Sound as *Multiplicity*: Spaces and representations in computer music composition

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***Abstract* — This text deals with the subject of sonic spaces within the field of computer music composition. Highlighted by the notion of multiplicity, the sound will be analysed as a *multi-representational space*. This central idea will take us to consider some proposals of the hermeneutical criticism of representation, where we'll observe the emergence of sonic spaces from an *action-perception* perspective: our musical significations appear at the very moment we execute a "local action" in the composition process. Multiplicity is produced by singularities as well as singularity is conceived as a multiple entity: depending on our *operatory procedure in music composition* we shall consider a sound as One or as Multiple. In music composition, human-computer interaction moves towards this problematic.**

I. INTRODUCTION

It is important to make clear that in this article the notion of multiplicity [1][2] is not employed as an adjective in the way it is used in speech, for example, when one says: a multiplicity of musical instruments, a multiplicity of styles, etc. Instead we are focusing on a "strong sense of this word" [3], as Deleuze has stated. The French philosopher refers directly to the "*Données Immédiates"* [4] of Bergson, where we find that "a number is a multiplicity", which is not the same thing as a "multiplicity of numbers". This article aims to explore the next idea: "a sound is a multiplicity", it also proposes that sonic interactions in a musical work create a "multiplicity of spatialities". We are thus considering a compositional strategy in computer music which recognizes the concept of sonic space not only as the physical medium where the sound is diffused, but also, as an 'operatory' category (*catégorie opératoire*) which outlines many other "composable spaces" (metaphorical or representational) every time that we interact with the computer.

II. COMPOSABLE SPACE

In the field of computer music composition we can see that the concept of "sonorous object" (*objet sonore*), reelaborated by the composer and theoretician Horacio Vaggione in many of his writings, keeps the same "strong sense" of multiplicity, as proposed by Deleuze. Vaggione develops the concept of musical space as a "composable space" [5] based on the emergence of musical meanings revealed in every single act of composition. Following the same line of thought, Vaggione assumes that the composer must deal with a multi-representational space contained in the alphanumeric environment of the computer, where an operatory category, that of the sonorous object is defined as a "multiple". More precisely, the sonorous object constitutes a "multiple unity" [*ibidem*].

The composable space is considered as an element that can be articulated; it is then conceived as a material, Vaggione affirms: "If the space is conceived as compositional material, that means that it is essentially a space of relations" [*ibidem*]. We could also visualize the computer itself as a "multiple unity": we understand that it is our interactive practice which generates a multiple sonic space. However, we could not musically evaluate the computer in terms of its calculation processes or in terms of its musical representations, because, as we know, a "musical space" does not exist in it; we *compose* this space of relations following our aesthetic assumptions, actually, we need to "musicalize the computer" [6], as proposed by Risset.

It should be clear that the composable space is made of a conjunction of operations producing musical significations. In computer music, these operations (producing musical meanings) can be found being part of both spaces, the real and the virtual; Risset has established that "the notion of space is consubstantial to the electroacoustic music […] it provides us a real physic [space] to play with the virtual" [7]. As we can see, the sonic space results from the interaction between the real and the virtual space, it is a composed element, a "multiple unity", as we have seen before. We could not certainly evaluate musically the diffusion of a sound in a physical space without a certain amount of "compositional background" (metaphorical, structural, etc.). It would be also difficult to musically think of a space represented in the computer without attesting it in a physical space. The sonic space is made of a connection between the real and the virtual space; according to Risset: "When we create a virtual space, we create a simulation of propagation in an acoustic space" [*ibidem*].

III. SPATIALITIES

In connection with the arguments of the hermeneutical criticism of representation, which will be developed later in this text, Vaggione affirms that an object is part of a network of objects, while at the same time containing its own network [8]. It is from this perspective that we can think of a sound as a multiplicity. This concept of the sonorous object, which is defined by the research field that concerns itself with the *operational procedures in music composition*, comes closer to the concept of sonic space as developed in this article.

