SVC Method for Textile Weave Recognizing

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Abstract

Support vector classification (SVC) method is proposed to dive the wrap and weft point, for recognizing the textile weave. As the densities of wrap and weft are known, this image of the textile can be divided in to rectangle of wrap and weft point. The wrap points' histograms of R, G and B channel are different from the weft points'. So the SVC can trains the swatch by their eigenvectors which are the histograms of R, G, B channel in the rectangle selected by man, then predicts the square to display the weave of the textile. The experiences show that this method is good at to recognize the weaves from the image of the textiles which made by twist yarn or have much soft nap.

Keywords*: Textile Weave, Support Vector Classification, Recognizing.*

1. Introduction

The Application of computer autoimmunization in spin is more and more important. Analyzing the weave map of textile's swatch is necessary in spinner. So far, the analyzing depends on man. The computer auto analyzing means we recognize the weave map of the textile with the textile image by using computer arithmetic to get the parameter of textile. Now, the research of this aspect is just beginning [1]-[3].

There are many methods base on recognize gray image. These methods can get the wrap and weft density by the change of brightness. But they usually lose a lot useful information of R, G and B color. They can't amylase exactly when the image color is mixed and complex, for example the wrap or the weft is made of twist yarn, or the nap fabric.

The method we used needs the R, G, B color information. We use the information as the eigenvectors, which can tell the region we appoint weather it is a wrap float point or weft float point. SVC method is the arithmetic we use to classify the different eigenvectors. This method needs man giving the values of wrap and weft densities to divide the picture into small rectangle which means the wrap and weft float points, and selecting the several rectangles as the swatch to be trained by SVC. The SVC predict the entire rectangle in the picture after trained, and get the result that display the positions of the wrap float point and weft float point. By this method we can analyze the fabric which is made of twist yarn or has mush nap.

2. Support vector classification (SVC)

SVC is a machine learning arithmetic which bases on 'Structural Risk Minimization' principle of Statistical Learning Theory (SLT). The main idea of SVC is finding the best hyper plane which can divide two class points properly in the n-dimensionality hyperspace, in order to make the correct rate high. There are three cases: linear dividable, approximately linear dividable and linear undividable, for example in 2- dimensionality space as the picture below [4]-[5].

The approximately linear dividable and linear undividable cases both can be transformed into case. The problem in this article is a linear dividable case, so we only talk about the linear dividable.

There are many planes which can divide the two class point in linear dividable case, but not all the plane has good extend ability. As the picture above display, H1 and H2 are two lines which pass the swatch whose distance to divide line are nearest, and parallel to the divide line. The distance between

such two lines called 'margin'. As the same with 2-dimensionality space, we called the distance that between the two parallel hyper planes which pass the swatch nearest divide hyper plane margin. The best divide plane can class known swatch properly that means the wrong training rate is 0, and the Margie is the widest [6]-[8].

The class plane is $wx+b=0$. The equation of H1, H2 can be $wx+b=1$ and $wx+b=-1$. The margin is $2/\|w\|$. Find the widest margin problem can be transformed into an optimization problem that needs to calculate variable w and b. To min $0.5\|w\|^2$, subject to $y_i((wx+b))\geqslant 1$ and $y_i \in \{-1, 1\}$ for $i=1,2,\text{---},l$. SVC constructs the hyper plane by getting the best result of w and b.

3. Textile weaves recognizing

The resolutions of images which are used to analyze fabric weave must be proper. The resolution we adopt is 1200 dpi.

For many textile image, especially the image of the textile which's wrap or weft densities is very big, it's very difficult to recognize the parameters of wrap and weft densities. It's necessary to input the parameters of wrap density, weft density and the start point of weft and wrap manually. The image is divided into many rectangles. Several rectangles will be selected manually to be trained by SVC. The work flow is displayed below in which the circle means computer auto recognizing and the square means man operating.

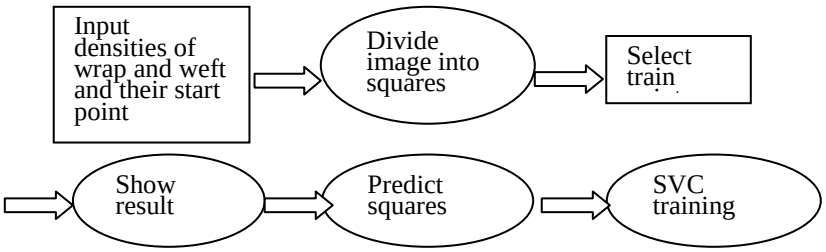
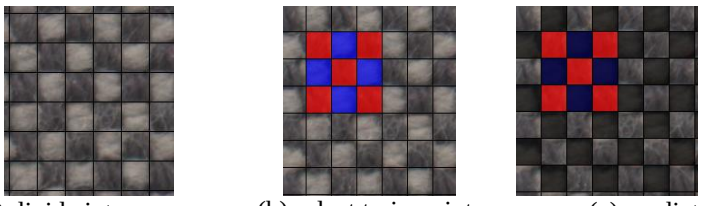


