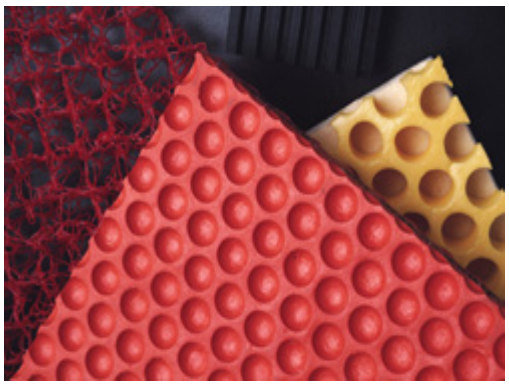
Automatic quality control for industrial printing

Results in Brief

Automatic tracing of defects' whereabouts

New quality prediction algorithms were developed for analysis of ceramic surface textures to improve defect detection and increase predictability of the final product. The knowledge-based control tools and methods derived show great potential for texture analysis in textiles or medical imaging where design plays a pivotal role.

INDUSTRIAL TECHNOLOGIES



Quality control is a vital and rather expensive process in the manufacturing industry. It is employed to ensure that the quality of the product meets a minimum set of requirements at critical points of the production line. The product is usually examined for defects and corrective actions are made to eliminate detected errors throughout the production process.

Ceramic tile manufacturing is among the most demanding markets in terms of product quality. European industry maintains a leading position in this market and this can be secured only by the superiority of the end products.

For this purpose new defect detection methods in stochastic (random) and pseudo-random surfaces were developed. Models of textural elements (texems) and affined templates were built and used as reference for defect identification.

Each model was based on different surface features such as size, colour or frequency space and their applicability was tested on a variety of surfaces. Statistical analysis tools such as the Parzen window, Gaussian mixture models, Eigenvalues, Chi squared similarity metric, etc. were applied to predict defects' localisation.

The majority of the algorithms developed produced good results. Real-time applications though proved unsuitable due to the heavy computational work arising from the screening process of new tiles against the developed models.

However, initial promising results were obtained from the frequency space analysis using the chi squared similarity metric on vibration lines. The new algorithm ran in real time but only a few data sets became available for further testing. Prominent were also the results from the affined templates method exhibiting comparable real-time applicability with fixed pattern tiles.

The design and implementation of the aforementioned algorithms in texture analysis opens new channels for further applications ranging from textiles to medical imaging. New insights are also given to the computer vision community in the field of scene analysis systems.

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