Compositionally Motivated Sound Synthesis

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Luc Döbereiner
Institute of Sonology, The Hague, The Netherlands

Introduction

It is the aim of this article to discuss relationship of musical technology, sound synthesis, and compositional positions. The "non-standard" sound synthesis approaches developed in the 1970s (et. al. G. M. Koenig's SSP, Paul Berg's Pile, Herbert Brün's SAWDUST, Iannis Xenakis's Dynamic Stochastic Synthesis) serve as a historical context. Given the large body of literature on the history of sound synthesis and computer music, it is surprising how little attention has been paid to these systems. They are often regarded as oddities or failed attempts, if they are not neglected altogether. In this article, these systems are read as compositional positions which are critically dealing with technology. Approaches to sound synthesis embody compositional, aesthetic, and political ideas. In their provocative radicalness, the "non-standard" approaches form truly experimental models, which aim at exploring the compositional possibilities unique to digital sound. It is my belief that the historical connections made in this article are of relevance to current problems and may serve to foster a discussion about foundational issues regarding sound synthesis in music.

Sound/Synthesis and Music/Composition

The systems, which are presented here, are rooted in the belief that electronic and digital means allow "the composition of timbre, instead of with timbre,"[5] that the sound production itself can be considered a compositional activity. As Stockhausen writes, "Jeder Klang ist das Ergebnis eines kompositorischen Aktes." ("Every sound is the result of a compositional act.")[17] Arguing from the etymology of the words com-position and syn-thesis, which are synonymous in their respective languages of origin, one may see their difference rather as a difference in time levels than in kind. Di Scipio writes, "synthesis can often be thought of as micro-level composition."[6] As suggested by Thomson, the "non-standard" sound synthesis approaches can be seen as "microsound’s digital beginnings,"[19] in their "impulse towards the atomisation of musical material and control of that material on ever-lower levels."

Every sound synthesis method draws fundamental distinctions concerning the description of sound. These distinctions define what is controllable and what not. By creating a sound synthesis model one creates distinctions that leave traces in the musical compositions, which are realized with this model. It is, therefore, crucial to examine these fundamental distinctions as they are underlying the musical decisions they make possible. One may say, a sound created with a certain method conveys most of all the underlying, implicit distinctions of that method.

The systems which are discussed here have all been developed by composers. The underlying distinctions of G.M. Koenig’s SSP, designed in 1972 and developed at the Institute of Sonology, are essentially musical ones, directionality and non-directionality, repetition, expansion and reduction find their abstracted forms in the selection principles of the program. These principles stem from his earlier composition program designed for the composition of instrument music, Project 2. Xenakis’s Dynamic Stochastic Synthesis is based on ideas of fluctuation and degree of change. In Brün’s SAWDUST, developed in the mid-1970s, the waveform itself becomes the basic element and is shaped by the composer’s craft in a bottom up process. P. Berg’s Pile, also developed in the 1970s, takes a slightly different approach, instead of using methods which are rooted in personal compositional activity for the composition of sound, a set of machine instructions are explored with respect to their usefulness in sound and music production, as Berg writes, "computers produce and manipulate numbers and other symbolic data very quickly. This could be considered the idiom of the computer and used as a basis for musical work with the computer."[2]

The "Standard" and the "Non-Standard" Approach

Many sound synthesis methods are built upon a concept of simulation; upon the belief that analysis leads to synthesis. The main body of research undertaken in the field is aimed at increasing controllability, simulation accuracy, computational performance, and generality; at developing techniques which allow the user or composer to ideally realize his or her preconceived objective. These sound synthesis methods can be subsumed under the term "standard" approach, a term which has been coined by Steven R. Holtzman:

> Standard approaches are characterized by an implementation process where, given a description of the sound in terms of some acoustic model, machine instructions are ordered in such a way so as to simulate the sound described.[9]

The term "standard" approach serves differentiation. Its counterpart is the "non-standard" approach, in which "the computer acts as a sound-generating instrument sui generis, not imitating mechanical instruments or theoretical acoustic models,"[11] and is described by Holtzman in the following way:

> The non-standard approach, given a set of instructions, relates them one to another in terms of a system which makes no reference to some superordinated model, […] and the relationships formed are themselves the description of the sound.[9]

Although the distinction is sensible, the terms "standard" and "non-standard" are not a very fortunate choice of words. Despite being more than a technical description, they do not serve to actually point out the differences other than the deviation from an assumed norm. The differences of "non-standard" and "standard" sound synthesis methods are differences of origin of principles of sound production. "Standard" methods are based on physics, acoustics, and psychoacoustics, whereas "non-standard" methods are based on compositional ideas of sound and musical organization. It seems, therefore, more appropriate to call them compositionally motivated sound synthesis methods.

