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Michele Della Ventura, *editor*

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Preface

This volume of proceedings from the conference provides an opportunity for readers to engage with a selection of refereed papers that were presented during the International Conference on New Music Concepts and Inspired Education. The reader will sample here reports of research on topics ranging from mathematical models in music to pattern recognition in music; symbolic music processing; music synthesis and transformation; learning and conceptual change; teaching strategies; e-learning and innovative learning. This book is meant to be a *textbook* that is suitable for courses at the advanced undergraduate and beginning master level. By mixing theory and practice, the book provides both profound technological knowledge as well as a comprehensive treatment of music processing applications.
The goals of the Conference are to foster international research collaborations in the fields of Music Studies and Education as well as to provide a forum to present current research results in the forms of technical sessions, round table discussions during the conference period in a relax and enjoyable atmosphere.
36 papers from 16 countries were received. All the submissions were reviewed on the basis of their significance, novelty, technical quality, and practical impact. After careful reviews by at least three experts in the relevant areas for each paper, 12 papers from 10 countries were accepted for presentation or poster display at the conference.

I want to take this opportunity to thank all participants who have worked hard to make this conference a success. Thanks are also due to the staff of "Studio Musica" for their help with producing the proceedings. I am also grateful to all members of Organizing Committee, Local Arrangement Committee and Program Committee as well as all participants who have worked hard to make this conference a success.
Finally I want to appreciate all authors for their excellent papers to this conference.

April 2019 Michele Della Ventura

Contents

Perceptual foundations for a nonlinear asynchronous expression

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Abstract. If we are going to begin to take music a step further and begin to explore new possibilities and new sonic environments we need to first assess how exactly we disseminate and communicate ideas that possess intrinsic temporal dimensions that defy the current linear framework. Linearity and synchronicity, while unifying, are concepts that constrain the temporal cognitive dimension of music and sound. Removing these constraints creates room for new possibilities that allow us to express more accurately the stream of new ideas pouring forth from within the temporal arts. With a means for communicating such ideas we can more accurately critique and reflect upon the ramifications of these new developments. When we call into question the premise of musical thought as a linear progression we are also calling into question the premise that time is a linear progression since both music and time are intrinsically cognate to one another. From a purely phenomenological perspective we can say that both a linear and nonlinear perception of time is inherently part of our experience of the world. While our experience of the present is best described as a linear progression, the role of memory and multisensory experience serves to disorient this explanation. Music serves to communicate the temporal facet of our experience that is at best described as irrational, serving as a kind of antithesis to semantical communication. If this is true then we must also ask why the linguistic framework of this mode of communication is of a purely linear design. Examining musical notation closely reveals room for a more harmonious marriage between nonlinear and linear design that ultimately awards us the freedom to impart an elegant and extra-dimensional array of concepts. This paper extrapolates upon these communicative principles to form the basis for a nonlinear asynchronous notation (NLAN) system.

Keywords. Nonlinearity, asynchronicity, graphic notation, linguistic relativity

1 Introduction

"There is an idea, the basis of an internal structure, expanded and split into different shapes or groups of sounds constantly changing in shape, direction, and speed, attracted and repulsed by various forces. The form of the work is the consequence of this interaction. Possible musical forms are as limitless as the exterior forms of crystals."
(Edgard Varese, 1959)

Musical notation has a long history of development bringing it to its current format.[1] There have been many modern and contemporary developments that call into question the role of the written score[2] and others that don't so much attempt to invalidate the written score but instead attempt to expand upon it or expose new dimensions to written musical expression. Musical notation is difficult to describe as a language because while it does possess inherent semiotics and syntax it struggles under the scrutiny of semantics. Research done in the realms of musical analysis and musical syntax and semantics[3] for the most part brings us to the conclusion, from a linguistic perspective, that musical notation and language diverge in very fundamental ways that can make efforts at strict comparison-based analysis exhausting and ultimately somewhat fruitless endeavors depending on the intent or hypotheses behind such efforts.[4] What this means to say is that musical notation can communicate very clearly that which cannot be expressed but is not suited for the dissemination of logical instructions ergo a piece of music can effortlessly express the sublime inner world we all experience erstwhile it is the least efficient means to instruct one on how to assemble a piece of furniture.

