POSITIONAL RHYTHMIC NOTATION: AN IMPLICATION FOR A POSITIONAL THEORY OF RHYTHM.

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Abstract

Computer modelling of music, and for that matter any applications in music, reflects a musical theory, which is in itself a *model*. Thus, if there is any inadequacy in the theory, a computer model that successfully embodies that theory will also include that inadequacy. One of such inadequacies is the assumption that duration is a concept central to rhythm. We claim, instead, that **onset positions** play a central role. Among the many potential consequences of such a claim we maintain that a purely rhythmic notation must reflect different positions within a tree hierarchy, rather than durations. Bearing this in mind, we devised a notation such that only either presence or *absence* of the onset of a sound on a specific locus are represented. Some issues related to the way a user thinks and acts when inputting musical data into the computer *vis-à-vis* positional notation, and the positional *concept* itself, are discussed. The impact of positional notation (and the positional *concept*) on music teaching begs special attention.

Brief Remarks on Interdisciplinarity

The interdisciplinary nature of Computer Music - computer modelling being one of its sub-areas - is one of its many appealing aspects. Moreover, interdisciplinarity *per se* is often, and most of the times rightfully, welcome in the academic world. Nevertheless, with the proviso that we strongly support interdisciplinary work, we will point out some problematic issues related to interdisciplinarity which constitute the more general and, in a way, more theoretical concerns that motivate the specific questions to be addressed below.

The first precaution one must take in interdisciplinary work concerns terminology. Technical terms, as we know, must have their meanings as precisely defined as possible. Assuming, on the one hand, that this is not a major problem (and sometimes it *is*) within one single, self-contained field of study, on the other hand, not few problematic situations arise when it comes to relating two or more disciplines, each of them built upon its own set of fundamental concepts, its own premisses and axioms. This situation requires work akin to that of a translation which will establish that one concept is attached to the term 'x' belonging to a given discipline 'A' and that the same (or approximate) concept is represented by 'y', that belongs to another discipline 'B'. An interesting, and potentially dangerous, situation occurs when 'x' (the *signifier,* as borrowed from semiotics) can be found both in 'A' and in 'B'. More often than we would like to admit, we tend to assign the same meaning to 'x' in 'A' and 'x' in 'B', and this, if their correct meanings are not the same, and if the concepts are of fundamental importance to the theories they belong to, can have disastrous consequences. (Of course we are much more aware of the same sort of situation when two different natural languages are involved). This problem, however, is mentioned here as a subsidiary issue as regards our main subject (see Grillmer 1986).

The other precaution we must take refers to the status of the disciplines or the theories involved. True interdisciplinarity must be established between theories bearing the same status. Most fields of study, with their corresponding theories, have a systematic character, due to rigorous and continuing investigation. These could be called true theories, theories *stricto sensu*, or simply theories. There are, however, some cases in which a collection of terms and rules related to a certain area of knowledge and activity is unduly known either as a theory or as a science. Typically, this situation occurs along with a process we might call *linguistic naturalization*, i.e., those constitutive terms and concepts, which could once have been strictly defined and interrelated, go through a loss in precision proportional to their ever increasing usage as everyday natural language. But, in spite of such *naturalization* - due among other causes to a lack of continuing investigation - tradition keeps ascribing this 'theory' the status of Theory. Hence, if there happens that a systematic discipline (i.e. theory proper) gets involved with a discipline of this second type (i.e. a pseudo-theory), the resulting interdisciplinary field is bound to lose some of its consistency. In other words, even when we are attentive enough to method and logic in our procedures, if we inadvertently accept the pseudo-theory as an adequate rendering or *model* of the object or problem under investigation, we might not only weaken our interdisciplinary field (from a formal point of view), but also bring into it some descriptive inadequacy, i.e., we may *distort the image of the object*, since the 'natural truths' embodied by the terms of a pseudo-theory tend to hide their lack of strict denotative relation to whatever referent in the phenomenal world (see Moraes 1991).

