COMPLEMENTARY REPORT TO THE ARTICLE "Semiotic structure labeling of music pieces : concepts, methods and annotation conventions" (Proceedings ISMIR 2012)

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Abstract :

At a low timescale (i.e. typically below 1 s) a music piece can be viewed as a combination of musical elements drawn from a limited inventory of predetermined conventional unitary items such as notes, duration values or chords. However, above a certain timescale, the organization of music is more relevantly described in terms of complex piece-specific objects linked to each other by a compact set of local self-deducible relationships, thus forming structured musical segments.

The present report proposes a model called "system & contrast" (S&C), which aims at describing the inner organization of structural segments in terms of a *carrier system* (i.e. a set of elements forming a simple network of logical relationships) and a *contrast*, namely a substitutive element (usually the last one) which partly deviates from the logical sequence induced by the carrier system.

We show that the S&C model is polymorphous in the sense that it applies to any type of musical information layer (melody, harmony, rhythm, rhymes, effects, etc…) in a very versatile way, therefore offering a powerful meta-description of musical content.

The model has been designed for specifying a methodology for music structure annotation [5], but we briefly mention also its potential implications in other domains of music analysis and music information retrieval (MIR).

Key-words : music structure, form, semiotics, semiology, relational graph, music analysis, music signal processing, music information retrieval, musicology, system contrast

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RAPPORT COMPLEMENTAIRE A L'ARTICLE

« Semiotic structure labeling of music pieces : concepts, methods and annotation conventions" (Actes d'ISMIR 2012)

Résumé :

A petite échelle (c'est-à-dire typiquement en dessous de 1 s), un morceau de musique peut être décrit comme une combinaison d'éléments musicaux issus d'un inventaire limité d'unités conventionnelles prédéterminées telles que des notes, des durées ou des accords. Cependant, au-delà d'une certaine échelle, l'organisation musicale s'explique de façon plus pertinente en termes d'objets complexes, spécifiques au morceau considéré et liés les uns aux autres par un ensemble compact de relations locales auto-déductibles, constituant ainsi des segments musicaux structurés.

Le présent rapport propose un modèle dit « système & contraste » (S&C) visant à décrire l'organisation interne des segments structurels en terme de *système porteur* (c'est-à-dire un ensemble d'éléments formant un réseau simple de relations logiques) et un *contraste*, c'est-à-dire un élément de remplacement (en général, le dernier du système) qui dévie pour partie de la séquence logique induite par le système porteur.

Nous montrons que le modèle S&C est polymorphe, au sens où il s'applique à n'importe quelle strate d'information musicale (mélodie, harmonie, rythme, rimes, effets spéciaux, etc…) de façon très versatile, offrant ainsi une méta-description puissante du contenu musical.

Le modèle a été conçu dans le cadre de la définition d'une méthodologie d'annotation de la structure musicale [5], mais nous évoquons aussi, brièvement, ses implications potentielles dans d'autres domaines de l'analyse et du traitement automatique de la musique.

Mots clefs : structure musicale, forme, sémiotique, sémiologie, graphe relationnel, analyse musicale, traitement du signal musical, recherche d'information musicale, musicologie, système contraste

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ABSTRACT

At a low timescale (i.e. typically below 1 s) a music piece can be viewed as a combination of musical elements drawn from a limited inventory of predetermined conventional unitary items such as notes, duration values or chords. However, above a certain timescale, the organization of music is more relevantly described in terms of complex piece-specific objects linked to each other by a compact set of local self-deducible relationships, thus forming structured musical segments.

The present report proposes a model called "system & contrast" (S&C), which aims at describing the inner organization of structural segments in terms of a *carrier system* (i.e. a set of elements forming a simple network of logical relationships) and a *contrast*, namely a substitutive element (usually the last one) which partly deviates from the logical sequence induced by the carrier system.

We show that the S&C model is polymorphous in the sense that it applies to any type of musical information layer (melody, harmony, rhythm, rhymes, effects, etc…) in a very versatile way, therefore offering a powerful meta-description of musical content.

The model has been designed for specifying a methodology for music structure annotation [5], but we briefly mention also its potential implications in other domains of music analysis and music information retrieval (MIR).

1. INTRODUCTION

The description of the organization of music pieces at a high timescale, i.e. the task usually called structural segmentation and labeling, constitutes an open problem.

