInspector is available in three versions: MeshInspectorLine for inline monitoring during the production process, MeshInspectorCross, which is a stand-alone inspection system for the measurement of framed wire screens and MeshInspectorML which is a portable system for sample measurement in the laboratory or alongside production machines at different locations. The MeshInspector Series can be used for quality control during the production process and for the finished products and also for the quality assurance of incoming materials.
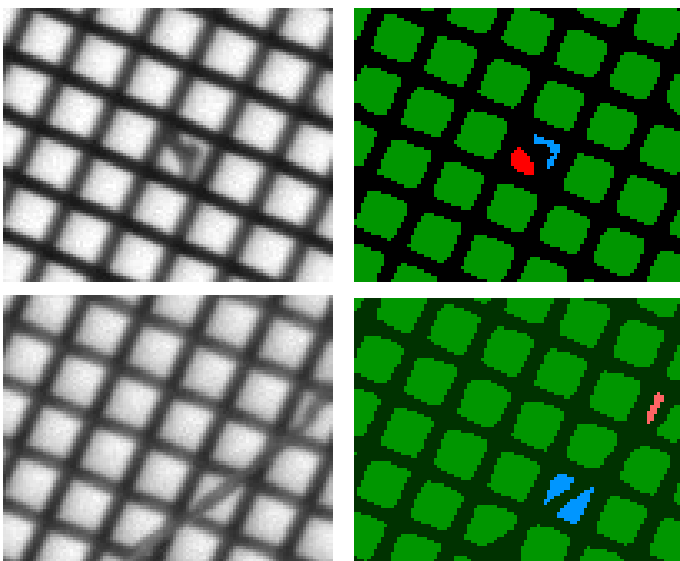
All three systems feature high measuring speed, clear display of the results and easy setup and operation.

This picture shows three detected defects: A weft defect (yellow), a mesh which is to small (blue, top right) and a mesh which is to big (red, bottom left).

The MeshInspector's key advantages:

- Automatic determination of standard mesh characteristics according to DIN ISO 3310
- Display and highlighting in colour of detected defects on the PC monitor (outside of specified tolerance and other defects)
- Contact-free and thus non-destructive
- Automatic calibration
- Statistical and analysis tools for a detailed examination of the material
- The systems are individually adaptable to the typical range of defects and the special characteristics of the customer's process.
- Automatic documentation of the detected defects, deviation from tolerances and measured mesh characteristics.
- Fast and reliable evaluation of production changes
- Line: Easy integration into existing processing lines due to small system size.
- ML: Mobile and therefore easy to use at different locations. The system can be connected to a standard Windows-based PC via IEEE 1394 (FireWire).
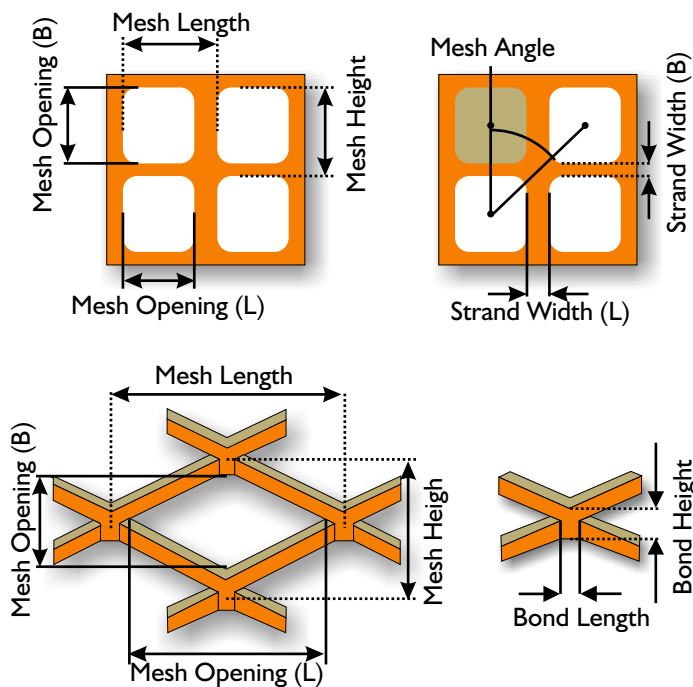

The MeshInspector can be used for the Inspection and measurement of wire and filter material, perforated metal, expanded metal, etc.

