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High performance computing algorithms for textile quality control

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Abstract

At the present time, industries like textile are in constant need of modernisation. Thus, their presence in the high technology area of high performance computing (HPC) based inspection is of strategic interest. Textile manufacturers have to monitor the quality of their products in order to maintain the high quality standards established for the textile industry. The scope of this paper is to present a HPC architecture which can be implemented at each step of the quality control process in fabrics. The prerequisites or the overall system are then discussed analytically, as well as the limitations and the restrictions imposed due to the nature of the problem. The software algorithm and the evaluation of the first results are also presented in detail.
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Keywords: High performance computing; Textile; Industry; Quality control; Computer vision; Inspection system

1. Introduction

Efficient automated product inspection is a key factor for the increase of competitiveness of the textile and clothing industry, since it can enable top quality of final products and reduce total cost, through reduction in inspection labour costs, rework labour and scrap material. High performance computing (HPC) technology can render feasible advanced quality solutions, thus providing an important competitive advantage.

Textile manufacturers have to monitor continuously the quality of their products in order to maintain the high quality standards established for the textile industry [1]. Regarding the type of the fabric to be inspected, there are almost 50 different kinds of flaws. The quality engineers have to deal with an extensive variety of defects either due to mechanical malfunction of the loom, or due to low quality vibers and spreads. At the present, the quality assessment procedures are generally performed manually by expert quality engineers and technicians. Hence, the detection and classification of these defects is a time consuming and tiring procedure. In addition, the low quality control speed (only

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few centimetres per second) when compared to the production speed reveals the bottleneck in the workflow.

The textile and clothing industry has an estimated turnover of 150 billions ECUs and employs about 2.5 million persons in Europe. The majority of the companies in this sector are SMEs, which are facing an ever-increasing competition by low price imports. Automation and technological development are suggested as key factors for the survival of this industrial sector. Another key factor is the production of new top-of-the-range products, which are less sensitive to price competition. Although the clothing industry has benefited from technological innovations, particularly in CAD, it is still a labour intensive industry.

Due to the specific nature of textile, the defects encountered within textile production must be detected and corrected at early stages of the production process. Thus, the visual defect detection is of utmost importance for the product's overall quality and cost.

This paper studies in depth the investigation of quality control requirements of the pilot textile companies, by analysing the quality control processes and establishing the feasibility analysis of using HPC based machine vision to substitute human operators. It describes the HPC-system developed in the framework of the European project "THEME", which features the following improvements in the field of textile quality control:

- full inspection of the fabric;
- online detection and classification of the defects;
- integration of the realtime system into the textile production process.

This paper is organised as follows. Section 2 provides information concerning the end-users requirements. The following section describes the system specifications and the overall system architecture. In Section 4, the software core of the HPC-system is presented in detail as well as system management and user interface. Finally, in Section 5, the system performance is assessed along with interoperability issues.

2. Requirement analysis (system-users)

The HPC inspection system consists of three main components:

- the inspection bridge with cameras and lighting;
- the inspection computer system, consisting of networked industrial PCs;
- the inspection console and one or more quality control consoles.

2.1. HPC-system installation requirements

An extensive requirement analysis took place for all of the mentioned components of the HPC-system.

2.1.1. Inspection bridge installation requirements

The inspection bridge is installed above and below the strip. The images acquired with the cameras have to be transmitted via cable to the analysis computer.

The bridge can be installed anywhere in the production process where a straight strip is available. If a specific application requires the concurrent use of two different image capturing and lighting methods, two inspection bridges may be installed one after the other.

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