A DSP Implementation of an AOM and its Application to Defects Detection in Textile Material

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ABSTRACT.

This paper explains a method of defects detection in textile material using a DSP. This Supervised Learning method will allow the detection of defects in anyone of the phases of production. An algorithm of pattern classification based on minimum distance is used to carry out this method. Scalar distance in an Associative Orthogonal Memory (AOM network) is used to provide a measure of the angle which form the 2 compared vectors too.

In our system, we can appreciate that the method doesn't require an excessive processing time, so we can implement it for real time processing.

Other advantage of the system is that it is applied to different types of clothes and defects (In general, other approaches are centred in only one type of defect). In the other hand, our algorithms produce rates of success around 94%.

These results are quite encouraging if we keep in mind that it has been analysed some complex cloth types (such as lined cloth).

To finish, and since the results obtained both in error rate and in execution times have been quite good, the application of this method can be very advantageous, moreover knowing that the development environment used is relatively simple.

Keywords: Defects detection, automatic inspection, quality control, visual inspection.

1. INTRODUCTION

To reach these objectives we should automate the production process **¡Error! No se encuentra el origen de la referencia.**, but at the same time we should also control not only the process but also the final product in order to make sure that the final result is a valid product for the market [1]. To be able to compare a sample taken in a certain instant with other previously classified we should apply computing mechanisms that measure the approach from the sample to those that we know. Previous to the classification of any measure we should know a series of well classified samples which will indicate us the degree of approach to the taken measure.

These classification algorithms will be based on characteristic vectors of images, with which was created the database with the classified patterns, (starting from now "pattern vectors"). These are the vectors that will be compared with the vectors of characteristic of the current image (starting from now "test vectors"). Therefore, and by means of the classification algorithm, we will be able to know to which pattern vector approaches more each test vector, and, consequently, if we know that the pattern vector contains defects, we could, in the same way, say that the test vector contains the same or similar defects.

To carrying out the experiments of defects detection in textile stuff based on AOM distance, we have worked with a card of digital signal processing (DSP). It is a Texas Instruments's card named PCI/C44S **¡Error! No se encuentra el origen de la referencia.** with two processors C44 (that works at 50MHz) which works in parallel to carry out the high speed classification of the captured images

¡Error! No se encuentra el origen de la referencia..

2. EXPERIMENTS

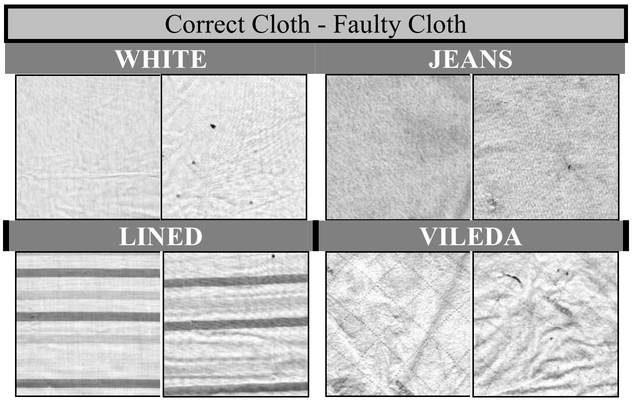
Considering the appropriate experiments to carry out in order to measure the power of the programs and the card with which it works, it will be formed 3 series of experiments, two of which will be commented later on.

With regard to the AOM classifier, and in order to reduce not only the necessary operations but also the processing time, we have eliminated the hidden layer of the AOM network so that the calculation of the AOM distance is reduced to:

To finish, we are going to show the parameters that have been used in the AOM classifier:

Parameters of AOM classifier	
Number of patterns	4 x 10
Distance method	Scalar Product
Filter f1	Scalar Product
Filter f2	Normalisation

Preparation Of Experiments



For the experiments carried out in this project, a battery of 40 images it has been created by scanning 4 different types of cloths (white cloth, jeans cloth, lined cloth, and "vileda" cloth). All the images have a size of 512x512 pixels, 256 grey levels and a 100 dpi resolution.

When creating the series of experiments, and because the group of samples is reduced (10 images for each cloth), we have considered the method **Leaving One Out**

This method consists on the use of a sample as test, and the other ones as training repeating the experiments, leaving every time a different sample, that's why its name.
The error rate will be the proportion between the number of fault experiments and the number of total experiments.

Image size	n x n
Window size	m x m
Number of Images	K
Number of Classifications x Image	$(n/m)^2$

$$T_e = \frac{\sum_{i}^{k} \frac{n^{o}\, errors}{(n/m)^2}}{k}$$

To summarize, we will expose the results obtained in three series of experiments. To obtain the answer time necessary to evaluate a window, we have to divide the total execution time of the complete image by the number of processed windows. In our case, the number of windows is always the same and it is equal to 64 (an 512 x 512 image can be divided in 64 windows of 64 x 64).

	Success Rate	Total Execution Time	Answer Time
Series 1	93.67%	4.797 s	0.075 s
Series 2	93.16%	2.847 s	0.044 s
Series 3	82.66%	4.072 s	0.064 s

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