Research Statement

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Cultural institutions around the world have, over the past two decades, implemented a policy of digitally safeguarding their artwork collections. Their goals are the digital preservation of artworks and the monitoring of their condition, as well as improving their accessibility to the public and to professionals. This policy has led museums to build extremely large image databases of artworks, available on the Internet at image resolutions of variable quality. Browsing such voluminous databases is a complex task. Works of visual art are quite distinct from natural images in that they are often stylized. This property introduces a subjectivity that influences one's understanding of the scene (through multiple ambiguities) as well as the impression conveyed to the viewer when he/she looks at the image. This latter effect is indeed unique to works of art. One does not look at a painting with the same attention as one does a natural image. As a case in point, visitors to a museum usually expect a certain aesthetic experience. Artwork databases thus require specific search tools that are complementary to conventional metadata approaches.

The main objective of my research is to propose new descriptors adapted to the specific content of two-dimensional artworks (e.g. paintings or drawings). Most of the approaches proposed in the scientific literature are based on statistical descriptors characterizing certain aspects of local image information. Several art historians, psychologists and cognition experts have tried to understand the visual and perceptual mechanisms of artistic creation and of viewing an artwork. A work of art has, indeed, the peculiarity of being produced through a human visual system, i.e. that of the artist.

Spatial organization of colors

During the first part of my doctoral research, I studied the spatial arrangement of homogeneous coloured regions within a work of visual art. This aspect is similar to the notions of composition and balance in an artwork. The way in which coloured regions are organized in an overall work concerns all types of visual art (paintings, photos, drawings and so on). It influences the perceived visual impact independently of the semantic content. This spatial organization is at the heart of the creative process of the artist. In light of this, I proposed a methodology to model the difference between the spatial arrangements of two images as a transportation problem. I also proposed an adaptive matching criterion based on a statistical approach, itself founded on a perceptual principle. I evaluated the performance of these methods on 5 different databases comprising a total of about 60,000 images. These contributions have been published in the journal *Computer Vision and Image Understanding*.

Pictorial effect of line artworks

The second part of my doctoral research focused on characterizing the geometrical information and pictorial impact conveyed by linear strokes. This type of visual content is closely related to the style of a work of art. This study is particularly suited to the graphic arts. These issues are also of great interest in computer graphics, specifically in the fields of image and line drawing rendering, since this research community is concerned with the problems of style transfer and analysing the aesthetic effect of a drawing. The methodology I developed here is based firstly on a novel method for the unsupervised extraction of stroke boundaries in line artworks. I also developed a set of methods to analyze the geometric content in these contours by extracting such intuitive measures as inflection points, stroke junctions, stroke endpoints and corners. The results obtained on a two line artwork databases drawings were used to validate my methodology and to compare its performance with that of a method based on the curvature scale space (CSS).

Research agenda

The current focus of my research is to generalize the unsupervised detection of linear strokes to other types of artwork, i.e. artworks that include 2D primitives in addition to linear (1D) strokes. This method will allow us to dissociate the 1D and 2D primitives in a given image. It could incidentally be of considerable interest for optical character recognition (OCR) systems in the case of complex backgrounds and for signature authentication systems.

Once we have separated the different dimensionalities in an artwork's content, a general indexing framework can be developed. This framework will rely on the indexing features that we previously developed for 1D primitives, and on a novel set of features that describe the 2D pictorial content. A specific class of images that could directly benefit from this indexing framework is clip art images or vector drawings. Indeed, the dimensionalities of the different objects contained in such images are known a priori. Due to their wide accessibility and low storage requirements, vector drawing databases can frequently contain over a million images. In addition, vector drawings are closely related to image rendering issues in computer graphic. This opens up new potential applications for our methodology. Therefore, I plan to focus an important part of my efforts during a postdoctoral internship on developing descriptors and indexing tools for vector images.

A funding source that could support part of this research is the *Canada Council for the Arts and Natural Sciences and Engineering Research Council New Media Initiative*. We plan to apply for funding from this program in 2008 together with Prof. Farida Cheriet, the artist Carlos Calado and Atelier Circulaire, the artist-run centre that has collaborated with us previously in this doctoral project. We propose to develop a 2D/3D computer-assisted tool for the production of artistic etchings. This project includes the design of a multimedia database management system that will benefit directly in many respects from the above-described research developments.