Sichtbarer Spektralbereich und Frequenzspektrum - ein Korrespondenzvorschlag

Visible and Audible Spectrums – a proposal of correspondence

André Rangel Macedo
Research Center for Science and Technology of the Arts (CITAR)
Portuguese Catholic University – School of the Arts
Rua Diogo Botelho 1327, 4169-005 Porto, Portugal
Tel.: +351 226196200, Fax: +351 226196291
E-Mail: armacedo@porto.ucp.pt, Internet: http://artes.ucp.pt

Zusammenfassung:
Demonstration eines Vorschlags der Korrespondenz zwischen Licht und Sound. Jede Tonfrequenz entspricht einer Lichtwellenlänge aus dem sichtbaren Spektralbereich. Diese Korrespondenz zwischen Licht und Sound wird veranschaulicht durch ein neues Hyperinstrument, welches dem Nutzer die Kontrolle über eine in Echtzeit generierte multisensorische algorithmische Komposition gewährt. Die verwendete Methode und das mathematischen Modell werden kurz vorgestellt, um als Referenz zu dienen für zukünftige Entwicklungen im Bereich multisensorischer Kompositionen. Die audiovisuelle Dokumentation und den vollständigen Text finden Sie unter: http://3kta.net/solu

Abstract:
Demonstration of a proposal of correspondence between Light and Sound. This proposal is materially exemplified by means of a new hyperinstrument, which gives its users the control over a multi-sensorial algorithmic composition generated in real-time. The employed methodology and mathematical model are also presented with some detail, insofar as they pretend to be matter and reference for future developments in the field of multi-sensorial composition. Audiovisual documentation of the demonstration and full paper available at: http://3kta.net/solu

I. Introduction

The senses of audition and of vision have always coexisted in human beings. According to researchers, new-borns understand all of their sensorial impressions as a whole, they do not differentiate light from sound from taste from smell (Campen, 2008), and it is only around four months of age, with neuronal and social development, that babies begin to modularize the senses. Paul Hertz considers works who merge two or more senses as Synaesthesic Art (Hertz, 1999), and three decades before that, Dick Higgins had already coined the term Intermedia Art to describe processes of multi-sensorial compositions which cross or merge the boundaries between different media, thus creating shared structures (Higgins, 1965). Correspondences between media are usually arbitrary, conditioned only by our cultural practices and psychological preferences. There have been several proposals of correspondence between colour and music in the last three centuries but, almost always, the proposed systems had their ground on the western musical scale of twelve half tones. Possibly because in western culture the musical scale is composed of seven musical notes and seven is also ordinarily conceived as the total number of colours of the rainbow. This study proposes a correspondence relation and system between Light and Sound by juxtaposing the spectrum of audible frequencies and the spectrum of visible frequencies by means of a mathematical modeling. To do that, the values of the wave frequency from 28 Hz to 4 KHz (nearly the spectrum of fundamental frequencies from the texture of a piano) have been converted to values of wavelength from 400 Nm to 700 Nm. By synchronizing sound and visual happenings we pretend to empower and motivate processes of conception simultaneously oriented to at least two senses: audition and vision. In order to demonstrate this correspondence we have designed and produced a hyperinstrument that allows any user to finalize a process of interactive algorithmic composition.

Multi-sensorial, intermedia composition, which combines systematized knowledge of Musical and Visual Arts together with scientific knowledge from the fields of sound and light physics, contributes to an understanding of the emergent transformations and interaction between Arts, Sciences and Technologies. Today, media can be described by mathematical abstractions and represented in digital formats; and so the syntax of intermedia composition can be built into a programming language. “Implementing compositional structures highly complex between media, computers offer the possibility of controlling and synchronizing different media” (Hertz, 1999).

II. Audible spectrum and Visible spectrum

Sound and light occurrences are phenomena of energy transport studied simultaneously by physics. They both propagate through waves, longitudinal mechanics in the case of sound, and transversal electromagnetic in the case of light [1]. Sound waves need a material medium in order to propagate, but electromagnetic waves as the light can propagate in the void. They both need a time interval between their emission and their reception. In spite of big differences in greatness and speed, both sound waves and electromagnetic waves are represented by the wavelength and frequency. It is an intriguing fact that we almost always represent sound spectrum in the frequencies domain and the visible spectrum in the wavelengths domain, seen that frequency and wavelength are inversely proportional magnitude.

III. Sound and Color

Along the times there have been several models and devices that aimed the real-time performance of visual and sound events. Of all the possible correspondences between sound and light, the mapping of musical notes or heights to color tonalities was the most common proposal in the last 300 years. Considering that the piano is the most commonly used instrument in the process of composition, and is besides that, from all the elements of the classical orchestra, the one that produces the largest spectrum of musical heights, we have decided to take it as a reference in our demonstration. The correspondence between light and sound that we propose was obtained by applying the mathematical model [2] that was better adjusted to convert the exponential spacing of the intervals between the fundamental frequencies of the notes comprised in a piano’s texture into linear spacing from the wavelengths of the visible electromagnetic spectrum.

IV. Conclusion

The implemented algorithm, which allows the correspondence between sound frequency and color light frequency, will certainly integrate future multi-sensorial compositions, seen that we consider its reutilization and betterment. In respect to the functionality of the project at a practical level, we do not yet have a representative sample of results and opinions, given the fact that our proposed correspondence and the hyper-instrument that demonstrates it have not yet been publicly presented. The hyper-instrument prototype that we present allow people with few or very few skills, while users and creators of audiovisual, to participate in a process of generative algorithmic composition. Therefore, we believe that this work is worth of continuation and deeper analysis, to develop after public implementation. I conclude that the correspondence between color light frequency and sound frequency associated to the conception of interactive multi-sensorial systems is fertile ground to future researches.

Notes

[1] - Although in modern physics light or electromagnetic radiation can be described by two complementary ways: as a wave in an electromagnetic field or as a flux of particles named photons. Though both are acceptable as light descriptions, the description of light as a wave is more appropriate to the purposes of our work.

[2] - Mathematical model developed to convert fundamental frequencies values of the piano notes to the color wavelengths of the visible spectrum:

$n = 700 - (12*(\log(f/220)/\log(2))+36)*3.44827586207$

The previous model was adapted from the following model: $n= 12*(\log(f/220)/\log(2)) + 57$

References

1 CAMPEN, Van (2007). The Hidden Sense, The MIT Press

2 HERTZ, Paul, Synesthetic Art, an Imaginary Number? Leonardo, Vol. 32, No. 05, pp. 399-404, The MIT Press, 1999.

3 HIGGINS, Dick; HIGGINS , Hannah, (1966), Synesthesia and Intersenses: Intermedia, Something Else Newsletter 1, no 1, 1966