

Trials on Integrating Spatial Information in Color Appearance Models

Mohamed-Chaker Larabi, Olivier Tulet, Christine Fernandez-Maloigne
University of Poitiers, SIC Laboratory

Poitiers, France
larabi@sic.univ-poitiers.fr

Introduction

The goal of this study is to model the influence of spatial frequencies on color perception. This model aims to correct the variation on perception like the current models do with flat stimuli. To create this model and to introduce the influence of the spatial frequencies on the perceptual features we conduct a psychophysical campaign.

The aim of this study is to extract a model of the behaviors of the HVS with regards to spatially modulated stimuli. These tests allow to measure the variation perceived between a flat pattern with a given color and a pattern with the same color, to which a given spatial frequency has been added, on the three output parameters of the CAM.

The experiments are conducted in a dedicated room, which respects standard conditions (lightness, screen calibration,...).

Experimentation

Test pattern

For this study, we used rectangular pattern of 11.8 degrees of visual angle. The modulating frequency varies from 1 cpd to 17 cpd. The patterns are constructed with three primary colors (red, green, blue). This property allows obtaining 63 configurations. The Figure 1 gives a snapshot of the test on the screen.

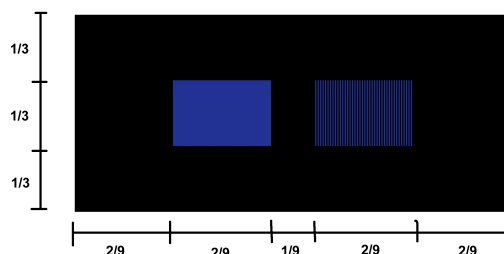


Figure 1 – Psycho Visual Test

Test procedure

In this psychophysical test, the observer is asked to tune some color properties such as (lightness J, Brightness Q and hue h) in order to obtain a perceptual similarity between a flat stimulus and another modulated by a spatial frequency.

This preliminary study has been realized with one background in order to reduce the number of psychophysical tests that are very difficult to construct and are time consuming. The test procedure is the following:

The observer is installed in the psychophysical test-room at a fixed distance from the display after a measure of visual acuity and a verification of color blindness. The test procedure is explained to him with the different tasks to do.

When the test starts, the observer is asked to tune only one of the three criteria (J, Q, h) of the modulated pattern in order to obtain similar color with the flat one. Notice

that the tuning criterion is improved by the test. This last step is repeated 63 times with 7 frequencies, 3 primary colors and 3 criteria. Notice that the test sequence is randomized and the starting color of the modulated stimulus is randomized too.

Test observers

With regard the recommendations given by ITU [7] the number of observers must be greater or equal to 15. Table 1 gives the repartition between men and women and vision affections.

	Normal	Myopic	Other affections	Total
Men	10	5	1	16
Women	2	3	0	5
Total	12	8	1	21

Table 1– Table of observers.

Results and discussion

This section gives the results of the experiments described above. These experiments allow us to characterize the variation of the color perception according to the spatial frequencies.

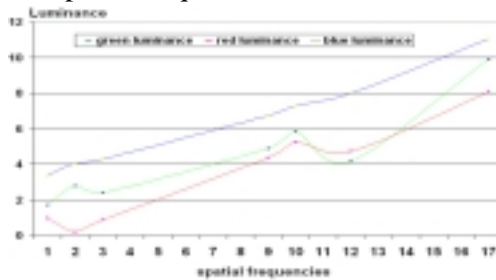


Figure 2 – Luminance perceived function of spatial frequencies on a black background

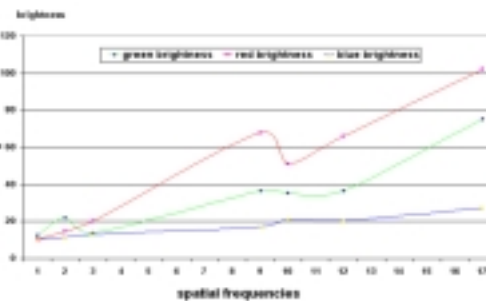


Figure 3 – Brightness perceived function of spatial frequencies on a black background.

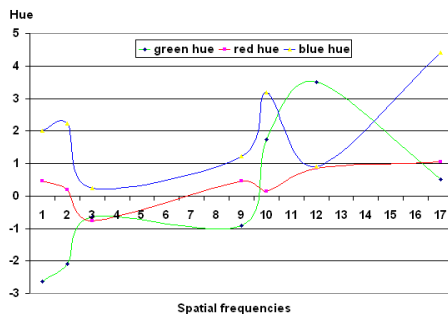


Figure 4 – Hue perceived function of spatial frequencies on a black background.



Figure 5 – Example of corrected pattern.

Figure 2, 3 and 4 show the gap perceived by the observer between a flat pattern and a modulated one for the three criteria (J, Q, h).

These figures show that on a black background the perceived difference on luminance and brightness increases according to the increases of spatial frequency.

This behavior was foreseeable because of the increase of the black repartition in the pattern. Nevertheless this experiment allows us to quantify this increase, which is not linear. Some incomprehensible phenomena could be seen at medium frequencies (9 to 11 cpd). These problems will be investigated in the future experiments.

This model has been integrated to CIECAM02 in order to make a correction of modulated patterns. An example is given by the figure 5.