

# Feature Extraction and Description from Image based on Isochromatic Information

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## Abstract

*In this paper, we proposed Isochromatic Information, which is a method of structural description of color images. Isochromatic Information is useful to extract line features which are color edges and so on. And, surface features which are regions and so on, too. First, we state Isochromatic Information and a method of its extraction. Next, a method of line feature extraction and description based on Isochromatic Information. And, a method of surface feature extraction and description. But, it's a future works.*

## 1 Introduction

Most of image processing systems use pixel information for extracting some features. However, when we recognize color scene, we use line and surface information. Therefore, in order to realize better image processing, we think that image processing systems should use information that is useful to extract and describe line features and surface features. In this paper, we proposed Isochromatic Information, which is a method for structural description of color images. And, we state its effectiveness against extraction and description of line features and surface features.

In section 2, we state Isochromatic Information and a method of its extraction. In section 3, we state extraction of line features based on Isochromatic Information. In addition, we state a method of extraction of color edges and extraction of character regions from color scene images by using edge classification. In section 4, we state extraction of surface features based on Isochromatic Information. But, it's a future works.

## 2 Isochromatic Information

### 2.1 Isochromatic Information

We proposed Isochromatic Information, which is a method for structural description of color images.

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Isochromatic Information is the set of Isochromatic Regions, that we extract for a phased description of color changes. And, an Isochromatic Region is a region that has a color equality on its surface. The conditions of color equality is given by considering a value based on the minimum value of color differences which we could recognize two different colors. And, we define every sphere of the color equality as Isochromatic Level. In addition, label of an Isochromatic Level is a vector whose dimension is same of the color space which is used at the extraction of Isochromatic Information.

By the way, we have proposed Isochromatic Lines in order to describe structures of gradually changes in the color, namely gradations. An Isochromatic Line is a line segment of boundary between two Isochromatic Regions. And, Isochromatic Lines have features which the narrower interval of the neighboring lines is, the more rapid change in the color is, and, the wider, the more gradually.

In consequence, Isochromatic Information have two kinds of information, which are the set of Isochromatic Regions and the set of Isochromatic Lines. Using the set of Isochromatic Lines, it's effective for the extraction and classification of color edges. This is stated in the following section 3. And, using the set of Isochromatic Regions, it's effective for region segmentation and description of region features. This is stated in section 4 as the future works.

### 2.2 Extraction of Isochromatic Information

In this section, we state the method of extraction of Isochromatic Information. And, the process is shown in Fig.1.

**Step 1:** Map all pixels to color space, for example the RGB color space.

**Step 2:** Segment the color space to many small clusters by dividing every axis by an equal step. And, every cluster corresponds to every Isochromatic Level.

**Step 3:** Make binary images on every cluster by assigning pixels in a certain cluster to value 1, and the others to value 0 (Fig.1(a)).

**Step 4:** Extract Isochromatic Lines by expansion and contraction processing and extracting contour lines on binary image of every cluster (Fig.1(b)). And, describing Isochromatic Information, we use these contour lines of Isochromatic Regions.

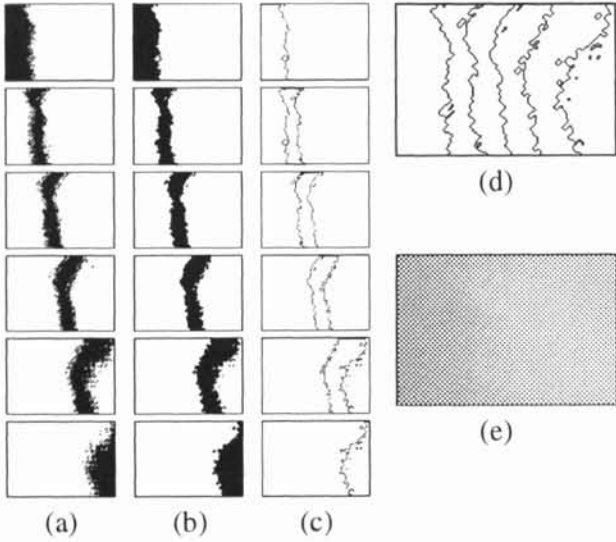


Fig.1 Extraction of Isochromatic Information.  
 (a) Binary images of every Isochromatic Level.  
 (b) Every Isochromatic Regions.  
 (c) Contour lines of every Isochromatic Region.  
 (d) Image of Isochromatic Information.  
 (e) Original color gradation image.

### 3 Color Edge Extraction and Classification

#### 3.1 Color Edge Extraction

In this section, we state extraction of line features and description from color image. First, we state extraction of color edges based on Isochromatic Information. Next, we state a method of feature extractions based on color edge classifications.

