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Short Paper

Similarity Analysis of Digitized Paintings

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1. Introduction

In the modern society, art is more and more involved with digital imaging techniques (e.g., Burge, 2007; Uchida and Shirayama, 2007). Among others the digital image processing techniques have widely been applied to analyze historical paintings and other similar arts of historical importance. But they are mainly focused on the restoration of aged paintings suffering from color change and surface cracks or on the exploration of the original design and color of famous paintings which are no more visible because of the repaint by the artists themselves or by the successors during the long time of creation. Only a few of the works have been focused to perform the scientific analysis of the expression style of the painting itself. In this regard Hockney and Falco (2000) and Stork (2004) have performed the analysis of perspective inconsistencies in the paintings and Berezhnoy et al. (2004) have given focus to complimentary color analysis of oil paintings of Van Gogh. All of these works are related to the analysis of the drawing techniques of the painter's specific paintings, not the overall comparative analysis of drawing techniques and styles in general.

In the present work, color and luminance expression of artistic paintings is investigated by a digital vectorscope and waveform analyzer working on the digital reproduction of the original paintings. Examples are taken from the "19th century paintings library" consisting of representatives of the Rococo-romantic, Romantic and the early and late Impressionist schools inclusive of the Pointism and Symbolism paintings. The vectorscope results are then cross correlated in terms of the hue and chroma distribution pattern, similarly to the music similarity analysis by Ohmi (2007).

2. Vectorscope and Waveform

Vectorscope and waveform monitor is the special device originally designed for the precision color analysis of analog TV signals, where vectorscope indicates chroma and hue on the polar coordinate basis, while waveform provides brightness information on the Cartesian coordinate basis. In the vectorscope, the chroma is scaled in the radial direction: at the center of the circle the chroma is zero while it is increased towards the border of the circle. The hue is varied in the circumferential direction as indicated by the color abbreviations around the circle. By contrast, the waveform displays signal timing information horizontally while the vertical scale is measured in IRE (Institute of Radio Engineers) brightness units ranging from 0 to 100.

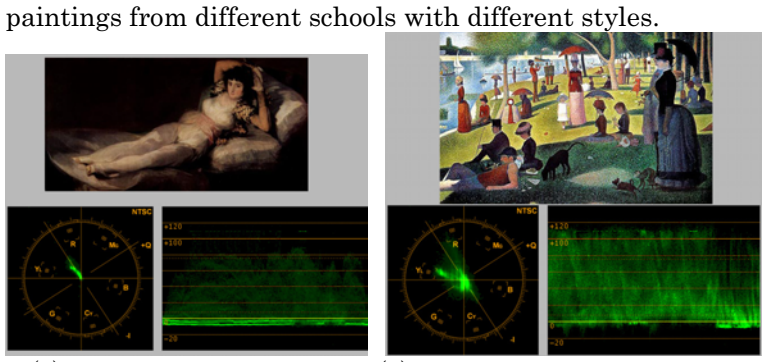
In the present study, the vectorscope and waveform monitor is realized on the Canopus EDIUS Pro 4 software (originally designed for video image editing) and the color use of some selected 19th century's paintings is mainly investigated through vectorscope results and their cross correlation. When computing the cross correlation of two vectorscope images, the scale marks in the vectorscope are once removed to avoid keen peaks in the center and then restored in the computed image.

3. Experimental Results

Six different paintings are taken from the representatives of the 19th century Rococo-romantic school, the Romantic school, the early and late Impressionist schools including the Pointism and Symbolism paintings. The selected paintings are "Clothed Maja" by Francisco de Goya, "Liberty Leading the People" by Eugène Delacroix, "Luncheon of the Boating Party" by Pierre-Auguste Renoir, "Impression: Sunrise" by Claude Monet, "Sunday on La Grande Jatte" by Georges Seurat and "Kiss" by Gustav Klimt. The vectorscope and waveform images are displayed together with the respective

paintings in Fig. 1. Characteristic use of colors in every painting is clearly depicted in the vectorscope results. The works of Delacroix, Renoir and Monet are rather rich in color chroma and hue, those of Goya and Klimt are more restrained in color hue and look rather monotonous in tone. The pointism work of Seurat is abundant in color hue but very moderate in chroma that gives rise to a pastel tone of colors. The cross correlation similarity analysis is conducted for couples of arbitrarily selected paintings. The results are presented in Fig. 2 together with their source paintings, from which it is understood that Delacroix's work has a certain degree of similarity of use of colors with any other paintings tested here. Seurat's pointism work has a tendency of showing increased similarity in specific color hues. Goya's work is less similar to other paintings from the viewpoint of use of colors.

In conclusion, vectorscope has successfully revealed the characteristics of the use of color in every 19th century art paintings. Cross correlation analysis was carried out for arbitrarily selected pairs of vectorscopes and showed some expected and unexpected similarity of color tone between paintings from different schools with different styles.

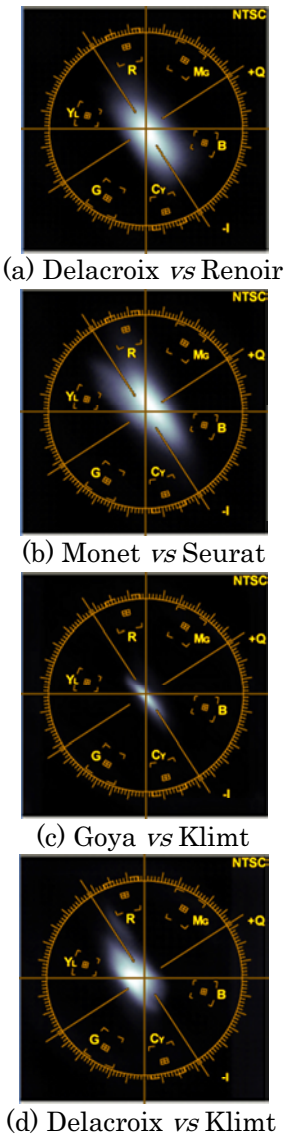


(a) Goya — Clothed Maja (d) Seurat — La Grande Jatte

(b) Delacroix — Liberty (e) Monet — Impression

(c) Renoir — Luncheon (f) Klimt — Kiss

Fig. 1. Vectorscope and waveform monitors.



(a) Delacroix *vs* Renoir

(b) Monet *vs* Seurat

(c) Goya *vs* Klimt

(d) Delacroix *vs* Klimt

Fig. 2. Cross correlation of vectorscopes.

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