Mesh Characteristics

The standard versions of the MeshInspector Series measure the following parameters: Mesh and knot size (length, height), yarn or wire thickness, mesh angle and the open (unmasked) mesh area.
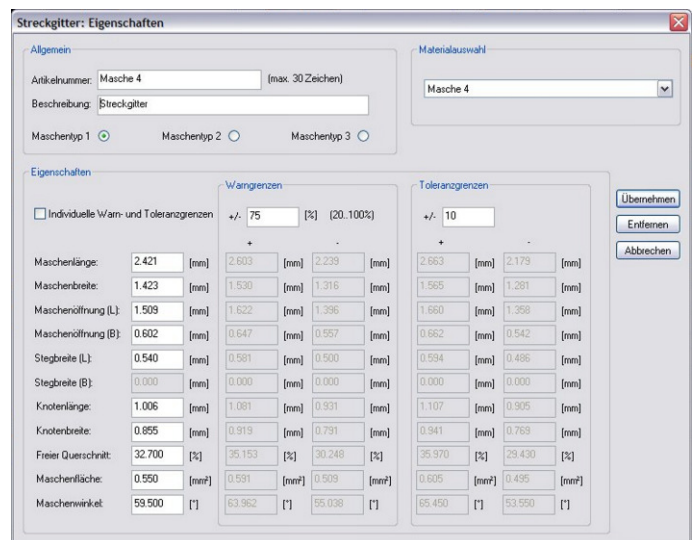

Optical Resolution

The images are captured using a high resolution camera with a telecentrical lens for capturing the images. This kind of lense allows precise and distortion-free pictures of the printed screen. The required resolution of the lense depends on the smallest structure of the mesh that needs to be measured. The chosen resolution is inversely proportional to the field of view (picture area on the sampled material). In turn, the time required to inspect the mesh depends on the mesh area and the field of view (how many pictures are required to capture the mesh). The inspection of a wire mesh with a size of 100 x 500 mm² and a mesh opening of 67 μm using an optical resolution of 3.5 μm per pixel can be made in less than 3 minutes. This corresponds to an inspection speed of over 60,000 meshes per second.

User Interface

During the design of the user interface for the MeshInspector Series, much emphasis was placed on the intuitive operation of the software. All of the steps are easy to accomplish, from entering the mesh and inspection parameters to starting a new inspection job, displaying the detected defects, printing and saving the inspection log and using the tools for the statistical analysis of the test results.

The parameters of the mesh material, the required mesh dimensions and the inspection tolerances etc. are saved in an internal database as so-called inspection recipes. They only need to be specified once, prior to the inspection of a new mesh material type. After that, they can be loaded again to carry out further inspections with the same mesh material. This helps to automate the inspection process even further.

Dialog box for specifying the inspection recipes (mesh parameters, inspection tolerances, etc.)

Field of View	8.5 x 7.1 mm²	13 x 11 mm²	22 x 18 mm²
Resolution	3.5 µm/pixel	5.3 µm/pixel	18 µm/pixel
Field of View	36 x 29 mm²	96 x 73 mm²	114 x 91 mm²
Resolution	28 µm/pixel	59 µm/pixel	89 µm/pixel

Relationship between field of view and optical resolution of the lense for six different lenses. Further lense types and resolutions on request.
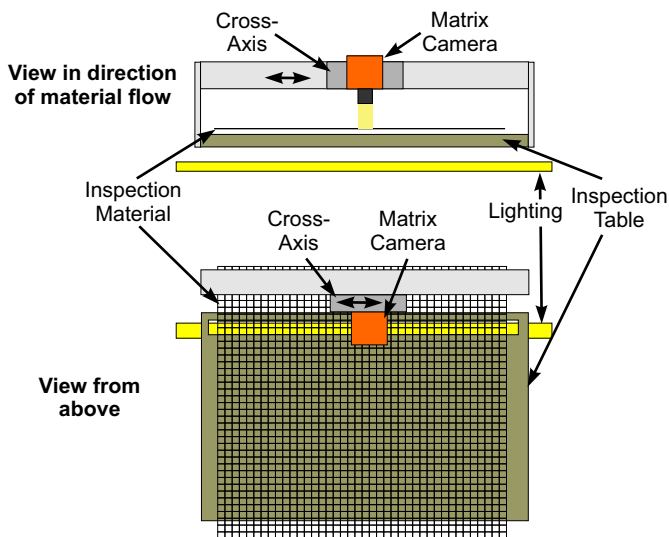
MeshInspectorLine - System Setup and Functionality

System Setup and Functionality

The MeshInspectorLine is intended for the online inspection of mesh-like material directly in the production line. It can be used for checking the mesh during production or during further processing steps.

The main components of the system are the control and analysis software, the high resolution camera(s) which, if necessary, are mounted on an cross axis, the lighting system, the encoder for synchronising the MeshInspectorLine with the production line speed and a high-performance industrial PC. The inspection table, shown in the figure is not always necessary.