One of the most crucial aspects of musical notation to consider when analysing its structural limits is the temporal nature of music.[5][6] Music is a temporal art,[7] and to a large part the consideration of time is what constitutes a considerable portion of inquiries into musical notation. The questions posed by composers such as Carnelius Cardew,[8] George

1 Rastall, Richard. 2008. *The notation of western music: An introduction*. Travis & Emery.

2 Wishart, Trevor. 1996. *On sonic art*. Routledge.

3 Monelle, Raymond. 2002. *Linguistics and semiotics in music*. London, Routledge.

4 Honing, Henkjan. 2009. *Musical cognition: A science of listening, translated by Marx, Sherry and Werff-Woolhouse, Susan van der*. Transaction Publishers.

5 Stockhausen, Karlheinz. 1959. **'***...how time passes…'* in *Musical Craftsmanship*, pp. 10-40. Die Reihe.

6 Maestri, E. 2016. *Notation as temporal instrument*. R. Hoadley, D. Fober, C. Nash TENOR 2016. International conference on technologies for music notation and representation. Cambridge, United Kingdom.

7 Thaut, Michael H. 2005. "Rhythm, human temporality, and brain function." *Musical communication*. Edited by Miell, Dorothy and MacDonald, Raymond and Hargreaves, David J. Oxford University Press.

8 Anderson, Virginia. 2006. **"***Well, It's a vertebrate…" Performer choice in Cardew's Treatise*. Journal of Musicological Research 25:3-4, pp. 291-317.

Crumb,[9] Pierre Schaeffer,[10] Karlheinz Stockhausen, John Cage,[11] and numerous contemporary composers and researchers working within the realms of real-time scoring,[12] graphic notation, laptop ensembles,[13] and animated notation[14] have often been drawn toward two branches of inquiry, albeit not exclusively one or the other, namely linguistic relativism and temporality. The standard linear approach to notation imposes limitations upon the composer who works with new tools and instruments that produce sounds outside the catechism of traditional western instruments that increasingly dissolve the restrictions of the linear composition framework. Linear notation becomes increasingly restrictive within a creative practice wherein the temporal aspects of music composition take on an entirely new dimension[15] which creates a space for both discovery and invention.[16]

Current research into graphical notation, unconventional scores, and generated scores have attempted to address questions in regards to the nature of music and sound, the role and identity of the written score, and also to address pragmatic concerns regarding the transmission of musical ideas within electronic music.[17] Much of this research, including my own, attempt to integrate the language of the machine and the performance[18] while establishing a better understanding between the performer and listener of the frangible temporalities of musical experience.[19]

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9 Kim, Hyangmee. 2008. *A performer's guide to George Crumb's Makrokosmos IV (Celestial Mechanics)*. University of North Texas.

10 Schaeffer, Pierre. 1952. *In search of a concrete music*. University of California Press.

11 Cage, John. 1967. *Silence*. MIT Press.

12 Winkler, Gerhard E. 2010. *The real-time-score: Nucleus and fluid opus*. Contemporary Music Review, 29:1, pp. 89-100.

13 Collins, Nick. 2003. *Generative music and laptop performance.* Contemporary Music Review, Vol. 22, No. 4, pp. 67-69.

14 Hope, Cat. 2017. *Electronic scores for music: The possibilities of animated notation*. Computer Music Journal, Vol. 41, No. 3, pp. 21-35.

15 Rebelo, Pedro. 2010. *Composing with graphics: revealing the compositional process through performance*. Sonic Arts Research Center.

16 Haubenstock-Ramati, R. 1965. *Notation: Material and form*. Perspectives of New Music 4: 39-44.

17 Manning, Peter. 2013. *Electronic and computer music, 4th edition.* Oxford University Press.

18 Rebelo, Pedro. 2006. *Haptic sensation and instrumental transgression*. Contemporary Music Review, 25:1-2, 27-35.

19 Brown, Nicholas. *The flux between sounding and sound: Towards a relational understanding of music as embodied action.* Contemporary Music Review, vol. 25, no. ½, February/April 2006.

2 Questions of nonlinearity

The ability to place the passage of visual time under compositional control gives us the framework from which to begin a serious inquiry into an alternative language for musical expression.[20]

When we examine the underlying framework of musical notation itself we can glean a lot of interesting information that reveals the character of how we think about music, and how music notation defines the limits of our understanding of music. Music notation has this power because it is a written form of communication for musical ideas, and the form or framework of a mode of communication has been shown by various degrees to have a direct influence in shaping our perceptions.[21]

The problem with how conventional notation shapes our perception is a systemic one. Igor Stravinsky is quoted to have once stated that music is the expression of time. With a firm grasp of the fundamentals of human visual communication we can begin to dismantle musical notation as a means of further understanding that influence which exudes the most force upon our perceptions, namely time.

