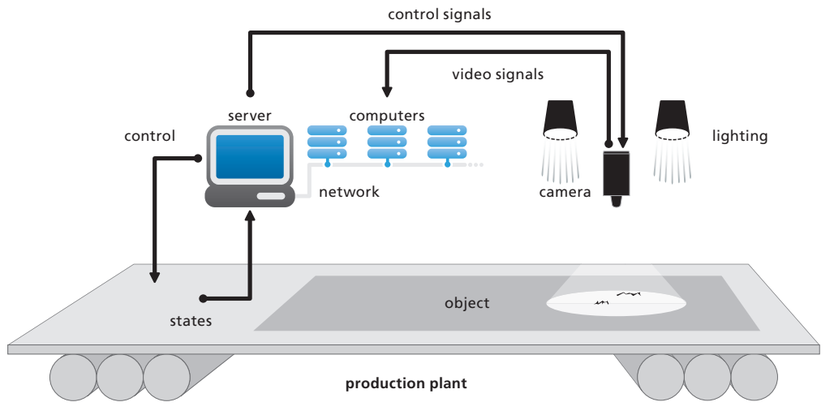

General structure of an inspection system

Projects

- Inspection systems for extension cells (metal)
- Ceiling panels (mineral fiber)
- Fire-protection panels (concrete)
- Leather inspection
- Automotive cabin air filters (nonwoven)
- Micro-cuvettes (medical engineering)
- Superconductor (high-gloss metal coils)
- Detection of holes in sinter belt (steelworks)
- Inspection and measuring of BLISKs (free-form geometry)
- Inspection of wooden furniture panels

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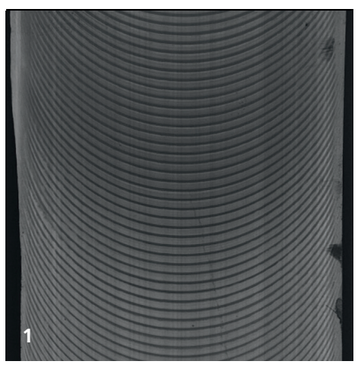
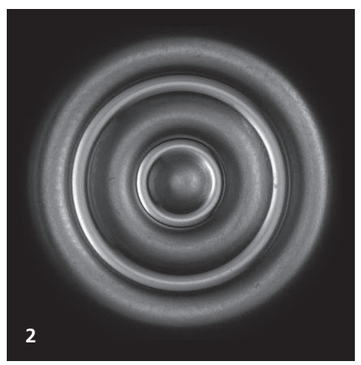
MASC – Modular Algorithms for Surface Control

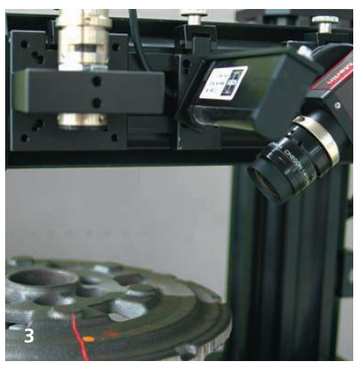
MASC – Systems for Surface Control



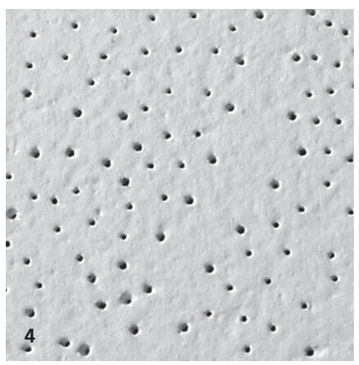
1 *Photomicrograph (steel, grinding pattern)*