In our way, we define that color edges are on Isochromatic Lines. In addition, we define that a strength vector of color edge is differential vector between two Isochromatic Levels. An Isochromatic Lines is a line segment of boundary where colors change from a certain Isochromatic Level into other Isochromatic Level in color image. Then, after computing all differential vectors of color edges on the all Isochromatic Lines, we extract and classify color edges by using the differential vector information.

The results of extraction of color edges based on Isochromatic Information are shown (Fig.2(b)). In this case, we defined the conditions of color edges were in the case that the square of length of the

strength vector was bigger than the dimension of the color space. In addition, the results by using a conventional method, namely Gaussian filtering, too (Fig.2(c)). In both of the results, there are only a little differences in the precision of extraction. However, the extracted edges by the conventional method have no information about the strength and the direction of color edges. For this reason, using the conventional method, it is not effective for description of edge features.

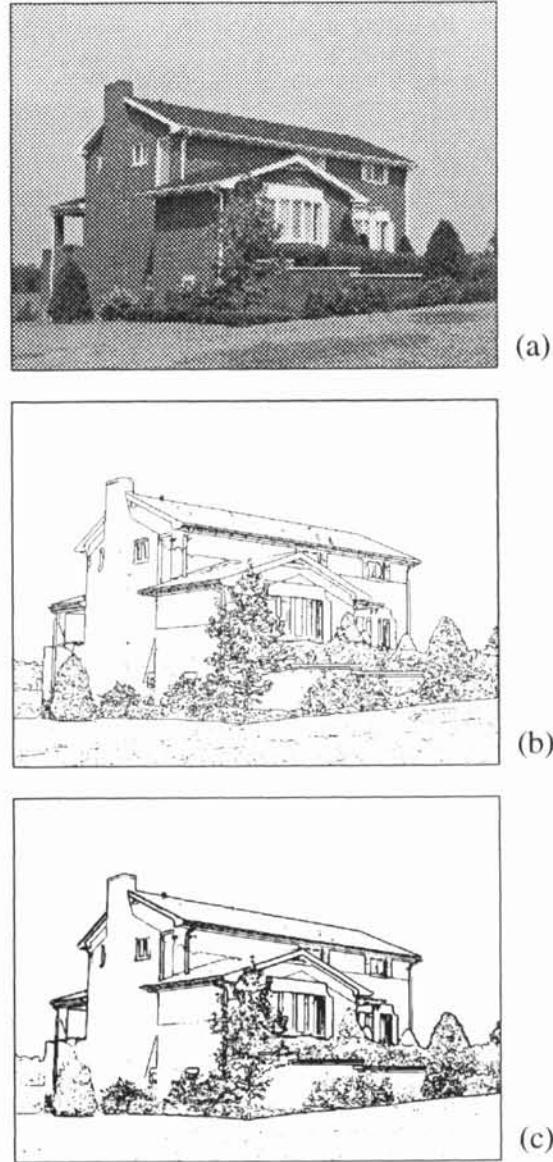


Fig.2 Results of Edge Extraction.  
 (a) Original color image.  
 (b) Edge Image by using Isochromatic Information.  
 (c) Edge Image by using Gaussian filtering.

### 3.2 Extraction of Character Regions based on Edge Classification

Besides this, we have proposed extracting character regions from color scene images by using Isochromatic Information and the edge features [Ueba 94]. The methods are as following:

- 1) Extract Isochromatic Information from color scene image. And compute strength vectors of color edges.
- 2) Classify color edges by using size and distance of the strength vector. And make every rectangle which circumscribes every set of the color edges.
- 3) The character regions are the set of rectangles whose arrangement are straight.

The sample of results are shown in Fig.3. (a) is Original color images. (b) is result image of edge extraction. (c) is result image of character regions extraction.