Technology

One may argue that computers cannot do anything one could not do without them, that they can only perform certain tasks much faster. This quantitative difference, however, can become a qualitative one. The qualitative difference the technological mediation causes is a central focus of the "non-standard" approach. As the composer Paul Berg writes:

> A myriad of sound-synthesis programs are based on models related to instrumental music or the design of a traditional analog electronic studio.
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> […] They all require the use of a computer because of the magnitude of the task. […] It is a valid, but it is certainly not the most interesting one. More interesting ones are to hear that which could not be heard without the computer, to think that which would not be thought without the computer, and to learn that which would not be learned without the computer.[2]

The thought of exploring the possible musical relationships that can be produced with certain techniques or tools is fundamental to electronic music. Koenig writes, that when composing electronic compositions, he has "always searched for causes in the technical conditions of the studio. […] the machines should not only be used economically, but also musically, they should take over form building tasks."[12]

In contrast to many approaches to sound synthesis, the "non-standard" approach is characterized by an avoidance of simulation. This position can be traced back to the electronic music of the 'Cologne School' , where one assumed that in order to compose 'new' music with a new kind of material, one has to find new ways of treating this material. If one assumes that art evolves from the examination of the means of its production, it is necessary to explore the possible ways of musical organization our means of production can provide us with, instead of searching for ways of emulating already known situations with new tools. However, a large – if not the main – body of research undertaken in the field of digital sound synthesis is aimed at simulation. One of the leading exponents of this direction is the composer Jean-Claude Risset, who argues not only for the indispensability of psychoacoustics in the development of sound synthesis methods, but also advocates the simulation of instrumental models:

> Insofar as the composer is familiar with the sounds of an instrumental type, he will inevitably find it simpler, in front of the computer, to make use of his previous musical concepts and his science of orchestration.[15]

From the "non-standard" perspective, making "use of previous musical conceptions and science of orchestration" as a goal for dealing with new tools can be seen as a strategy of preventing change. It is as a position in diametrical opposition to the "non-standard" approach. "I'm very annoyed", says G.M. Koenig, "with composers using the most modern tools of music making […] and making twelve-tone series […], or trying to imitate existing instruments. That has, of course, its scientific value, but not necessarily a creative value in new music making."[16]

Xenakis's search for the minimum of necessary constraints, Koenig's expansion of the concept of musical material, Berg's exploration of a music idiomatic to its means, and Brün's subjectively treated set of machine instructions, are approaches which search for possible roles of technology in music. Its role is here not a given, not predetermined, it is part of the composer's work to establish such roles. The "non-standard" approaches critically embrace technology. Agostino Di Scipio writes:

> Adorno observed, too, that an artist's labor always implies a personal or shared "critique of technology," but it can actually only do so only by confronting and exploiting the technology without getting rid of it. […], we can argue that, today, art can confront technology in an approach of 'subversive rationalization'.[7]

Connections with "Radical Constructivism"

Many sound synthesis methods are derived from the scientific description of an 'external reality'. Systems theory, cybernetics, biology, and other scientific disciplines have raised questions about the way in which we acquire knowledge, which cast doubt on the objectivity of representations of an 'external reality'. Instead of viewing knowledge as a compilation of empirical data, it is seen as actively constructed by cognitive processes. As Heinz von Foerster famously formulated, "the environment as we perceive it, is our invention."[20] The emphasis is thus not placed on the consensus a model engenders, but the possibilities of action it creates. First of all, this view can be seen to have consequences for the work's and composer's relation to the listener. The listener is seen in an actively constructing role, which frees him from his role a passive consumer, thereby creating new possibilities for composition. Martin Supper writes in his book Elektroakustische Musik und Computermusik:

> Der Radikale Konstruktivismus kommt beim Hören Elektroakustischer Musik […] doppelt zum Tragen: Der Zuhörer errechnet nicht nur eine Realität, sondern er konstruiert auch eine Realität. die er bisher nicht kannte.[18]

