



## Image Retrieval based on Invariant Features and Histogram Refinement

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### Abstract

Colour histograms are widely used for content-based image retrieval. Their advantages are efficiency, and insensitivity to small changes in camera viewpoint. However, their drawback is that all structural information is lost. Colour histograms lack spatial information, so images with very different appearances can have similar histograms. In this paper we try to solve the problem of losing the structural information in colour histogram by extending the colour histogram approach by features that take into account the relations within a local pixel neighbourhood [9, 10, 11]. Also, to solve the problem of lack of spatial information, a histogram-based method is used for comparing images that incorporates spatial information which classifies each pixel in a given colour bin as either coherent or incoherent based on whether it is part of large similarly-coloured region. Experimental results show that this technique can give superior results for image retrieval.

**Keywords:** Image Retrieval, Knowledge Discovery, Data Mining, Colour Histograms, Intelligent Agent

### 1. Introduction

A user may wish to retrieve all images similar to a given image from a large database of images. Colour histograms are a popular solution to this problem [3, 5, 7]. Colour histograms are computationally efficient and generally insensitive to small changes in camera position. However, a colour histogram drawback is that all structural information is lost, and a colour histogram provides no spatial information; it describes which colours are present in the image, and in what quantities.

A general method for the construction of invariant features is explained in [1, 9]. We concentrated on the invariant features for the group of translations and rotations and their theoretical invariance to global translation and rotation. These features have proven to be robust to independent motion of objects, different object constellation and articulated objects. Invariant features are

developed to characterize images independently from absolute object positions. So, these features are suited for image retrieval [11].

A colour coherent vector [4] classifies each pixel in a given colour bin as either coherent or incoherent based on whether it is part of a large similarly-coloured region. A colour coherent vector stores the number of coherent versus incoherent pixels with each colour and provides finer distinctions than colour histogram by separating coherent pixels from incoherent pixels.

In this paper we want to use the nonlinear monomial kernel functions to extract the local colour features (solving the problem of losing the structural information in the normal colour histogram) and use the colour coherent vector on the result image to take spatial information into account.

### 2. Construction of invariant features

Let  $I = \{I(n_0, n_1)\}$ ,  $0 \leq n_0 < N_0$ ,  $0 \leq n_1 < N_1$  be a gray value image, with  $I(n_0, n_1)$  representing the gray value at the pixel coordinate  $(n_0, n_1)$  [10, 11].  $G$  is denoted as a transformation group with elements  $g \in G$  acting on the image.

For a group element  $g$  of the group of translations and rotations and an image  $I$ , the transformation image is denoted by  $gI$  and can be expressed as:

$$(gI)(n_0, n_1) = I(n'_0, n'_1)$$

Where (1)

$$\begin{pmatrix} n'_0 \\ n'_1 \end{pmatrix} = \begin{pmatrix} \cos \varphi & -\sin \varphi \\ \sin \varphi & \cos \varphi \end{pmatrix} \begin{pmatrix} n_0 \\ n_1 \end{pmatrix} + \begin{pmatrix} t_0 \\ t_1 \end{pmatrix}$$

Let  $I$  be the given gray-value image and  $f(I)$  is a kernel function; it is possible to construct an invariant feature  $F(I)$  by integrating  $f(gI)$  over the translations and rotations group