I raise the question as to whether there must be something intrinsic and heretofore intangible about the nature of time that eludes our perceptions due to our most fundamental expression of our experience of it?

One of the underlying influences musical notation has on our perception is linearity. We read information in most Western languages from left to right, with a cohesive beginning and discrete end. We also tend to think of music linearly as evidenced by conventional musical notation, which is also read from left to right and has a cohesive beginning and end. We build musical structure within this framework and often composers frame their structures using many of the same elements of literature, such as developing episodes of introduction, climax, and resolution. This begs the question as to whether time can be percieved nonlinearly if a mode of communication can allow us to structure our thoughts and perceptions nonlinearly?

The question to me conjures up images of Pierre Schaeffer's spiral recording when he speaks about the creation of "...A sliver of sound isolated from any temporal context, a clean-edged time crystal, made of time that now belongs to no time."

These questions also beg us to explore the nature of sound, and whether the pure expression of the medium holds any answers. As a result we must consider that sound expands in all directions simultaneously from its source.[22] The graphical representation of waveforms tells us that we perceive or at least are prone to perceiving sound as something that is not static in that its graphical representation implies both motion and change over time. What it fails to provide us with however is a truly three dimensional representation of the

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20 Evans, Brian. *Foundations of a visual music*. Computer Music Journal, Vol. 29, no. 4, Winter 2005, pp. 11-24. MIT Press.

21 Tubbs, Stewart L. and Moss, Sylvia. 1994. *Human communication*. Singapore, McGraw-Hill, inc.

22 Barber, Antony. 1992. *Handbook of noise and vibration control*. 6th Edition. Oxford, Elsevier advanced technology.

nature of sound. If we wanted to come closer to a representation of sound that fully exposes the potentialities of musical abstraction we might want to look to wave forms as a rudimentary place to start. With time being a critical factor in human communication and sound itself being a three dimensional force, an accurate graphical representation might look more like a three dimensional helix,[23] or a close approximation of one in two dimensions. [24]

3 Inquiry through live looping

So far there exists several fundamental issues in regards to the perceptual framework of musical abstraction which have been exposed by the developments of new technologies for the creation of music and there have been some preliminary explorations into how we can begin to restructure our typical mode of thinking to allow us to begin to define a nonlinear perceptual framework for the transmission of musical ideas. To address the questions posed by linearity I began a practice based inquiry using live looping. My practice revolves around the coordination between the performer and music software during live performances, the primary tools being the Sooperlooper live looping engine[25] and the JACK pilot audio routing interface.[26] With these tools I found my practice continually dissolving the structures of the linear compositional framework.

Not only does live looping allow for the repetition and layering of musical phrases that can be repeated perpetually alongside real-time non-repetitive phrases but it also creates room for microrhythmic variations that become transparent as looped phrases pass through multiple cycles, emphasising an uncanny resemblance to orbital systems. What I began to witness were the structures of meter and rhythm also beginning to dissolve within these live-looped compositions. By first isolating the phrases and then notating them I began to realise that a nonlinear framework allowed for unified musical phrases that do not share a synchronized or unified meter or rhythm. This asynchronous phenomenon encourages the dissolution of shared note values or distinct rhythmic intervals as the main device for signalling when other voices enter or exit a composition. This opens up new dimensions for a temporal structure that can become transitory, reconfigurable, and alive.[27]

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23 Tubbs, Stewart L. and Moss, Sylvia. 1994. *Human communication*. Singapore, McGraw-Hill, inc.

24 Hall, T., 2016. *Pitchcircle3D: A Case Study in Live Notation for Interactive Music Performance*. International Conference on Technologies for Music Notation and Representation - TENOR2016, Anglia Ruskin University, Cambridge.

25 Chappel, J. 2005. *Sooperlooper – Live looping sampler (Computer software), V1.7.3*. Retrieved from http://essej.net/sooperlooper/