Music Theory

Music theory is a typical instance of what we have called pseudo-theory. Many authors, in particular those engaged in interdisciplinary work, corroborate this assertion. Lindblom (1976) states that "*traditionally, music theory works with impressionistic, non formalizing methods*". Hackman (1975) says: "*it took far too long for me to realize that the methods of music analysis had to bear at least a superficial resemblance to other methods of scholarly and scientific inquiry*". We shall also mention Babbit (1975) (quoted by Hackman): "*If scientific method is not extensible to music theory, then music theory is not theory in any sense of the word*"; and Jackendoff & Lerdahl (1983): "*It* (music theory) *severs questions of art from deeper rational inquiry; it treats music as though it had nothing to do with other aspect of the world*".

Of course, much has been done in the last decade in the way of filling this gap. Work done by psychologists, linguists, computer scientists, and others doing research in musical cognition are all decisive contributions towards a systematic theory of music. Yet, there is a shady area that remains apart from mainstream spotlights. This regards those very elementary concepts related to music, i.e., *not* those related to larger structures but those 'natural truths', those fundamental terms that, once *naturalized* , are used as universal premisses upon which theories and models are built. As to rhythm, which is our central concern here, this situation might well be illustrated by Martin (1972), to whom "*rhythm appears to be taken so much for granted in music training that there is only one book on rhythm theory although there are many on melody, harmony and cuterpoint*". Martin is not very accurate as to the number of books he mentions, but we would argue that the situation has not changed essentially (i.e. rhythm taken for granted=*naturalized*) since then.

Computer Modelling of Music: is it interdisciplinary work?

At first glance we could admit that computer modelling of music - let us take it as an applied branch of the computer sciences - does not correspond to a strict notion of interdisciplinary work, since this modelling would represent a relation between a discipline (computer science) and its objects (musical phenomena in this case). However, one could argue that computer modelling of music should be considered as a branch of the musical discipline in which the computer (considered not only as hardware but as a complex notion including related theories and methods) would have the status of a privileged tool. For our part, as a music teacher, we could choose to support this last view, but we are obvioulsy far from having computer modelling of music and systematic music theory (which is, in a way, a *model* of music as far as it is Theory) as one and the same discipline in which the conceptual model and its physical counterpart would be complementary aspects of the same *inquiring* process (explanatory, not only descriptive).

Furthering this discussion is a task that is obviously beyond the scope of this paper. For the sake of our interests, we will only add that, at present, computer modelling of music should be understood as interdisciplinary work. In modelling music, one is not modelling *music itself* but rather relying on much knowledge about music that is *taken for granted* . This means that what we have is not a simple relation between a discipline or technique and its object but a potential relation involving two disciplines. Provided that due attention is given to unresolved and problematical issues still belonging to a 'pure', independent music theory, we will have true interdisciplinary cooperation. Computer (or programming) courses within music curricula are still exceptions rather then rule, as should be the case, and music courses - maybe theoretical courses mainly - in computer curricula would, of course, enhance interdisciplinarity.

Rhythm: a problem

No one would deny the fundamental importance of rhythm to music. Many would agree that music is *par excellence* the art of time and rhythm, and that this idea has more heuristic power than the truism *music is the art of sound* . Nonetheless, we should also agree that rhythm is a very elusive subject. Linguists (see Benguerel & D'Arcy 1986) would say: "*it is already obvious that a detailed account of language will require a lot more knowledge about rhythm*", (but) "*rhythm is very difficult to define satisfactorily*". Addressing a similar situation, Willems (1954) tells us that back in 1738 "*Matthenson reconnaisait l'importance de la thèorie du rythme mais la regardait 'une science confuse'* ". Meschonic (1982) quotes Paul Valéry: "*ce mot 'rythme' n'est pas claire: Je ne l'emploie jamais*".

However, in spite of that elusiveness, it seems that music theory (the elementary *naturalized* 'theory') has some sort of answer to all that: just pick up a series of proportional durations (most of them materialized as sound) and put rhythm within our rational reach. Better still: look at those simple arithmetic relations made visible by quarter and eight notes or even by their x.y rendering like in a *piano roll window* of a MIDI sequencer. No more mystery. Durations! that is the stuff rhythm is made of.

Contrary to this, Piaget (1946) would conclude that duration (pure duration) could be "*but a myth*", or at the most, a concept that is not a primitive (fundamental) one but a result of previous operations based much more on topologies than on any kind of linear measurement. On the musical side, we could agree with Piaget by saying that we cannot directly assess duration in a categorical way (like in: duration of note *a* equals 0.25 of note *b*'s duration). Bachelard (1933) would say that "*in music, a note's duration is not one of those pure elements, clearly primitive, as sight-singing teachers would make us believe*".