Depending on the required resolution of the images, the speed of the production line and the material width, there are two possible inspection methods: Inspection of the entire mesh or the inspection of specified or random mesh samples.

There are two approaches in the case of specified or random samples: A single camera can be mounted on a movable traverse and take sample images at different X positions. Alternatively, several cameras can be mounted at fixed X positions and then sample the mesh material only at these distinct positions.

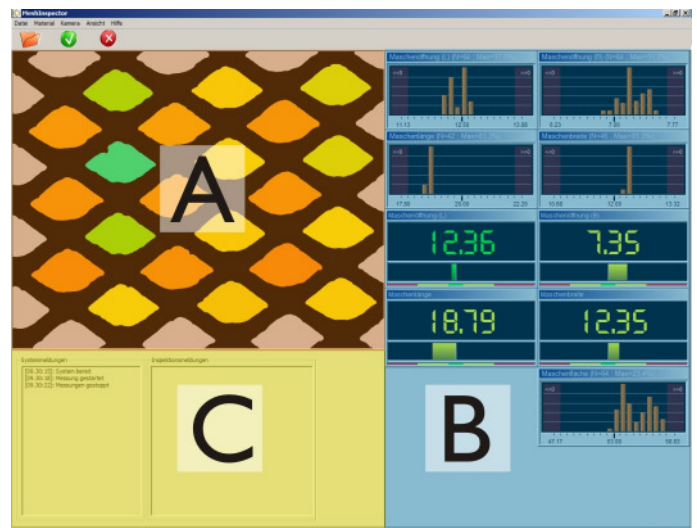The camera takes the pictures using transmitted light. This makes the inspection indifferent to the mesh colour or gloss level. The image capture is triggered by the encoder, which makes the system largely independent of the material speed on the production line.

Thereafter, the image is analysed for mesh defects and the mesh characteristics are calculated. Detected defects and measured values are displayed on the PC monitor and are written to an inspection log. Mesh defects can also trigger a signal to alert the operator or for machine-to-machine communication. In addition, detected defects can be optionally marked directly on to the material.

At the end of each inspection, the defects log and a global defects map can be printed out so that employees and customers can assess the quality of the mesh at a glance. The logs can be archived on the PC and can be opened again later on any office PC, for instance in case of a customer complaint, using an offline log file browser.

The User Interface

The main screen of the MeshInspectorLine is divided into three areas. Area A shows the current camera image, whereby the measured mesh values are shown in different colours. Area B is user-configurable and can display measured values or histograms of accumulated values. Area C shows the inspection log and system messages, such as when and by whom the inspection was started. The inspection log shows detected defects or measurements which are outside of the tolerances.
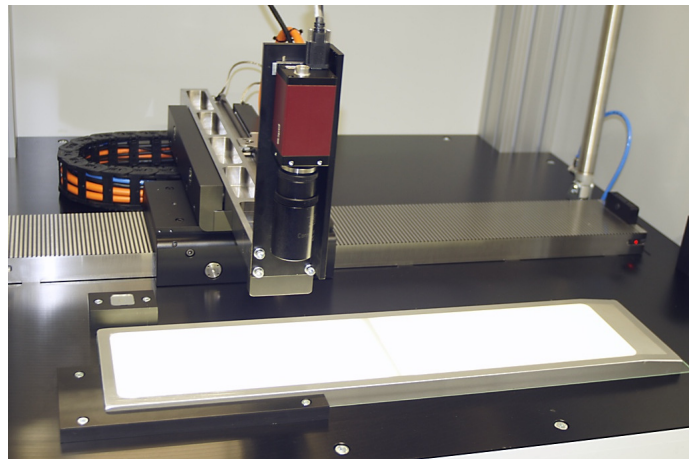
System Setup and Functionality

The MeshInspectorCross is a stand alone inspection system for framed wire screens (see picture below). During the inspection process, the entire screen is checked and all relevant geometrical characteristics are determined. In addition, every single mesh is checked for compliance with the specifications. Foreign objects such as fluff and holes in the mesh are also reported.

Depending on the size of the frame to be inspected, it can be constructed as a cross table with two axes (as shown on the right) or as a gantry setup (one X axis and two Y axes). Since typical screens for technical applications have mesh sizes of around 20-100 μm, the processing can only be done in a clean room. Thus the system is equipped with air-lubricated bearings for the axes and direct linear drives. This not only ensures a high dynamic response and thus high inspection speeds but also makes the system wear free.