Several recent studies [1-4] in the context of MIR have been aiming at characterizing structural segments and producing annotated resources accordingly, but they all have been facing difficulties in formulating general properties which would qualify objectively and (almost) unambiguously the segmental units, independently of a given music genre, style or musical property.

Our research group has been investigating this question both from fundamental and experimental viewpoints. The annotation, discussion and adjudication of several hundreds of pieces, and the experience thus acquired, has gradually led us to the conclusion that the key features that create the perception of autonomous structural segments in music are not primarily some properties of their intrinsic substance but *patterns* of their inner organization.

In this report, we are therefore considering the "intermediate" level of music organization, which corresponds to timescales typically ranging between 1 and 16 *snaps* (analogous to down-beats), which we call the *morpho-syntagmatic bandwidth* [2] and which lies below the level at which the structure of the entire piece is usually described.

This report presents what we consider as the core of the inner organization of structural segments in conventional music : 1) a small set of self-deducible relations between musical properties forming a logical *carrier system* and 2) an (optional) deviation of the last element, called *contrast,* and which acts as both a modulation and a punctuation of the system. We call this model *system & contrast* (S&C).

An S&C can be described as a simple network of relationships between a small number of morphological elements and it can be used to characterize structural segments both in terms of boundaries (segmentation) and distinctive properties (labels), independently of their actual substance.

The present article starts, in section 2, by presenting the principles of the S&C model in a completely intuitive and metaphoric manner, so that the reader can easily grasp the basic concept. Section 3 formalizes the S&C model in the case of square systems, without any reference to music, up to this point.

It is only in section 4 that we instantiate the S&C model in connection with music information layers and we show how the model is able to describe a considerable variety of familiar (and less familiar) patterns, governing the organization of structural segments.

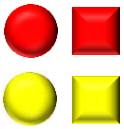
Section 5 extends the model to non-square configurations. Section 6 concludes on how the model has been used in the context of structural annotation and on its potential in other domains of MIR, Computer-Aided Music and music education. Analyses of S&Cs occurring in actual musical examples are provided at the end of the report.

This report focuses on the principles of the S&C, whereas [5] presents extensively how the S&C model has actually been used for annotating the semiotic structure of a set of approximately 500 songs.

If you wish to cite this report in one of your publications, please be kind to contact the first author for updated pointers towards potentially more accessible, extended and peer-reviewed versions of this work.

2. INTUITIVE PRESENTATION

2.1 The square system



These 4 elements form a *system* based on the combination of two binary *oppositions*, in terms of shape and colour. We will call this system a *square system*.

Figure 1 gives a few examples of square systems, for which it is easy to *deduce* which are the properties used as oppositions, and therefore to *explain* easily the system.

Figure 1 : Four examples of square systems

2.2 The contrast

A fundamental property of a square system is its redundancy.

Indeed, figure 2 depicts a few incomplete square systems, i.e. systems for which the 4th element is missing (and replaced by a question mark).

Figure 2 : Four incomplete square systems

As can be easily experienced by the reader, some properties of the 4th element are predictable and can be logically inferred from the knowledge of the first 3 elements.

As a consequence, it is easy to determine, on the basis of the exposition of 3 elements and the presentation of a fourth one, whether this 4th element matches or deviates from the system, and in what respect.

The 4 elements beside form a *system & contrast (S&C)*. The shape and colour properties of the 4th element both contradict the combination expected in 4th position, from the first three elements. The 4th element creates a logical *contrast*.

2.3 Carrier system and contrasting properties

The characterization of a system and its contrast requires the determination of the set of properties which form the system and the identification of those which take part in the contrast.

Carrier system (no contrast) | Colour-based constrast | Shape-based contrast | Size-based contrast

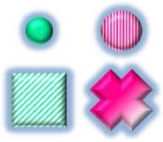
Figure 3 : examples of various contrasts, based on the same carrier system

Figure 3 illustrates several configurations where the contrastive property varies over the same baseline square system, which we call *carrier system.*

It is important to note that the contrastive properties act as a *logical modulation* of the information conveyed by the carrier system.

2.4 Analyzing a S&C

Let's now consider the following quadruplet of elements :



A close study of this set leads to the following analysis : *shape, size progression, colour, homogeneity* and *halo* are properties of the carrier system. Among them, only *shape, size progression* and *homogeneity* participate to the contrast. *Texture* varies erratically and is therefore an off-system property. The status of *orientation* is not decidable.