And composer Karlheinz Essl writes in his article "Kompositorische Konsequenzen des Radikalen Konstruktivismus" ("Compositional Consequences of Radical Constructivism"):

> Thus, the recipient leaves his socially prescribed passivity and becomes a co-creator by constructing "his own version" of an artwork, based on his personal preconditions.[8]

Herbert Brün, who had been a long-term friend and colleague of Heinz von Foerster, draws further compositional consequences. With his idea of "anticommunication" he argues for the departing from previously established laws and orders, or channels of "communication". Truly new types of organization, i.e. non-trivial connections, even if they may initially seem "implausible", should be open to be discovered by the listener:

> Communication uses the order and the law that is meant to be recognized by the receiver as the receiver's own; anticommunication creates the order and the law that is meant to be discovered by the receiver for the first time.[4]

The listener is thus not seen as a passive system, which is fed with a certain input and – provided he is trained enough – will understand it. The relation to the music is rather like a perturbation (Maturana, Varela) of the receiving system causing structural change in it. This view entails an abandonment of trying to convince the listener. Convincing – it derives from the Latin word con-vincere meaning 'to conquer, to overcome' – is seen as an coercive act; it "negates listening."[13]

Fields such as 'music psychology' and musically applied psychoacoustics claim to produce descriptions of the subjective perception of music and its organization. Many composers in turn believe in the musical relevance of these investigations and strive to have their music comply with the standards set by these disciplines. This is most curious, given that the subjective perception of music and its organization has been studied for centuries; by composers. Another problem of the psychoacoustic investigations of musical organization is the way they are conducted. The scientist, who claims to produce 'neutral' test sounds in order to achieve an unbiased, scientifically relevant study finds himself in a dilemma. If it is the scientists aim to compose 'neutral' test music, or noncompositions [14], he is faced with creating a compositional context, however limit it may be, in which the results of the conducted study may be valid. Therefore, in order to have some relevance to current compositional activity, the psychoacoustician needs compositional training. As J.K. Randall writes:

> It seems to me that any psycho-acoustician who forges ahead blithely out of touch with current concerns in musical analysis and musical composition is putting himself in an excellent position to produce silly science, silly music, or silly both.[14]

In 1970 G.M. Koenig described his system SSP, which had not yet been implemented at the time:

> As opposed to programmes based on stationary spectra or familiar types of sounds, the composer will be able to construct the waveform from amplitude and time-values. The sound will thus be the result of a compositional process, as is otherwise the structure made up of sounds. [10]

The system is based on the fundamental proposition that "musical sounds may be described as a function of amplitude over time." [10] Similarly to Iannis Xenakis's Dynamic Stochastic Synthesis the system abandons existing acoustic models and tries to derive sound synthesis methods directly from compositional activities.

The approaches towards material present in all "non-standard" synthesis programs stress the notion that the material and the organization in which it is embedded are inseparably interlinked, that the material is a product of compostional work, and that "form is the result of the treatment of the material."[12] As Di Scipio writes referring to Brün and Xenakis, "this represents a thoroughly constructivist approach: nothing in the music has the status of something that exists prior to the composer's work, not even the so-called 'sound material'."[7]

Organizational Principles

When organizational principles are borrowed from science, it is often forgotten that these descriptions are invented models of explanation. This confusion can become restrictive, when – sometimes in an attempt at 'scientification' – these models of explanation are assumed to deliver general compositional constraints. This confusion can be exemplified by François Bayle's statement that, "the cognitive faculty functions according to psychoacoustic schemes,"[1] which is untrue since "psychoacoustic schemes" are invented models, which may or may not explain aspects of the workings of the cognitive faculty, but never prescribe them. From a constructivist perspective we are dealing here with a false sense of "representation". Ernst von Glaserfeld writes:

> If the view is adopted that "knowledge" is the conceptual means to make sense of experience, rather than a "representation" of something that is supposed to lie beyond it, this shift of perspective brings with it an important corollary: the concepts and relations in terms of which we perceive and conceive the experiential world we live in are necessarily generated by ourselves.[21]

This shift of perspectives can have compositional consequences. There is a common view that symbolic representations, such as musical notation, spectra, waveforms etc., represent a real sound world. From the constructivist point of view, there is no real sound world containing immanent structural order and information with is then represented. It works the other way round. The symbolic access creates the order. Thus, we are always dealing with an observer dependent, constructed reality.

