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# Image Sequence Analysis using Color Multiplex Image

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**Abstract**

*The analysis of color image sequence is very heavy if the analysis is carried out for each image. But, in many practical cases, there is no need to know the precise motion and shape. In other words, the rough estimation of motion and shape is sometimes practically enough to understand image sequence. To achieve this rough estimation of motion and shape speedily, a method using color multiplex image is proposed in this paper. The color multiplex image is defined as a time averaged image of a given image sequence. In this paper, principle and effectiveness of the proposed method are discussed. For example, it is shown that if the moving object is square, the size and the velocity of the moving object can be estimated by the analysis of color multiplex image.*

## 1 Introduction

There are several ways to estimate the motion from the image sequence. For example, the motion can be estimated by the correspondence of the object features, such as corners, points, lines, boundaries of the surface reflectivity [1][2]. Another approach is based on the calculation of the optical flow [3][4]. Furthermore, the motion can be estimated by the analysis of spatio-temporal space [5][6] and so on.

The analysis of image sequence is very heavy if the analysis is carried out for each image. But, in many practical cases, there is no need to know the precise motion and shape. In other words, the rough estimation of motion and shape is practically enough to understand image sequence. To achieve this rough estimation of motion and shape efficiently, a method using color multiplex image is proposed in this paper. The color multiplex image is defined as a time averaged image of the image sequence. For example, we assume that the background color is blue and the color of moving object is red. In this case, the background color(blue) and the object color(red) are mixed in the region where the object moves, and the new color(purple) will emerge in the color multiplex image. This new color has the information of motion and shape of the moving object. Therefore, the extraction of motion and shape can be carried out using this color multiplex image. In this paper, principle and effectiveness of the proposed method are discussed. For example, it is shown that if the moving object is square, the size and the velocity of the moving object can be estimated by the analysis of color multiplex image.

The details on the color multiplex image are discussed in section **2**. In section **3**, the moving object is assumed to be square, and the method to obtain the size and the velocity of the moving object from the color multiplex image is shown.

## 2 General features of color multiplex image

The color multiplex image is defined as a time averaged image of the image sequence (Fig.1). Three images are time averaged in Fig.1. The background color is assumed to be blue, and the object color is assumed to be red. The moving object is assumed to be square for simplicity. In this case, two new colors emerge in the color multiplex image by the mixing of the background color and the object color. These new colors reflect the information about color, motion, shape of the

moving object. Therefore, the extraction of motion and shape can be carried out using this color multiplex image.

To extract these new colors, color histograms in RGB space are made from the color multiplex image and one of the image in the image sequence. The difference of these two histograms is shown in Fig.2. (The count of RGB histogram of one image is subtracted from the count of the color multiplex image.) The ○'s show the colors where the count becomes minus, and these colors correspond to the background color and the object color. The +'s show the colors where the count becomes plus, and these colors correspond to the new colors which reflect the color, motion, shape and so on of the moving object. Therefore, by the analysis of the color histograms, we can extract the background color, the object color and the spectrum of the new colors.

## 3 Estimation of size and velocity from color multiplex image

The moving object is assumed to be square. (The side length is 50 pixels.) The color spectrum is shown as a function of velocity in Fig.3. The velocity is 5, 10, 25 and 50 pixels/image. The color multiplex image is made by the time average of 8 images. The spectrum is obtained by the subtraction of the count of