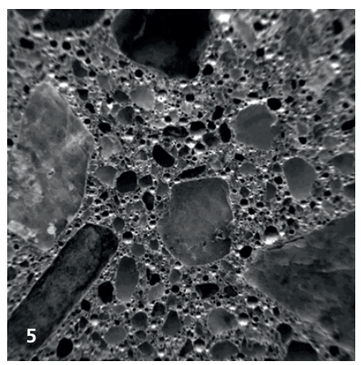
2 *Extension cell*



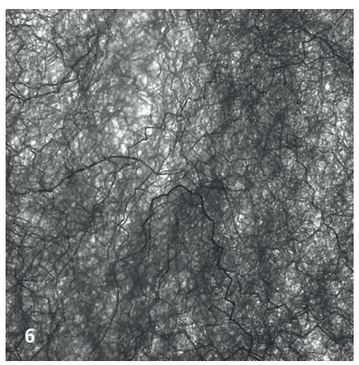
3 *Casting*



4 *Ceiling panels*



5 *Concrete*



6 *Nonwoven*

To permanently weather the challenges posed by competitive markets in the production industry special importance is placed, among other things, on the quality and appearance of product surfaces. The guarantee of a 100 % control is therefore one of the main requirements.

If the surface is in the end customer`s field of view, the aesthetic aspects, next to the functional aspects will have to be increasingly brought into focus. There is a variety of possible surfaces and also at least as many acompanies. To accomplish these tasks, the method of choice in many factories is still the manual final inspection by specially trained staff. The main advantage of having humans performing the quality control is their fast adaptive capacity to changing inspection conditions like e. g. geometry or texture changes. On the other hand, humans tend to quickly tire and thus, inspection results may possibly depend on their personal well-being and daily condition and are therefore subjective.

In high speed productions, however, humans may carry out spot checks, a manual 100 % control is no longer possible. Then again, components with a complex surface such as free-form surfaces have to be checked manually requiring a considerable investment of time and personnel.

Automatic Surface Control

Prior to applying an automatic surface control in the production process, the technical feasibility or practicability normally have to be examined and demonstrated in a preliminary study. For this purpose, suitable sample parts are being used in the image processing laboratory to develop and test potential hardware setups whilst always taking into account the subsequent production conditions. This initially involves selecting the appropriate hardware (camera, optics, lighting), then the actual job has to be done: The useful configuration of this hardware in order to depict defects in such a way that they can reliably be detected by applying the appropriate algorithms. The cycle times of the production process usually have to be closely observed, thus, not only the hardware has a key role to play but especially the careful selection of algorithms. The algorithms not only have to ensure fast data processing but must also allow for process stability and reproducibility which are the essential features of systems developed at the Fraunhofer ITWM.

In inline production inspection systems, defects are being detected and subsequently classified – in case this is necessary. We apply a combination of mathematically founded image processing algorithms and machine learning approaches. The data resulting from the image analysis are stored in a protocol and are further processed to deliver statistics of the inspection process.

Competences

The main competence of the Fraunhofer ITWM is in the field of mathematics and especially image analysis. The in-house software libraries ToolIP and MAVIkit contain a wide variety of image processing operations and algorithms. These libraries include standard algorithms optimized for online use, as well as state of the art mathematical solutions. Additionally, approaches have been supplemented by various machine learning methods. Ass we also have expertise in selecting the appropriate image processing hardware, we implement projects starting with preliminary studies and feasibility evaluations up to a customer-based inspection system as a complete system. That means, that we support our customers from the installation and optimization phase up to helping ensure acceptance during online inspection, by continously offering service and maintenance.

We integrate into existing production systems considering difficult assembly specifications. The inspection system is developed according to customer requirements either as a standalone or isolated solution. It must be considered, however, that an inspection system does not only consist of a camera, the lighting and algorithmics. We define interfaces, we query system states and possibly intercept system failures. The design of the graphical user interface and the transfer of the evaluation results are carefully planned and implemented, again according to the customers requirements. One of the most important requirements, however, is that the image analysis is both reliable and robust. On the one hand, it is important to ensure that all defects will be detected. On the other hand, certain variations in the appearance of the defects or textures must be tolerated so as not to be forced to constantly readapt the inspection after each batch change. We consider it an art of its own to have the image analysis algorithm be robust and modular, detecting everything in a fast and traceable manner while at the same time minimizing pseudo defects.