If we discard duration as a concept central to rhythm (as common music theory *and* notation would make us believe), we must have some other concept in its place. We will claim that this key concept is *position* as proposed , among others, by Martin (ibid.) and by Howard and Perkins (1974). After having stated that rhythm cannot be viewed only as a linear concatenation of segments, Martin, whose article involves both music and speech rhythm, states that "*temporal patterning would refer to the onset of each musical note or syllabic vowel*"... and that a certain rhythmic rule "*applies not to syllable duration but to syllable loci, specifically their vowel onsets*". From a specifically musical perspective, Howard and Perkins define *impulse* as "*certain but not all perceived discontinuities, abrupt changes in the ongoing auditory stimulus*" (....)"*we follow Allete (1951) in considering such auditory events as central to rhythm, in contrast with durations of notes, for instance*". They will also add that "*an impulse is 'at' a point in time and not at other neighboring point*".

Positional Notation.

Notation is a very economic, yet powerful, encoding tool. Unlike words, i.e., the linguistic-discoursive apparatus, a set of graphic signs like that of music notation bears no symbolic-arbitrary relation to the thing it represents, but, to a certain degree, it has an iconic relation to the thing it represents. Thus, we expect to *see* reflected in music notation every important property of the thing represented. Sometimes, specially in music notation, that relation may (unconsciously) be perceived as an indexal relation (in the semiotic sense), and written notes become, as it were, a symptom of the thing represented, if not the thing itself! (whereas no one has ever tried to bite the word "apple").

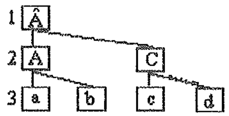
If we now go from musical notation back to music, we would be tempted to admit that if music notation *has* (represents) durations, then music (rhythm) has duration as one of its important properties. This is one of the mechanisms (of sophistic logic) that, by virtue of the subliminal convincing power of notation, make us believe that duration is the stuff rhythm is made of. However, if - considering what has been claimed above - we seriously reconsider our premisses regarding the important properties or , the relevant structural and perceptual properties of rhythm, we can, again, go from music to notation, with the result that the notation must, in some way, reflect the new premiss. One of such results is positional notation.

Positional Notation is supposed to be a purely rhythmic notation (it does not allow for pitch representation) and is not intended as a universal substitute for conventional notation. It is not a descriptive or analytical notation but rather an extremely economic and synthetic tool, both graphically *and* conceptually. As we have been testing it in several situations (teaching f.ex.) since 1980, we claim that positional notation bears a closer relation to musical-rhythmic perception and cognition (as compared to 'durational' notation).

We start from the idea that rhythmic pulse-metter is structured as a topology similar to that of verbal phrase syntax (see Hackman-1975, Martin-1972, Jackendoff-1977, Jackendoff & Lerdahl 1983). Unlike verbal syntax, whose hierarchic trees are constituted by labeled nodes bearing specific syntactic-grammatical content (like Noun Phrase, Verb Phrase, etc), rhythmic syntax bears no content in that sense.

Each graphical sign of the positional notation will account for the events (impulses, as in Howard & Perkins, or, simply the attack of a sound) relative to one pulse (rather an *expanded* pulse) as represented in figure 1.

Figure 1.



In Figure 1, each node, i.e., each rhythmic locus or *position* has an arbitrary label such that level one (main pulse, or what we would call simply *pulse level*) is represented by label Â. Level two have two elements (A and C) and level three has four elements (a b c d). Figure 2 shows a series of four (expanded) pulses.

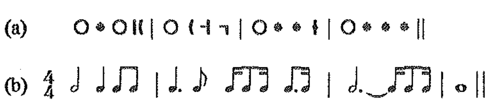
Figure 2.

In Figure 2, the black nodes indicate that an attack (a discontinuity) has occurred on the position in question, such that the rhythmic phrase thus represented would conventionally read ♩♫ ♬♬ ♫ (considering any x/4 time signature). Since lengths of notes are not of major relevance to positional representation, a number of other readings would be as well possible, i.e., we could use rests to shorten the notes, provided that their onsets have been kept untouched.

