The Sound Wave and the Virtual Harpsichord: Adventures in the Simple and the Complex or How to Explore Human Perception of Music through Audio Synthesis

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Perception is one of the most important supports of music, and thus, any well-defined model about musical phenomenon must include not only the musicians and their instruments, but also the spectator perception. Over the last years, there was an increasing interest on evaluating the human perception of music by both scientist and composers, because it helps to increase the knowledge of the brain, as well as acquire new resources to create contemporary music.

The technological advances of recent years increasingly suggest us the need of a new music paradigm [1, 2], in which it makes no sense to talk about notes as basic unite of sound anymore. The signal theory [3] tell us that sound is compounded by both harmonics and partials [4], or just sound waves, for sake of simplicity. Using these small components, sound waves, the sonorous university available to musicians and composers is greatly enriched, as the resulting sounds could be arbitrarily complex, unlike the traditional instruments, which are tied to the laws of acoustics and physics.

Science always played an important role in music throughout history. The state of technology at every time was crucial to supply new resources of musical expression to musicians, who exploited them with vividly passion, as happened with Beethoven and the invention of the piano, or Theobald Böhm and his improvements of the western flute. In that sense, unstoppable advances in IT technologies are called to revolutionize our relationship with music. However, these advances are accepted very slowly by contemporary musicians, most likely due to their prejudices and preconceptions about the contribution of science in music [5]. On the other hand, the conception of knowledge as a universal phenomenon has a growing presence in our society. There are important scientific theories that show reality as a one complex entity built from simpler elements highly interrelated, instead of having several complex entities with lower interrelation, like "science" and "arts", as we were taught at the school. Thus, a multidisciplinary background is very important to study and understand successfully the phenomenon beyond music [6].

This article is mainly focused on the study of the human perception of sound, using a scientific and artistic approach. The authors propose the use of sound synthesis techniques to create virtual custom instruments by computer, which are based on the simplex and complex principle [7, 8], that is, using simple rules describing individual sounds to build up an arbitrarily complex entity, the virtual instrument (ex. a Virtual Harpsichord), a piece of software that can act as a musician, playing scores or interacting with other musicians in real time. Despite of being an article on sound technology, its main contribution is a proposal of a new methodology based on synthesis techniques,

which can be used by researchers to perform tests on human perception. This approach intent to be innovative respect to existing investigations, as it uses well-known technologies in a new and creative way.

The article is structured in five parts. The first part introduces the general points about human perception of music, and the interest of researchers and musicians in this subject. The second part uses the basics of signal theory to explain the most important synthesis techniques, including references to software currently available. The third part is where the methodology is exposed, following the fourth part dedicated to experiment validation. Finally, the fifth part deals with conclusions and future work.

References

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