Figure 1: Textile Waves Recognizing Processing



(a) divide into square (b) select train points (c) predict

Figure 2. Textile Weaves Recognizing Effect

The eigenvector we abstract is every square image's histograms of R, G, B channel. Suppose the eigenvector of one square S is $v_{xy}=\{r_0, r_1,\text{---}, r_{255}, g_0, g_1,\text{---},g_{255}, b_0, b_1,\text{---},b_{255}\}$. Where r_i, g_i, b_i mean the number of pixels whose R, G, B channel's value equal to i.

The eigenvector which contains the R, G, B channel's histograms can distinguish the wrap float point and weft float point of the textile whose image has very complex color or contain much nap. The dimension of the eigenvector containing R, G and B channel's histograms is 768 (3*256).It's necessary to reduce the dimension. We box the eigenvector: suppose the value of box is l, l must divide 256 exactly. So its dimension of eigenvector is $768/l$. The new eigenvector is $v_{xy}=\{r_0, r_1,\text{---}, r_{256/l-1}, g_0, g_1, \text{---},g_{256/l-1}, b_0, b_1,\text{---},b_{256/l-1}\}$. And r_i, g_i, b_i is the average values of the R, G, B channel in the interval. The box value that we adopt is 8, so the dimension of eigenvector is 96.

The histograms of the textile images whose wrap and weft colors are different can be differentiated. As the image above displayed, the weave peak means the number of pixels whose brightness value equal to the abscissa value is the biggest. The position of weave peaks' difference means the colors' difference which SVC is sensitive to. SVC can find the classify panel even the difference is very small.

Usually, the number of textile image colors is not much, so the number of wrap and weft float points' color is small. The eigenvectors of wrap and weft float points' rectangle are Linear dividable. So the kernel function is $K(x_i, y_i)= x_i*y_i$ where x_i, y_i are the eigenvectors in training gather.

The training gather is selected manually. The selection of training gather influences the results of predicting. The predicting gather is made of the entire rectangle. The rectangle whose areas are smaller than the standard rectangle must throw away. SVC judge the square whether it is the wrap float point or weft float point by classifies its eigenvector. As the picture show, the rectangle pained into black are wrap point. We can see the result is good.

4. Discussion

For the textile image whose color is complex and the image of the textile has much nap, this method can recognize the weave well, for example as the picture below:

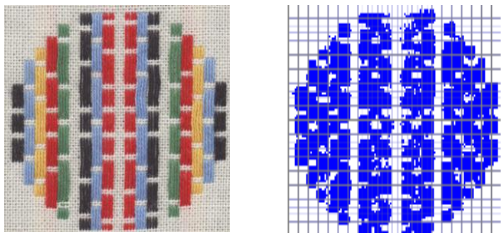


Figure 3. Complex Image of the Textile

The image's color is complex and the fabric weave's shape like a ball (1:12 zoom out). The textile weft is twist yarn and has much nap.

For the textile image above, if we use the divide their wrap and weft by the tolerance of weft colors and wrap colors is difficult. Some colors' tolerance is very small but man can distinguish them. If we select the value of tolerance is big, we can not distinguish the color by computer, but if we select small tolerance value, there are no enough information to get from picture.

In the square we divide, the distributing of the colors in every wrap float point square or weft float point square is the same, but the difference between the distributing of the colors in wrap float point square or weft float point square is big. So SVC can class the wrap and weft float point.

The method we use can give a good answer in recognizing the fabric weave of the textile image whose color is complex and the image of the textile has much nap, but it also has limitation in some cases. The case influence the correct rate included.

Divide the image manually: Some time man can't give the proper value of wrap density or weft density, so the square can not divide properly.

The Selection of training gather: If we select wrong weft float point or wrap float point, the training will be influenced, so the result of predict will be wrong.

The image is not regular: sometimes the wrap or weft is diagonal. We can not divide such image into regular rectangle.

5. Summarize

This article introduces are new method in recognize the fabric weave by SVC. As the depiction above, we can see this method is good at recognizing the textile image whose color is complex and the image of the textile has much nap.

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