We thus consider the musical work as a sonic space where a "multiplicity of spatialities" emerges. In order to clarify this idea, we can refer to the sonorous object defining its own space of operations, but being, at the same time, part of a group of operations contained in the space of a musical work. In music composition a "multiple unity" is a sonorous object, but also, it could be a piece of music, so to speak a morphology, which in every case contains multiple *operations*. The notion of *sonic space* is thus considered as an "operatory category" located in the micro and the macro level of sound, it is something that we use to compose our "musical distinctions", pointing out the difference between the layers of time in our music: "The musical space is something to be composed" [cf. 5], as has been clearly stated by Vaggione.

What we're looking for as composers when working with computers is a "composable space", more than a "represented space" (an *a priori* representation of a sonic space where, hypothetically, we would develop a thinking about the objects contained in it). In a composable space the objects themselves put forward a spatial thinking, we can see that their forms result from their operations; in fact, as it has been proposed by Granger: "object's space and operation's space are reciprocal" [9][10]. We employ an interactive approach when we claim this reciprocity between the objects and their operations. Under this perspective, the space of the musical work is a particular kind of object giving us the possibility to compose the relations of objects during a temporal flow. We shall recognize a sonic space as defined by an ensemble of operations situated at different layers of time.

IV. Composable Distinctions

In computer music composition, we are focusing on an interaction of a multiplicity of musical spaces of many kinds (physical, operational, perceptual and metaphorical). We thus understand the composition of the musical work as a "multiplicity of composable spaces". To paraphrase Deleuze, it could be said that we are distinguishing "the kinds of multiplicity" [cf. 3]. Certainly, this statement sets us apart from a dialectical position between the One and the Multiple, and the composer is thus engaged in differentiating the levels between them: one musical figure that could be perceived as unitary in one representational scale, could be defined as a multiple in another. As Vaggione has put it, as composers, we are led to make "composable distinctions" [cf. 5]. The numerical field has allowed the composer to work in this sense, as we know, the alphanumerical code has opened more possibilities for the composition of the sonic material, revealing to us the finest differences contained in sound.

The musical syntax has been increased because of this micro-temporal manipulation of sound; we thus distinguish several concepts close to this multiplicity, as we have seen before, that of the sonorous object could be applied to all temporal sizes, marking out a multiple space in a musical work. Even if we are not establishing a dialectical position between the One and the Multiple, it is important to observe that in order to articulate a multiple space which conveys all composable distinctions, we need to set (encapsulate) the connections between the operations. Vaggione makes the following statement concerning this aspect of the multiplicity of the sonorous object: "In the informatic jargon, the *encapsulation* term corresponds to a linkage of an ensemble of proprieties and behaviours pointing out the creation of an object" [11]. The encapsulation procedure furnishes a singular attribute to the work, some kind of artistic quality which marks out a musical context. We can think in a composable space as a multiplicity of encapsulated entities, which is underscored by Wittgenstein's remark establishing that "the configuration of objects produces state of affaires" [12]. It is important to mention that a sonic space conceived as a state of affaires, would mean that we are engaged with a permanent critical point of view vis-à-vis the sonic relations, definitely, this alert attitude allows the composer to establish the different degrees of its sonic material, which could go from the One to the Multiple.

V. Proprieties and Behaviours

As it has been analyzed in a precedent article [13], it should be clarified that a computer cannot create music by itself; however, it can help us generate musical ideas when we introduce a *behavioural specification* into it: by interacting with users, other computers or physical systems. One special feature of multiplicity is underlined when we approach a behavioural specification: the *reduction* of contents when the composer works (*designs*) with the representational environment of the computer.

Music creation with the computer conveys an irreversible process of time; it changes at every step of transformation. The composer cannot determine all the representational features of sound that would correspond to his aesthetical assumptions, the sonic space of the piece is something that emerges by an action-perception perspective thanks to a selection of sonic elements that constitute local musical significations. In the line of Granger's ideas we would say that the composer locates "knots of new significations" [cf. 9, p. 389] in the sonic space of the piece. Briefly, the composer creates a musical representation in the computer that makes *sense* to his ears.

