

Quality Control of Ceiling Panels

For quality control of ceiling panels, the Fraunhofer Institute for Industrial Mathematics ITWM has developed an automatic inline-inspection system which is running for several years now.

Above: MASC-STEX used in production

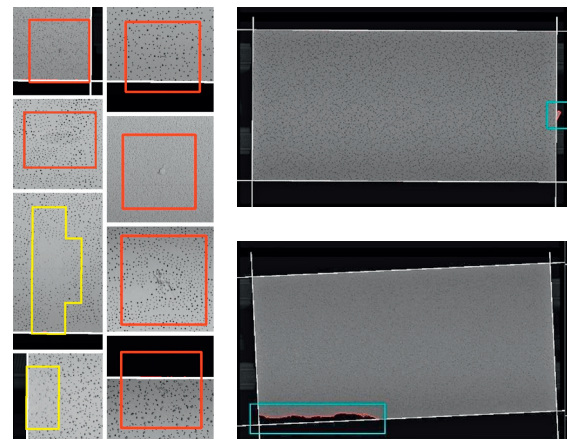
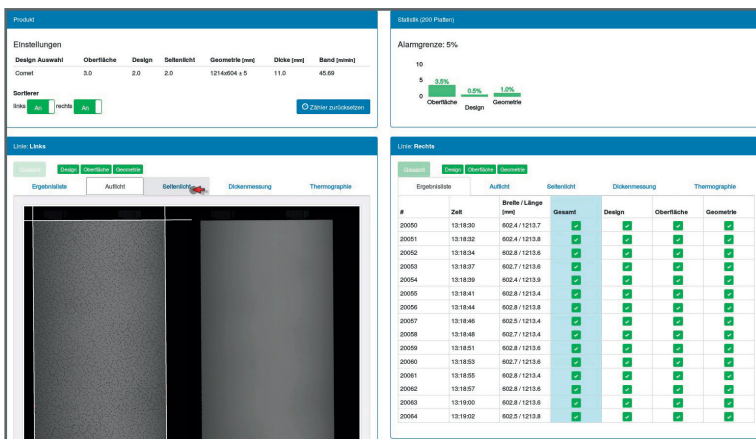
Ceiling panels are used in buildings, among other things, for fire protection, thermal insulation, and to improve room acoustics. They are available in a variety of different designs. Defects on the surface not only detract from the visual overall impression, but often compromise the above-mentioned functionality.

Competences

- Solution features
- Online defect detection
- Defect classification
- Position and geometry monitoring
- 24/7 solution
- Webbased graphical user interface

Typical Defects

- Global defects (design irregularities, large stains)
- Mechanical defects (breakouts, imprints)
- Local defects (dust, small stains)
- Scratches



Left: Web-based Graphical User Interface (GUI); middle: various defects on different designs: global (yellow), local (red); right: registration of panels with geometry defects

Task

In the production of ceiling panels, a wide range of visible defects can occur. Those are due to the fluctuating quality of raw materials as well as irregularities during the manufacturing process. The situation is aggravated by the fact that the defects are usually located in the middle of the surface pattern and are difficult to detect by a human inspector under fast, continuous production conditions. Harsh production conditions with dust and heat generation also place special demands on the robustness of hardware and software against disruptive environmental influences.

System Design

The MASC-STEX system consists of several computers, one of which acts as a server control station. The images of the surface are acquired at production speed by two high-resolution cameras. Since not all defects can be captured from a single angle, the system has two types of illumination generating a so-called dark-field and bright field image. The computer system then evaluates the recorded data. The results are displayed visually, and the sorting decision directly communicated to the extruder.

Image Processing

A Modular Machine Learning approach is used to learn the different designs of the ceiling panels. By using an expert-tailored set of image features, the system learns the characteristics of a defect free panel, instead of learning each defect. The advantage is, that new product variants can easily be taught as well as new kinds of defects detected – as a deviation from the “normal”.

This learning approach is combined with pre- and post-processing with highly optimized image processing algorithms as well as the classification of defects by their characteristics.

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