The inspection starts automatically after positioning the screen and selecting the inspection parameters (inspection recipe) in the software. Prior to scanning the screen step by step, the system automatically calibrates the image scale of the camera lense. The defects detec-
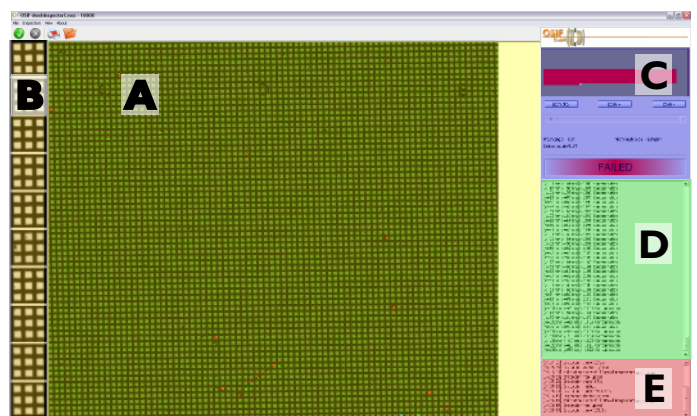
ted during the inspection process are displayed on the PC monitor and are included in a defects log. At the end of the inspection process, the system grades the screen as PASSED or FAILED depending on the specified inspection parameters and tolerances. In addition, a defects log and defects map are created. They can be printed out and attached to the screen as an audit report. The logs can be opened again later on any office PC, for instance in case of a customer complaint, using an offline log file browser.

Inspection of a wire screen with the MeshInspectorCross

The User Interface

The main screen of the MeshInspector-Cross is divided into five areas. Area A shows the current, already analysed camera image. Detected defects are marked in colour. Area B shows the last detected defect as an image. Area C shows the inspection progress, some measured values and the assessment (PASSED/FAILED). Area D contains the defects log and area E the system messages.

MeshInspector ML -
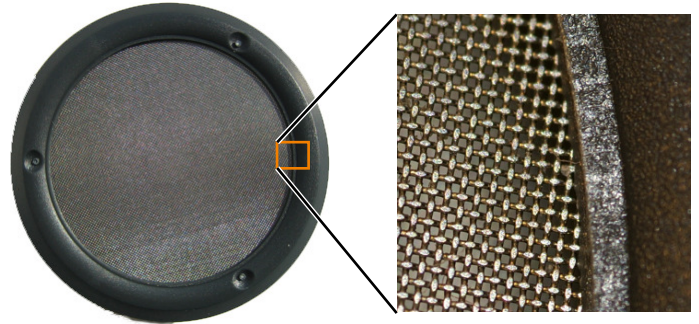# System Setup and Functionality

System Setup and Functionality

The **MeshInspectorML** (Mobile/Lab) is a portable inspection system for inspecting mesh samples next to the processing line or in the lab. It is connected with a standard PC or a laptop via an IEEE 1394 (FireWire) interface. This makes it very flexible and easy to set up.

To make an inspection, the mesh sample is placed over the lighting, the material type is chosen in the inspection software (e.g. expanded metal, wire screen, or punch metal) and the measurement is started. All characteristic mesh values are calculated from a single camera image by analysing each individual mesh. In addition, certain values and statistical distributions are calculated as mean values over all meshes.
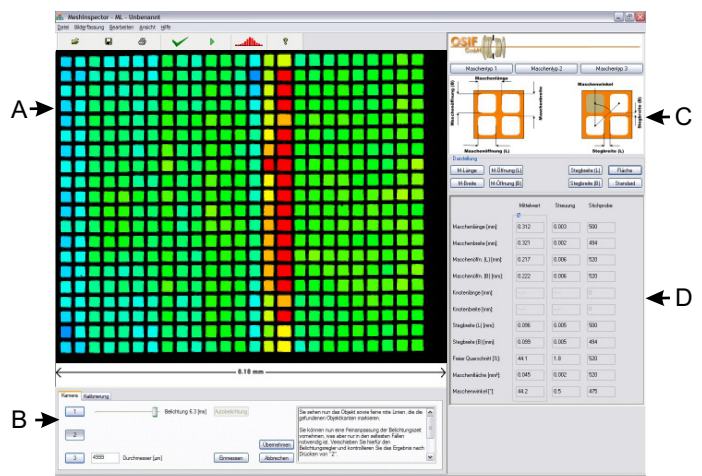
Each mesh of the displayed camera image is coloured according to the measured values. This makes it easy to observe the overall compliance of the meshes with the chosen tolerances. If the cursor is moved over one mesh, the values of the single mesh are displayed. Thus a detailed analysis of each mesh is possible. Finally, you can create an inspection report with a single mouse click. This drastically reduces the documentation work.