26 Davis, P. & Grame. 2001-2011. *Jack Pilot (computer software), v1.9.8*. Retrieved from http://jackaudio.org

27 Rebelo, Pedro. 2010. *Notating the unpredictable*. Contemporary Music Review, 29(1): 17-28.

4 Case Studies

4.1 *Chronos: 12th Sphere*: Emergence of a framework

Figure 1 demonstrates my initial experimentation into one of the possible forms a nonlinear asynchronous notation (NLAN) can take through the composition *Chronos: 12th Sphere*, for looped cello. By notating repeating phrases within a series of evolving concentric circular musical staffs the intention of the piece is formulated, and the broader temporal potentialities begin to manifest themselves. It can easily be imagined that by simply rotating any musical staff upon its central axis the piece can change dramatically. Also of importance to note is the different time signatures within each staff, when combined with the perpetual potential of each phrase, that correlate to the potential for completely dissolving any sense of linear restriction or structure. Further dimensions open up when we consider that each phrase need not necessarily be read in clockwise motion. The addition of linear musical fragments in a graphically modular format juxtaposed to the score could also further expand the potentialities of the piece. The phrases themselves also need not be arranged concentrically if we wanted to indicate differences or similarities of tempo, timbre, or a myriad of other possibilities. As you can see there are innumerable possibilities that can be explored, which are beyond the scope of this paper, but comprises material for a much larger inquiry into nonlinear asynchronous musical forms.

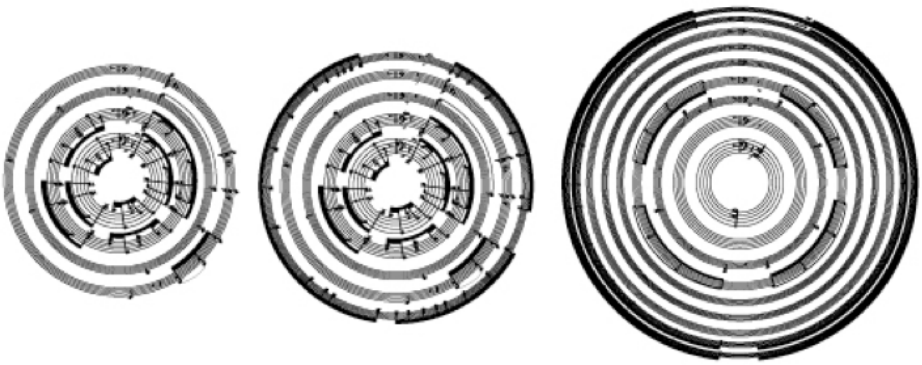

Fig. 1. Excerpts from *Chronos: 12th Sphere*, for looped cello.

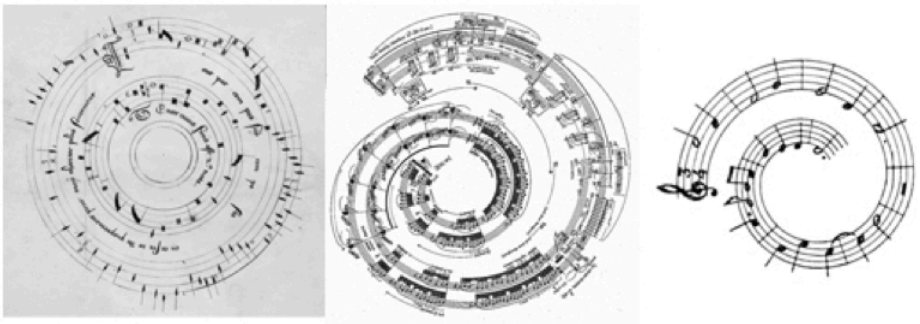

Fig. 2. From left to right, *Circular Canon* by Baude Cordier, *Makrokosmos 1* by George Crumb, and *Spiral recording* by Pierre Schaeffer.

In figure 2 I've included a brief set of examples of graphical notations by other composers that are visually similar to *Chronos: 12th Sphere* to illustrate the functional and philosophical differences between existing graphical notations and my first experimentations with NLAN through the composition of *Chronos: 12th Sphere*.

My intention for a nonlinear asynchronous notation system with the creation of *Chronos* was to expand upon the existing language of musical notation, not out of a desire for more control, but to give the expression of new musical structures more freedom. The goal, in essence, was to devise an unconventional hybrid system of open and closed notation to expand the temporal elements of music through a nonlinear asynchronous form and grant its expression liveness.

As a practice based methodology of research, the composition of *Chronos* is concerned mostly with the structures that arise from the permutations of pitch, amplitude, rhythm, timbre, duration, and morphology within the context of looping recorded sounds and musical phrases, their orchestration, and exploring the potential in musical and sonic composition that arise from examining their graphical representation as a visual counterpoint to the temporal phenomenological facets of nonlinear asynchronous musical forms.

Fig. 3. Excerpt from *Ghost Chamber*, for looped cello.

I explored the permutations of circularity as a nonlinear form further with the development of *Ghost Chamber*, a 6 minute piece for live looped cello that expands upon the framework developed with *Chronos: 12th Sphere*. In *Ghost Chamber* the same framework is used however a series of circular musical spheres is used instead of a concentric framework to establish the contrast between looping phrases and real-time phrases by placing looping phrases within a series surrounded by an all-encompassing real-time phrase.

