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A novel method for the identification of weave repeat through image processing

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Conventionally, weave repeat is identified manually by extracting individual warp or weft yarns from the fabric. This process can be troublesome and time-consuming. Therefore, automatic methods capable of identifying woven fabric repeat can be very useful.

This paper describes the application of a new algorithm using image processing techniques for the development of an automatic method, capable of identifying weave repeat. This method is based on scanning and obtaining a gray scale image of the original sample and enhancing it by morphological operations. The enhanced image is filtered by steerable vertical filters and then segmented into blocks showing either a warp or a weft point. The blocked image is divided into specific sub images, followed by operating sum over their columns and forming a matrix from them. A primary and secondary threshold is then defined giving rise to the formation of the weave pattern in the form of black and white squares. To identify the weave repeat, a matrix, replacing the black and white squares of the weave pattern by zero and one is produced. Then the first repeating row and column are found, showing the start of the next repeat vertically and horizontally, leading to the identification of weave repeat.

Keywords: weave repeat; image analysis; morphological operations; steerable filters; nonlinear diffusion filtering; fuzzy c-means clustering

Introduction

The weave repeat of any woven fabric can be defined as a specific array of a certain number of warp and weft points in the form of a square or rectangle, repeating itself in the width and length directions of the fabric. Warp point shows the warp crossing over the weft and vice versa. The reproduction of a woven fabric requires the identification of its weave repeat, so that the correct drawing-in, shed formation and weft insertion can be carried out. This guarantees the correct reproduction of the original weave.

Conventionally, weave repeat is identified by extracting the individual warp or weft yarns manually from the fabric and determining whether warp is crossing weft or vice versa at each crossing point. Simultaneously, a space on a point paper is or is not marked for a warp crossing weft or a weft crossing warp accordingly. The marking of the point paper must continue until the repeat is recognized. For complex weaves, it may be necessary to continue marking until the obtained pattern contains just over two repeats vertically and horizontally. For many basic and simple weaves, it is enough to mark the point paper until the first row and column starts repeating itself. Then the repeat can be identified. The manual repeat identification can be tiring and time consuming, especially for dense fabrics and complex weaves. Therefore, automatic methods capable of identifying weave repeat can be very useful.

Basic weaves, i.e., plain, twill, and satin have a square form repeat. Plain weave, which is the simplest, has only one kind of repeat but twill and satin have different kinds. Basic weaves can be expanded leading to new repeats. Twill and satin can also have derivatives. Warp rib, weft rib, and panama are examples of plain weave expansion.

This paper describes a novel algorithm, using image processing techniques, leading to an automatic method, capable of identifying any weave repeat.

Literature review

The basic research in the area of weave repeat identification has focused on Fourier transform techniques, making use of the peaks in the related power spectrum image, in order to extract frequency terms of periodic elements (Ravandi & Toriumi, 1995; Xu, 1996). Although this technique can identify basic weaves, it is not capable of discriminating different kinds of twill or satin weaves. Xu, (1996) using Fourier transform, employed the lines and their directions for the identification of different weaves from each other. Kang, Kim, and Oh (1999) identified crossing points first, followed by their separation into warp or weft points and finally the color of each warp or weft point. Ohta, Nonaka,

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