The same rhythm represented in figure 2 could also be represented by the arbitrary labels used in figure 1. Thus we would have the representation : Â BC abcd a*cd, where the sign * marks the empty position b. This 'notation' , which is a symbolic one, is now closer to something we might call a Notation, but it lacks those graphic features we would expect from a notation designed for fast and easy visual recognition. We shall, then, present a set of graphical signs that - in a one-sign-per-pulse basis - will indicate a) which level we are in, b) which position(s) has/have an attack and c) which position(s) is/are empty.

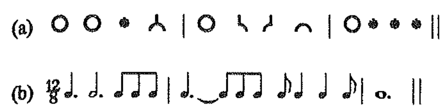
As to the first level, we will associate Â (an attack in Â) with the sign O, and the empty position will be represented by *. The two elements on the second level will each be associated with a *different* shape such that A corresponds to a vertical straight line and C to the sign (. If there are two attacks (on A and C), this would be represented by the sign I(. If only C has an attack, we should write (, so that the empty position A is negatively represented by the absence of the respective graphical element. Absences (no atttack) either in C or in both, A and C, would mean that we are on the first level. As to the third level, we would have four *different* shapes such that a b c d correspond respectively to ⊣ ⊥ ⊢ ⊤ (left, up, right, down). Four attacks on this level will be represented by the sign +. In case attacks occur only in a or c (b *and* d being empty), this woud mean that we are either on level two or level one. Absences on level three, just as on level two, are negatively represented by deletion of the corresponding graphical element, just as in ⊥(abc*) ⊤(a*cd) ⊢(*bcd) ⊣ (a**d) ⸸ (*b**). Figure 3 shows (a) a rhythmic phrase in positional notation, and (b) the same phrase in conventional notation (the durations are full or *default* durations).

Figure 3



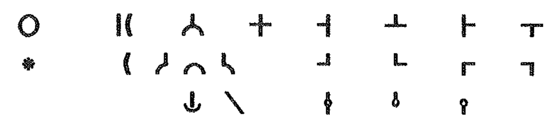
The topology represented in figure 1 obviously corresponds to what we would conventionally call the simple time (let us call it α system). Compound time (let us call it β system) could be represented by a similar scheme: A first level Â and a second level bearing three nodes or positions x y z. The graphical signal corresponding to an attack in Â will be the same signal O. The three non-empty positions x y z will be respectively represented by the signals / I \ (going up, up, going down). Three attacks on level two β would read ⅄. As in α , empty positions on this level entail signals such as ⌒ (x*z) and ⸝ (xy*). Figure 4 shows (a) a phrase as represented with these positional signals and (b) the same phrase in conventional notation.

Figure 4.



The total number of possible signals relative to α system may be easily obtained by calculating 2^4 , that is: sixteen (16) different signals. As for the β system, we will obtain 2^3, that is: eight (8) signals. Considering that signals O and * are shared by both α system and β system, we will have twnty-two signals. Other symbols could be created so that we could account for a fourth or a fifth α level (8 and 16 elements respectively) , or for a third, etc. β level. However, this would work against the economy of the system as a whole. Rhythms like § ♫♬ could always be represented as ⅄ (O II I( ), once we have established that the signals inside the parentheses belong to a single pulse. Figure 5, then, shows the twenty-two symbols.

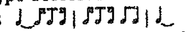
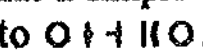
Figure 5.



The symbol's spatial distribution in figure 5 bears a relation to the way we allocate each character (of a *TrueType* font of characters we have developed - and have used here) relative to the keys of the computer keyboard. No musical logic is in question, but rather a simple mnemonic criteria (e.g. the clockwise 'rotation' of the signals ⊣ ⊥ ⊢ ⊤ ┘ └ ┌ ┐ , which have been allocated to the positions relative to the keys yuio hjkl in the table of charecters). This makes the writing of rhythm in text editors considerably faster in relation to other existing methods (althow we must admit that positional notation remains somewhat less universal than durational notation!). The use of simple *macros* (a common tool in text editors) makes the process still faster. This will be addressed below.

Some Potential Uses for the Positional Representation.