In summary, the carrier system is based on 5 properties and the contrast comes from the deviation of the fourth element, from 3 of these 5 properties. Indeed, the 4th element is a *large heterogeneous cross* instead of being a *very-large homogeneous square*, which can be visually depicted as :

3. FORMALIZATION

3.1 Specification of the carrier system

A square system (in its carrier form) can be denoted as :

$$S_0 = \begin{matrix} x_{00} & x_{01} \\ x_{10} & x_{11} \end{matrix}$$

As S_0 forms a square system, a network of relationships exists between its elements :

- horizontal relationship : $x_{01} = f(x_{00})$
- vertical relationship : $x_{10} = g(x_{00})$
- diagonal relationship : $x_{11} = f(g(x_{00}))$

This can also be stated as a logical proposition :

> x_{11} is to x_{10} what x_{01} is to x_{00}
> and
> x_{11} is to x_{01} what x_{10} is to x_{00}

This is nothing else than the *generalization* of the well-known "rule of three", i.e. the relationship between 4 numbers forming a *system of proportions*.

Note that f and g may apply only to a subset of the properties of the elements of S_0 (which we will call *structuring* properties of the system).

Altogether, the carrier system boils down to a seed element (x_{00}) and a *redundant* network of relationships (f, g and fog).

3.2 Formulation of the contrast

Following similar notations as in the previous subsection, the system & contrast can be noted :

$$S = \begin{matrix} x_{00} & x_{01} \\ x_{10} & z \end{matrix}$$

Whereas the horizontal and vertical relationships (*f*, *g*) remain identical to that of the carrier system, we now have a specific diagonal relationship : $z = k(x_{00})$, with $k \neq fog$.

A contrast results from the *disparity* between k and fog and this disparity can itself be viewed as a *function* γ which relates the actual element z to the (virtual) *expected* one $x_{11} = (fog)(x_{00})$, i.e :

$$\gamma = ko(fog)^{-1}$$

As a result of the presence of the contrast, we have now the following situation :

> z is <u>not</u> to x_{10} what x_{01} is to x_{00}
> and/or
> z is <u>not</u> to x_{01} what x_{10} is to x_{00}

Element z is breaking the "natural" flow of events and creates a logical rupture. Function γ thus appears to create a discordance in the system, which incidentally conveys some additional information which can be decoded by first deducing and then factoring out the properties of the (aforesaid) *carrier* square system S_0.

3.3 Visualization of the S&C model

Figure 4 below depicts a square S&C as a diagram representing elements x_{ij} and z together with the network of relations f, g and γ. The black line with double arrows represents the order in which the elements occur if the S&C is unfolded in time as : $x_{00}\ x_{01}\ x_{10}\ z$.

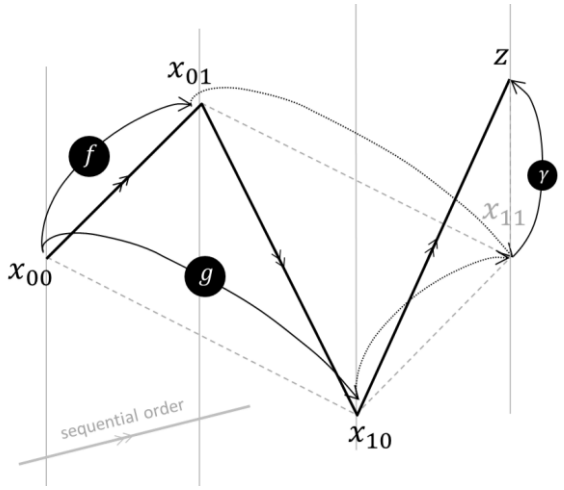


Figure 4 : a schematic view of the S&C model components for an unfolded square system

4. THE S&C MODEL FOR MUSIC

In this section we discuss how the S&C model applies to music, and in particular how it is suited to describe the inner organization of structural segments.

We consider S&Cs whose elements are musical fragments with typical size of a few seconds and which relate through *simple-to-detect* syntagmatic relations.

From now on, we represent square systems in an unfolded way rather than as a matrix.

4.1 Musical information layers

As mentioned in the introduction, by musical information layer, we mean any property of the musical content which evolves in an *organized* manner at the snap scale, in the sense that it can be accurately described and tracked at that scale by a sequence of levels, values or states which samples its behavior over time and range.