The "non-standard" approach is not searching in nature or a scientific explanation of it for musical structures, it has no interest in objectivity. Instead it elevates its own compositional premises to the level of universal models. Validity is not borrowed from science. Compositional systems are ways of creating contexts of validity, ways of creating conditions under which sounds can be endowed with functional value. Herbert Brün writes:

> While the sciences observe or stipulate systems which are to be analogous to an existent truth or reality, and while technology stipulates and creates systems that are to function in an existent truth or reality, the arts stipulate and create systems which are analogous to an existence desired to become true or real.[3]

Essentially, the "non-standard" approach searches for principles of musical organization in the means of its production, that is both the technical and the compositional means. The organizing principles in music – whatever they are based on – are thus understood as invented explanatory models used during the production, they leave traces which do not equal the principles themselves.

Conclusion

The presented systems hold a special position in the history of computer music. They can be read as utopian projects. Not only are they pioneering works of in the field of microsound, they are most of all truly experimental models, which aim at exploring the compositional possibilities unique to digital sound. They are truly experimental, because they are endeavors into an uncertain terrain. In doing so, they depart from previous musical ideas and try to create frameworks for the construction of relationships to be discovered. They critically embrace the artificial, in contrast to the simulating "naturalism", which has since found its way into "electroacoustic" music.

In this paper, I have tried to give a summary of the compositional and theoretical ideas behind these systems. Moreover, I have tried to point out connections between so-called "Radical Constructivism" and compositionally motivated sound synthesis.

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References

[1] F. Bayle. Musique acousmatique proposition ... positions. Buchet/Chastel - INA-GRM, 1993.
[2] P. Berg. Pile–a language for sound synthesis. Computer Music Journal, 3(1), 1979.
[3] H. Brün. Technology and the composer. UNESCO Report on the Stockholm Meeting, "Music and Technology", La Revue Musicale, 1971.
[4] H. Brün. Drawing distinctions links contradictions. Perspectives of New Music, 12(1–2), 1973–1974.
[5] H. Brün. When Music Resists Meaning, chapter From Musical Ideas to Computers and Back (1970). Wesleyan University Press, 2004.
[6] A. Di Scipio. Inseparable models of materials and of musical design in electroacoustic and computer music. Journal of New Music Research, 24(1), 1995.
[7] A. Di Scipio. Systems of embers, dust, and clouds: Observations after xenakis and brün. Computer Music Journal, 26(21), 2002.
[8] K.-H. Essl. Kompositorische konsequenzen des radikalen konstruktivismus. positionen, 11, 1992.
[9] S. R. Holtzman. A description of an automated digital sound synthesis instrument. Computer Music Journal, 3(2), 1979.
[10] G. M. Koenig. The use of computer programmes in creating music. UNESCO Report on the Stockholm Meeting, "Music and Technology", La Revue Musicale, 1971.
[11] G. M. Koenig. Composition processes. Computer Music. Canadian Commission for UNESCO, 1980.
[12] G. M. Koenig. Genesis of form in technically conditioned environments. Interface, 16(3), 1987.
[13] H. Maturana and B. Pörksen. Vom Sein zum Tun. Carl-Auer-Systeme Verlag, 2002.
[14] J. K. Randall. Three lectures to scientists. Perspectives of New Music, 5(2), 1967.
[15] J.-C. Risset. Synthesis of sound by computer and problems concerning timbre. UNESCO Report on the Stockholm Meeting, "Music and Technology", La Revue Musicale, 1971.
[16] C. Roads. Interview with gottfried michael koenig. Computer Music Journal, 2(3), 1978.
[17] K.-H. Stockhausen. Texte zur elektronischen und instrumentalen Musik, chapter Elektronische und instrumentale Musik (1958). Verlag M.DuMont, 1963.
[18] M. Supper. Elektroakustische Musik und Computermusik. Wolke Verlag, 1997.
[19] P. Thomson. Atoms and errors: towards a history and aesthetics of microsound. Organised Sound, 9(2), 2004.
[20] H. von Foerster. Understanding Understanding, chapter On Constructing a Reality (1973). Springer Verlag, 2003.
[21] E. von Glasersfeld. An exposition of constructivism: Why some like it radical. Constructivist Views on the Teaching and Learning of Mathematics, 4, 1990.