There is a connection between the *action* of creation in a representative space and the *perception* of these acts. We deal with the operations of two kinds of sonic spaces in order to create a musical signification. In composing with computers, we have a tendency to randomly multiply the sound transformations in our imagination (our musical ideas are normally formless), however, it would be better to consider this cognitive uncertainty as an inevitable aspect of music invention. Thus we use the computer to *unify* this *multiplicity* in a composition strategy. In keeping with the words of Winograd (in the informatic field) who stated that "Design is by nature both holistic and ruthlessly simplifying" [14], we shall then introduce one of the central lines of thought of this text which is that the *design* of sonic spaces is both holistic and simplifying. We use the computer to *unify* or to *multiply* a sonic space.

It could be stated, paraphrasing Risset, that when we design a sonic space we create *simulations* of propagation of sound as well as *simulations* of the representations of this propagation, in fact, we have a reduction of contents in both simulations. Those reductions of contents are directly influenced by our musical practices which deal with our aesthetic postulations. Following the words of Winograd we clarify the remarks presented here: "A designed artifact, whether it is a piece of communications software or a city park, must address the complex mixture of human needs, embodied in a weave of physical and social interaction. But the design itself cannot embody all of these complexities if it is to be constructible and understandable. The design must embody a simplification, leaving room for the texture of the world to be filled in by the interpretation and practices of those who use it" [*ibidem*].

The design of a sonic space must also embody a simplification of its multiplicity in order to be constructible and understandable. In electroacoustic music, when several variables are engaged in the process of composition (signal treatment, spatialization process in real time, multi-channel recorded 'tape', musicians playing), it is better to follow this suggestion. In complex systems of music production, when this simplification is not apprehended, it could result, for example, that spatial treatments of sound will not be perceived: too many movements of sound between the speakers will form a confused texture which would cancel a detail of the spatialization, as it could be, for example, the directional trajectory of sound covering the physical space.

Certainly, it should not be understood that multiplicity has "simplest" audible results only. What we have been talking about refers directly to a creation of a composition strategy that should be explicit in its own terms and operations. It conveys a design following the proprieties and behaviours of a sonic space involving the composer and the machine. Multiplicity in a sonic space is revealed by its singularities, however, a compositional problem appears: how can we compose a multiplicity without loosing a detailed perception of singularities?

VI. Singularities

We have been referring to simplification within multiplicity. Thus it is interesting to reflect upon how much our musical strategies are transformed when we direct towards complexity, which at a first sight would have more points in common with the concept of multiplicity. Singularity, nevertheless, unfolds other questions about the construction of sonic spaces.

In an interactive situation involving the notion of multiplicity, the computer can be considered as an *integration interface* where several compositional operations are symbolically formulated in non-dialectic terms (composer-computer). As composers we situate the representational space of the computer in an artistic perspective: it is a compositional tool and a musical instrument. We perceive it as a *spatial interface* which gives us the possibility to codify musical (compositional) ideas within a representational environment. We also view it as highlighting the dynamic nature of our musical practices: "it offers us the possibility to transfer *abstract-artistic* to *symbolic-algorithmic* information" [15].

The computer can help us to multiply the transformational possibilities of sound when we "discover" its representational space, which is made up of many symbolic layers of sound. This space, or network, could thus be seen as a *multiplicity* which is constructed out of an infinity of interconnected *single acts* (these acts are referred to as *singularities*, due to the *aspectual* and *qualitative* features of sound that interest the composer during the process of its transformation in a computational environment).

The present text could also have been untitled *"Sound as Singularities"*. It is clear that the sound holds a multiplicity made of an ensemble of singularities. Thus it is important to consider that the representational space of the computer allows the composer to go deeply into the sound, searching for details. The composer can now articulate these micro-elements and change of temporal scale at every time of the process: "The computer is an ideal tool that allows us to deal with this situation", affirms Vaggione, and he continues: "With this tool we can reach any level of operation and explore all the desired and possible links between different levels. It is true that we are forced to use different systems of representation, choosing the ones more adequate to each particular level. This is why we are confronted with disjunctions and nonlinearities; a symbolic system that describes well a given morphology at a particular level can become nonpertinent when applied in another level" [16]. Those disjunctions and nonlinearities create singularities in the sonic space, as composers we are confronted to particular cases at every level of representation. Multiplicity is formed by the ensemble of particular cases in our process.