A non-limitative list of these properties is :

- Melody / melodic contour
- Harmony / harmonic progressions
- Rhythm / rhythmic cells
- Energy distribution and flow
- Drum sequences and loops
- Chant (phonetic flow)
- Rhymes in lyrics
- Arrangements and supports
- Special effect schemes
- etc…

Musical information layers must be distinguished from musical sources (i.e. the actual vehicles of the musical substance). It is also worth noting that macroscopic musical properties, such as tonality, modality, tempo, timbre, etc... which usually vary at a slow rate, can acquire the status of musical information layer (within the morpho-syntagmatic bandwidth), if they happen to create *patterns* in a passage.

The identification of musical information layers is a key step in the analysis of the inner organization of structural units. However, the S&C model indifferently applies to any combination of musical information layers, i.e. independently of the actual musical substance of the structural segments.

4.2 Morphological elements

We assume that the typical basic elements of the system (namely the x_{ij}) are musical fragments whose typical span is 4 snaps (i.e. 2 bars). However, they can occasionally be twice smaller, twice larger or irregular (variable number of down-beats).

4.3 Syntagmatic relationships

As the carrier system must be easily self-deducible, syntagmatic relationships *f* and *g*, are prone to be rather simple. For instance : *identity, translation* (shift on the scale)*, inversion, complementation, transposition, quasi-repetition, hold, suppress, augment, decrease, …*

Of course, not all morphological elements show obvious relationships on all musical layers. It is sometimes impossible to formulate a simple correspondence, and the syntagmatic relations must be understood as a *de facto* mapping function from one element to the other, which we will denote *new*.

However, it is generally the case that, within a structural segment, one or several layer(s) form(s) an obvious syntagmatic network of relations which thus ensures (and signals) the overall cohesion of the segment. It must also be noted that comparable lower scales systems usually develop simultaneously within the segment).

Concerning the contrast, "low-complexity" functions are frequently used, and the special case when $\gamma = id$ (no contrast) leads to the (flat) realization of the carrier system.

4.4 Morpho-syntagmatic patterns

In this section, we denote as *a* the seed element (previously x_{00}), to simplify the notations.

Given the network of syntagmatic relationship *f*, *g* and γ, the unfolded sequence of morphological elements can now be written :

$$a \;\; f(a) \;\; g(a) \;\; \gamma(g(f(a)))$$

The use of the identity function (*id*) for *f* and/or *g* on some layers is rather frequent and leads to typical patterns. Let's therefore consider the special (*id-or-new*) case when one of the relations *f* or *g* within the system is either *id* or *new*, and let's denote as *b*, *c* (and later *d*)*,* distinct elements from *a* (and from one another).

Generating all S&C based on a *id-or-new* network of functions yields the following 8 patterns (two of which being particular cases of the others, where *c* = *a*) :

f	*g*	Non-contrastive ($\gamma = id$)	Contrastive ($\gamma = new$)
id	*id*	*aaaa*	*aaab*
id	*new*	*aabb*	*aabc (aaba)*
new	*id*	*abab*	*abac (abaa)*

Table I : list of typical morpho-syntagmatic patterns generated by the S&C model (*id-or-new* case)

The patterns listed in table I indeed correspond to configurations frequently observed in music pieces, especially in pop music, at typical scales between 8-10 seconds up to 25-30 seconds.

These particular patterns turn out to be very easy to detect, as identity (or "*close-to-id*") is undoubtedly the most easily deducible function within a S&C, whichever musical information layer is involved.

Seven other patterns can be obtained as the combination of 2 to 4 distinct elements (see Table II). Three of them are analyzable as contrastive S&Cs, whereas the other four may happen to be constrastive or non-contrastive, depending on the actual relationship of the last element with the other ones : for instance, in *abbc*, it depends on whether there exist a simple function which relates *c* to *b* in the same way as *b* is related to *a*.

Patterns of tables I and II can easily be generalized to "*close-to-id*" (quasi repetition) or to "*begins-like*", which are very frequent relations between morphological elements, such as *aaa'b*, *aba'c*, *aa'bc*, etc…

f	*g*	Constrastive or non-contrastive	Contrastive
$new_{a \to b}$	$new_{a \to b}$	*abbc (abba)*	*abbb*
$new_{a \to b}$	$new_{a \to c}$	*abcd (abca)*	*abcb, abcc*

Table II : list of secondary morpho-syntagmatic patterns obtained as combinations of 2 to 4 distinct elements

Note also that in the particular case when $g = f^2$, the sequence of carrier morphological elements forms a *regular progression* : $a\ f(a)\ f^2(a)\ f^3(a)$ which can be inflected in the last position by applying the function *new* as a contrast to $f^3(a)$, thus yielding $a_1a_2a_3b$.