To archive a high measurement accuracy, the system is supplied with a highly accurate optical reference target, which allows easy and fast calibration of the system.

User Interface

The main screen of the MeshInspectorML is divided into four areas (see picture below). Area A shows the current, analysed camera image. In the example, some of the meshes are too large due to a shifted warp wire. They are shown in red. Area B shows the dialogue for the camera setup and calibration. Whereas the calibration can easily be done in three steps. Area C is used to select the mesh type. Area D shows the measured and calculated values. They are shown as mean values over all meshes or for a single mesh (if you click on the mesh with the mouse).

Status Pages

The systems **MeshInspectorLine** and **MeshInspectorCross** generate status pages in HTML format during the inspection process. They contain information on the product being inspected, the detected defects, total system hours, etc. and can be opened with a standard internet browser from any location within the companies local network (if the corresponding LAN access privileges are set). This allows access to information on the current inspection process from another location.
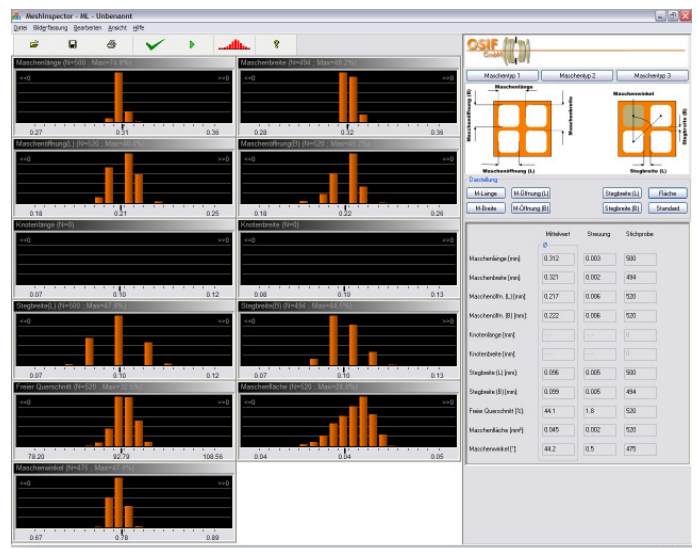
Statistical Analysis

The statistical analysis module is already included with the ML system. It is available as an option for the systems Line and **Cross** and must be ordered separately.

The statistical tools allow you to process and analyse the results of the measurements. The statistical distribution is calculated for each characteristic value (mesh height, mesh width, mesh area, etc.). You can choose whether to calculate the distribution over all meshes or just for all meshes in the last camera image. The standard deviation, mean value, min or max value and Cpk (process capability values) are also calculated with each analysis (see picture on right). Analysis of the production process is very important for product quality and process improvement. For example, by looking at the distribution of the mesh area, you can make conclusions on the uniformity of the production.

The statistical analysis module in **MeshInspectorML** is also capable of analysing the characteristic values based on the data for each individual mesh. Each mesh of the displayed camera image is coloured according to the compliance of the measured values with the specified tolerances. For example, a mesh with an area which exceeds the tolerance is coloured in red. This makes it easy to check at a glance if the meshes have been manufactured according to the requirements (see

screen picture of the **MeshInspectorML** main screen). If the cursor is moved over one mesh, the measured and calculated values of the single mesh are displayed.

Another possibility for production quality control are individual statistical analyses using the MS Excel® export function, which saves the measured values in an MS Excel® readable form. This allows each user to generate his or her own analyses, such as time series, material series or trend analysis.

Distribution of the measured values over all meshes

Custom Versions

Each customer has his own range of products and often unique manufacturing processes. Please get in contact with our engineers if you would like us to adapt our system to meet your production needs. For instance, you may want to store the measured values in your own production database, include special statistical values in the analysis or maybe you would like to have special control elements in the user interface of the software.

OSIF GmbH –
Location

OSIF **GmbH**

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Train

From main train station by metro or by foot (3 min. walk, following the "Bahnhof-strasse" direction city centre) to "Kröp-cke". Then take line 4 direction "Garbsen" to station "Marienwerder/ Wissenschafts-park". For about 500 m walk on the "Holle-rithallee".

Car

Exit the A2 at "Hannover-Herrenhausen". Drive on the B6 towards "Hannover". After crossing the „Mittellandkanal", leave B6, turning left at the following traffic light.

Hanover Airport

We will pick you up from the airport (approx. 20 min).

We are looking forward to your visit!