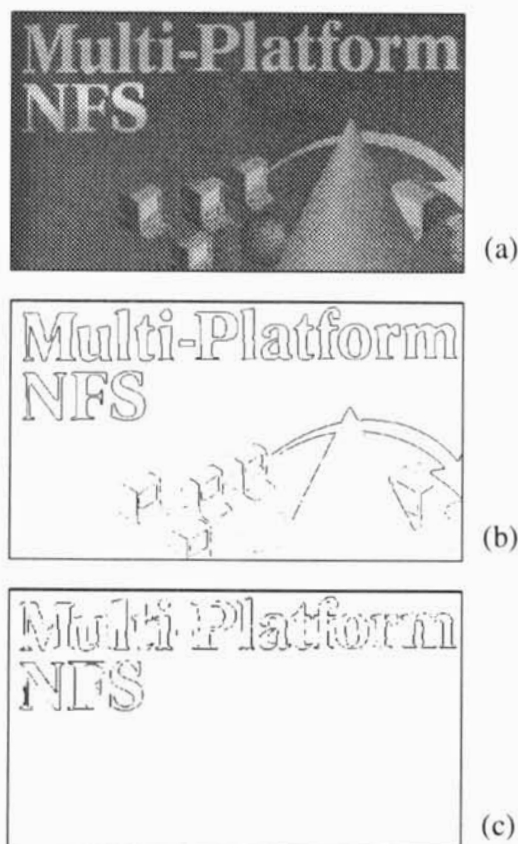


Fig.3 Extraction of Character Regions.  
(a) Original color image.  
(b) Image of Color Edges.  
(c) Result Image of the Extraction.

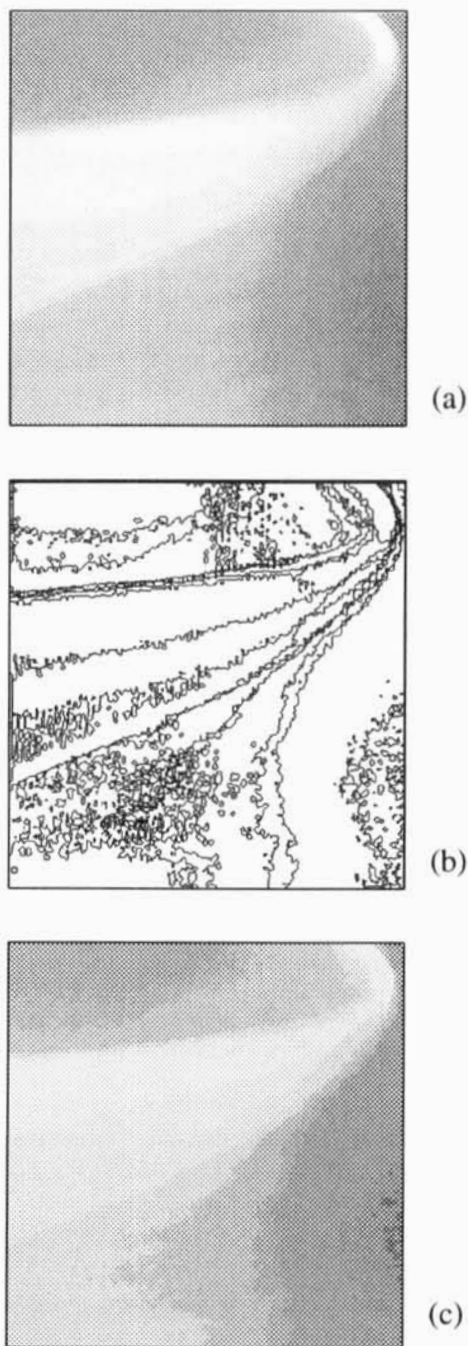


Fig.4 Gradation Regeneration.  
(a) Original color gradation image.  
(b) Image of Isochromatic Information.  
(c) Result image of the gradation regeneration.

### 4 Description of Surface Features

In this section, we state extraction and description of surface features from color images. But, we only introduce the followings as future works.

Using the set of Isochromatic Regions, it's effective for region segmentation and description of region features. In this method, a region is defined

a subset of Isochromatic Regions. And, we define the subset as a set of the connected Isochromatic Regions which have each other gradually changes in the color. This means that we can treat every surface of the region as a pure gradation.

By the way, in Fig.4, we show a result of extraction of Isochromatic Information from a pure gradation image. Fig.4(a) is the original gradation image. (b) is image of Isochromatic Information. (c) is the result image of gradation regeneration by linear interpolation. Presently, we would like to develop the structural description by Isochromatic Information into simpler symbolization or description by natural languages. For this reason, if we apply these new descriptions to every region, it will be possible for us to get better descriptions of color features of the surface.

## 5 Future Works and Conclusion

In this paper, we state the features of Isochromatic Information. And, we state feature extractions and descriptions based on Isochromatic Information. Image processing by using Isochromatic Information is useful to extract line features and surface features. In the extraction of line features, we got good results of character extractions by using color edge classifications. In the extraction of surface features, they are the future work, but the description of complex features of color changes in region surfaces, it may be effective.

The image processing based on Isochromatic Information may be effective for noise countermeasures. In our methods, because noise countermeasures are done at extraction of Isochromatic Information, we have no need for noise countermeasures in the later image processing.

We would like to extract macro features based on Isochromatic Information.

## References

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