4.2 *Terpsichore, Mnemosyne*: Permutations of nonlinearity

Terpsichore (Fig. 4) is a 7 minute composition for live looped cello that celebrates and explores Pierre Schaeffer's *Spiral Recording*. Terpsichore began by establishing a grid (Fig. 5) with intervals extending outward from the center of the space based off of the fibonacci sequence on the x and y planes as negative and positive values to a power of ten, with each whole value representing a single pixel. From there each vector within the ellipse of the curved musical staff was aligned to every other fixed interval on the grid starting outward from the central point of origin. This created an aesthetically harmonious series of seven possible staffs within an aspect ratio of 16:9. To ensure as much of the notation fit within the fibonacci series I also created a secondary circular grid in which each sphere had the same central axis as the musical staffs. Each circle was then created with a radius that increased by a value commensurate to the fibonacci sequence. From these circles I aligned the outward edge of the musical staffs to create a continuous line as a starting point for each bar.

Fig. 4.*Terpsichore*

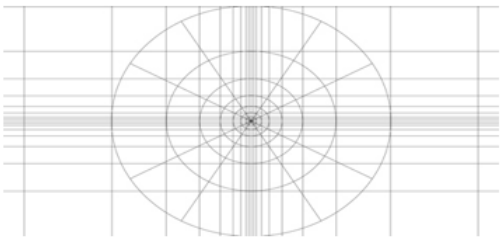

Fig. 5. Grid system for *Terpsichore*.

At this point as I was creating the rest of the notations I began to question whether separating the phrases into bars was necessary. It could be possible that the note values could be drawn into the staffs from this point without the need for a unifying meter in each staff, however a unifying tempo might be necessary in lieu of a meter if the phrases were written with the strict intention of being played in some sort of cohesive or unifying temporal sense, although leaving the matter of temporal unification up to the performer could be an interesting facet to explore within the scope of a nonlinear system.

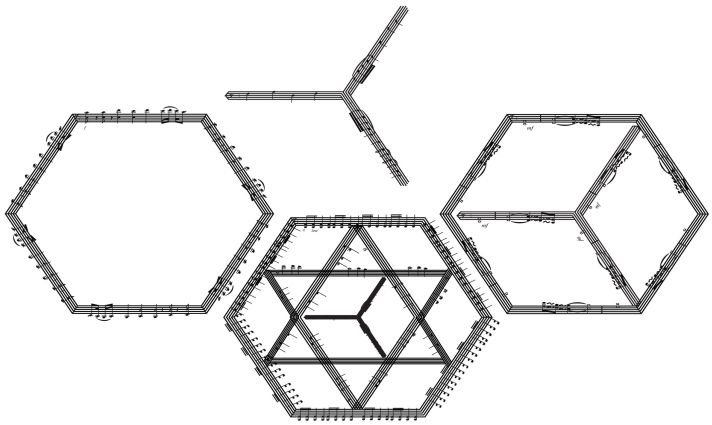

Fig. 5. Excerpt from *Mnemosyne,* for looped cello.

Mnemosyne (fig. 5) is a 7 minute piece for live looped cello that originally aired on the Canadian radio show *Acoustic Frontiers* on CKCU 93.1 FM in Ottawa. *Mnemosyne* was an experiment in possible alternative geometric iterations of a nonlinear framework. One of the most intriguing iterations of *Mnemosyne* is the use of an open and closed hybrid system of graphical notation used to convey a choice of two possible iterations of the second bar of a melodic phrase. Aside from these considerations the experimental notational structure of *Mnemosyne* draws the conclusion that perhaps a noncircular approach to nonlinear inquiry eschews more of the profundities available to such a pursuit. From these two case studies it can be seen that while further iterations on the concept of Chronos: 12th Sphere yield a variety of aesthetic material, the notation of nonlinear asynchronous expressions is fundamentally circular by design and spiral in scope.

5 Conclusion

After an extensive review of literature in the fields of graphical notation, unconventional notation, real-time notation, and animated notation it becomes evident that NLAN has the potential to build upon research into all of these fields with the exploration of uncharted temporal and graphical dimensions within the field of music, music notation and electroacoustic practice. Several of the composers, researchers, and authors reviewed hint towards unknown thresholds of temporality and structure in their work. A Nonlinear

Asynchronous Notation system promises the potential to expose new dimensions to this existing body of knowledge, and the opportunity to transmit a newer understanding of the temporal and structural dimensions of musical sound that have yet to be explored.

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