VII. Synoptic View

Multiplicity reveals the diversity of elements contained in a unity, outlining a contextual vision of the ensemble. We thus attain a "spatialized vision" of details contained in a sound. In these circumstances, we do not lose our approach to the qualities of sound, they are, so to speak, projected in a multiple space, amplified or disturbed by the contact of the ensemble. Singular elements (individualities) presented in the multiplicity attain other sonorous qualities in their macro-morphological arrangement. According to Morin: "The organization of the whole is something more than the addition of the parts, because it uncovers the qualities that would not exist without this organization" [17]. As composers we are thus interested in the "emergent qualities of the singularities".

We compose a dimensional space within multiplicity, our perception goes around the ensemble of singularities. This exploration of the multiplicity is confronted to heterogeneity, however, our listening, as well as our view, has tendency to rebuild regularity in heterogeneity: "Things that resemble each other are tied together in vision", has stated Arnheim [18]. In music composition, this proposal takes us to reflect on the qualitative emergence of the sonic space when multiplicity is constructed by the connection between sounds and not by connecting "term to term", which would be a restricted linear-logical construction of our musical structures. As composers we strive, following Wittgenstein's remarks, "not after *exactness,* but after a synoptic view" [19].

VIII. Critical Remarks

In order to clarify the action-perception remarks exposed in this article, an approach to the hermeneutical criticism of representation is exposed here. We need to consider the texts which have been published since the end of the 1970s up to the present time in the field of informatics and cognitive science (offering some alternative propositions to classic cognitivism). Of particular interest for this critical position are the proposals of Brooks [20][21]; Chapman [22]; Dreyfus [23][24], Wegner [25]; Winograd [26]; Winograd and Flores [27]. The argument developed by these authors has been clearly formulated by Vaggione: “representations do not have an intrinsic reality, they are tools pointing out a contextual emergence, corresponding to a *situation*” [cf. 8]. We, of course, understand that sonic spaces do not have an intrinsic reality either. The notion of *interaction* is then centred in the midst of the composition process, avoiding the predictability of closed systems and reductive formalisms.

Vaggione employs an interactive approach when he claims that “Operatory representations in music could not be identified as representations of “mental processes”: Even if the musician keeps and deals with quantities of musical relations (defined as elements out-of-time) in his mind, these elements will always be part of an “external world”, that of the music” [cf. 8]. This argument in the field of music composition evokes the work of Winograd in the field of computer theory in which several theories regarding a hermeneutical approach to informatics have been developed. He recognizes that “the concepts emerge in the interaction more than in the machine or in the head of the user” [28].

This critical position that we have classified as an operatory procedure in music composition maintains that musical ideas result from human interaction with the computer, similar to how one interacts with a musical instrument or with a sheet of paper on which one organises the notes. As a criterion for compositional position, musical ideas are thus intended as sonic operations represented in a configuration system (a *composable space* as Vaggione has stated). It is clear that musical ideas constitute one more space which should not be considered in dialectical opposition to the representational space of the computer.

Physical spaces as well as representational spaces produce compositional operations where music emerges. In the line of Di Scipio’s ideas, Solomos affirms: “The concrete space –the place– is part of the music to be composed. This aspect makes the music itself an emergence” [29]. This last sentence confirms one of the central ideas of this article: sonic spaces (physical or representational) are operatory categories in music. According to Nono “the sound reads the space” [30], this would also be understood as an operatory procedure because we have to deal with the qualities of a space in order to produce music: “the space could be “morphophoric”, it could serve to specific musical forms” [cf. 7], has stated Risset.

We compose the space at the same time as the space recomposes musical structures, we turn around this interactivity. We are part of the composable space, we are an interactive singularity of the space, integrating all the elements suspended in it. It could be then said, in the sense of Merleau-Ponty, that we are there “as a point or level zero of the spatiality” [31], producing musical operations.

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