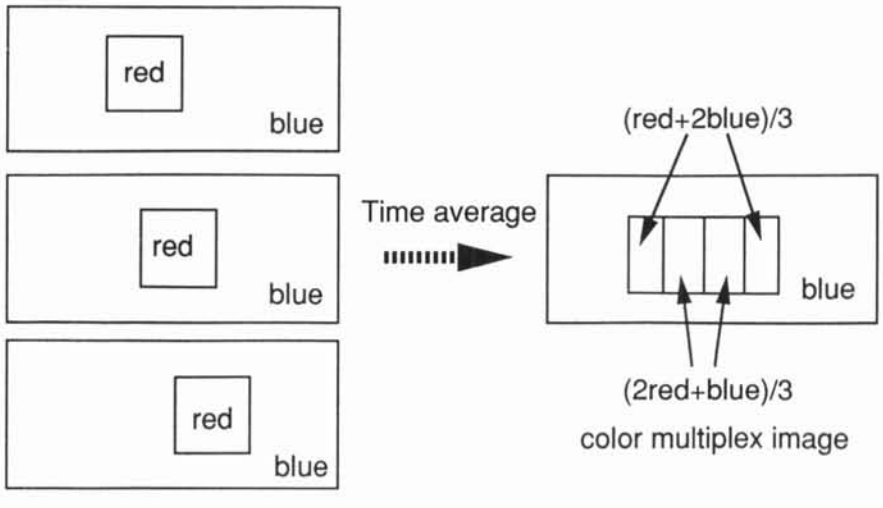


Fig.1 Definition of color multiplex image

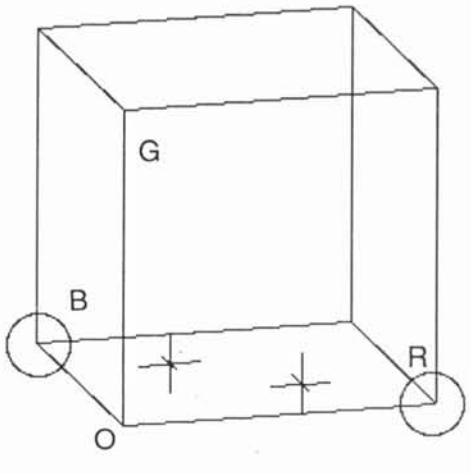


Fig.2 Color spectrum in RGB space

RGB histogram of one image from the count of the color multiplex image. The left side of the color spectrum shows the background color. The right side of the color spectrum shows the object color. As the color multiplex image is made by the time average of 8 images, at max, there emerge 7 new colors in the color multiplex image.

The center position of the new colors becomes closer to the background color, when the velocity of the object becomes faster. The center positions of the new colors are shown in Fig.4 as a function of the velocity. (The back ground color is 0, and the object color is 1.) Using this results, the V/L(=velocity/side length) of the object is obtained by the extraction of the center position of the new color. The total amount of the new color is $L^2+(N-1)VL$. (N is the number of time averaged images, and $(N-1)V > L$ is assumed.) There are two unknown parameters V(velocity) and L(side length). By the analysis of color multiplex image, we can obtain two equations. Therefore, if the moving object is square, we can obtain the size(L) and velocity(V) by the analysis of the color multiplex image.

## 4 Conclusion

In this paper, a method to achieve the rough estimation of motion and shape using color multiplex image is proposed. As an example of the analysis of color multiplex image, it is

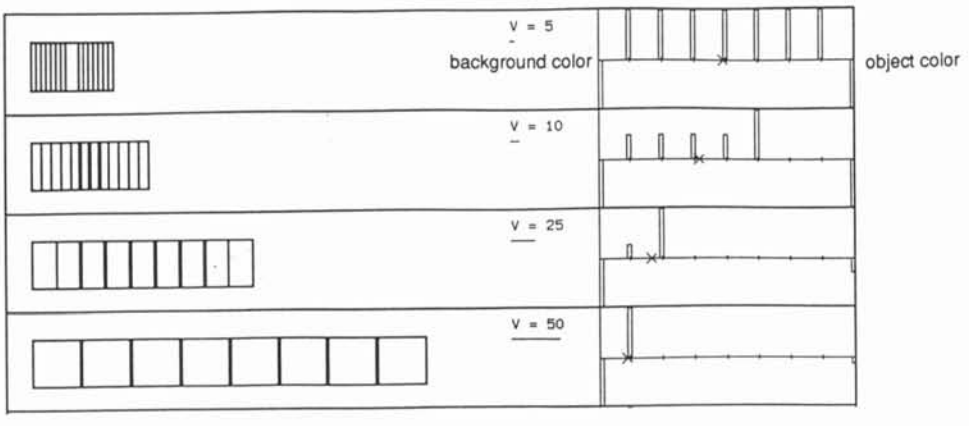


Fig.3 Color spectrum as a function of velocity

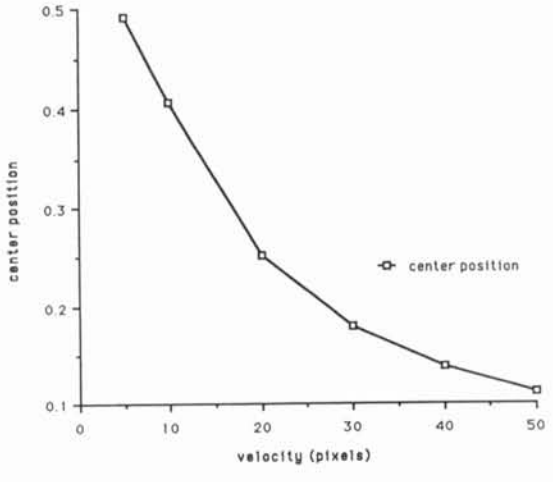


Fig.4 Center position of color spectrum as a function of velocity

shown that if the moving object is square, the size and the velocity of the moving object can be estimated by the analysis of color multiplex image. It remains as a future work to find what can be done with this color multiplex image, and to apply this method to natural color images.

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