Music notation and MIDI sequencing software, as a rule, offer various methods for inputing musical data. These methods, however, fall basically into two cathegories: those based on the metaphor of someone (conventionally) writing music and those based on the metaphor of someone playing music. These are two radically different activities as regards the mental and physical processes involved in performing them. Writing music is an analytical task and, as far as rhythm is concerned, it *necessarily* (yet see above) requires as many choices as there are notes as to which duration comes next (we will not discuss the fact that we actually *tend* to think by way of groups of notes). This activity has no relation to any mental or physical musical process whatsoever (assuming that duration has nothing, centrally, to do with rhythm makes things even worse). Writing music in a computer (using *drag and drop* or numeric pad etc.) is, hence, duly regarded as a slow method. So, we choose the other method: just play, and the computer will do the job. As we know, this is still a fictitious promised land, no matter how sophisticated is the *quantizer* we have. We know, however, that playing music is as close as we can get to ....music itself. If we could at least transfer some of the mental and physical operations of musical performance to the act of music writing, without the inconveniences of the you-play-'he'-writes method...

As we know - and this is not at all new - there is a way of writing rhythms in which one acts neither as a writer only nor as a player only. If we take two objects like key 1 (say, #one of numeric pad) and key e, and continuously type 1eeee1e111e11e1e1eee, we will realize that our right hand has actually performed a rhythmic phrase such as  . But also, there is, running parallel to the performing-real-time process, analytical activity enough to ensure that a simple computing device (e.g. the *macro* we are activating now) will transform 1eeee1e111e11e1e1eee into . We would claim that much can still be done in the way of applying these principles (as well as their visual interface: positional notation) to many areas of computer music and of music cognition. As a footnote, we would add that positional notation can be easily added to printed music through the *lyrics tool* of a notation software.

No Duration in Music Teaching.

As we have mentioned above, we have been working with these ideas since 1980, both in a more theorethical fashion and in everyday teaching. Although we still cannot rely on rigorous measurements, strong evidence allows us to state that, in music teaching, when we eliminate the concept of duration altogether and use instead premisses and resourses such as those presented above, the learning process is considerably faster than with traditional strategies. This would mean that the positional theory might be a consistent path towards a better understanding of rhythmic (musical) cognition.

REFERENCES.

Bachelard, G. (1933). *A Dialética da Duração*. Ática.
Benguerel, A.P. and J. D'Arcy (1986). Time warping and the perception of rhythm in speech. *Journal of Phonetics*, 14 vol. 2.
Grillmer, S. (1986). The transfer of terminology from one field to another may be hazardous and counterproductive for interdisciplinary interaction. *Jounal of Phonetics*. 14 (1).
Hackman, W. H. (1975). A Clarification and Reconstruction of the Concept of Metter for Music-Structural Rhythmic Analysis following Philosophical-Analytical Paradigms. PhD. diss. Peabody School for Teachers.
Howard, V.A. and D. N. Perkins, (1974). Toward a Notation for Rhythm Perception. *Interface* Vol 1-2, 69:86.
Jackendoff, R. (1977). *X' Syntax: A Study of Phrase Structure*. The M.I.T. Press.
Jackendoff, R. and F. Lerdahl (1983). *A Generative Theory of Tonal Music*. The M.I.T. Press.
Lindblom, B. and J. Sundberg (1976). Generative Theories in Language and Music Descriptions. *Cognition* 4:99.
Martin, J.G. (1972). Rhythm (hiererchical) versus serial structure in speech and other behaviour. *Psychological Review*, 79 (6).
Meschonic, H. (1982). *Critique du Rythme: Antropologie Historique du Langage*. Éditions Verdier.
Moraes, Marcos R. (1991). *Por uma Teoria do Ritmo: O Caso da Metátofa Musical em Lingüística*. Master diss. Universidade Estadual de Campinas, UNICAMP.
Piaget, J. (1946). *A Noção do Tempo na Criança*. Record.
Tomita, Yo (1994). Bach, The Font: Inline Musical Graphics for Databases and Spreadsheets. *Computing in Musicology: An International Directory of Applications* Vol. 9 (ed. Hawlett and Selfridge-Field) CCARH, Menlo Park, CA.
Willems, E. (1954). *Le Rythme Musical*. Editions Pro Musica, Fribourg.

ACKNOWLEDGEMENTS

This paper has been produced within the context of research project 11/93/PRPPG-UFES, supported by Fundação Ceciliano Abel de Almeida and Pro-Reitoria de Pesquisa e Pós-Graduação da UFES.

Conventional music notation was printed with a registered copy of the font of characters *Bach*, (see Tomita 1994).

Sistemas e Linguagens para Composição