It therefore becomes clear at this stage that the S&C model is able to encompass a wide variety of well-know morpho-syntagmatic patterns under a unifying (and simple) framework.

4.5 Correspondence with musicological concepts

Clearly, there is a direct conceptual connection between the S&C model and the *carrure* as mentioned by Fetis [6] and used extensively by Mozart. Also, the contrast (as defined here within the S&C model) can be viewed as an element that punctuates and concludes the flow of a musical segment, thus constituting some sort of morpho-syntagmatic *cadence*.

Furthermore, Schoenberg [7], and after him Caplin [8], define two types of structural segments, referred to (by Caplin) as *formal types* : the *period* and the *sentence*. Both types are normatively 8-bar segments, even though they may last 16 or even 32 bars. They begin with what Schoenberg calls a "two-measure phrase" (Caplin, a "two-measure idea", or a "basic idea"), which occupies the first quarter of the segment (typically our morphological element).

The difference between the period and the sentence lies in the way the repetition of the basic idea is handled.

- In sentences, the basic idea is repeated immediately so it is presented twice in a row, forming what Caplin calls the *presentation*. The second part of the sentence, the *continuation*, can either be the result of transformations (or formal processes)[1] of the presentation, or the presentation of new ideas (cf. function *new*).
- The period differs from the sentence in the postponement of the repetition. This is done using the introduction of what Caplin calls a "contrasting idea[2]" between the two occurrences of the basic idea, which normatively lasts a quarter of a period. The first half of the period is called the *antecedent*, and the second half the *consequent*.

A period may therefore normatively be written as *abac*, with *c* being unspecified. As for the sentence, it may be written as *aabc*, with both *b* and *c* being unspecified.

It is altogether extremely positive to note that the S&C model encompasses, under a single framework, the two major formal types of musical segment constructions identified by expert musicologists and musicians and extends them further.

Figure 6 illustrates a variety of S&Cs analyzed on 3 passages of pieces from different music genres.

5. EXTENSIONS TO NON-SQUARE SYSTEMS

Up to this point, focus has been put on systems composed of 4 elements, which constitute some sort of canonical configuration (which we will codify, by rendering its matrix *shape*, as 2×2).

However, the principles behind the square S&C model can be extended to non-square configurations so as to enable the analysis of configurations of fewer (2, 3) or more (5, 6, …) morphological elements. This is what we discuss in this section.

5.1 Dyadic systems

Even if we consider a timescale where structural blocks are typically composed of 4 morphological elements, there happens to be, at that timescale, segments with systems consisting of 2 elements, which we call dyadic (and codify as 1×2). They usually appear either as a repetition *aa* or a difference *ab* and they can be analysed as a square S&C at the immediately lower half-scale.

The immediate repetition of a dyadic system forms naturally a non-constrastive square system : *aaaa* or *abab* and this situation is frequent in some types of pop music. Such situations can be codified as a $2 \times (1 \times 2)$ shape.

5.2 Triadic systems

Triadic systems can be viewed as a singular class of square systems where function *g* (and the corresponding morphological element x_{10}) is missing. The typical triadic carrier system can be written as : $a\ f(a)\ f^2(a)$ and its contrastive form is $a\ f(a)\ z$, where $z = \gamma(f^2(a))$. Its shape can be codified as 1×3.

In particular z can be close-to-identity variants of a or $f(a)$ (i.e, $\gamma \approx f^{-2}$ or $\gamma \approx f^{-1}$), yielding *aba* or *abb* triadic patterns. Note also that, if $f = id$ (but γ is not), one obtains the pattern *aab*.

[1] This resonates well with our concept of syntagmatic function.
[2] In the present report, the "contrasting idea" does not strictly correspond to a contrast, but to an *opposition*.

5.3 Truncated square systems

Some triadic segments can also be analyzed as particular cases of *square* systems. Those correspond to situations where the segment can be understood as the realization of a square system for which the contrastive function γ is the "*delete*" function.

This yields a sequence of morphological elements which can be denoted as : $x_{00}\ x_{01}\ x_{10}\ nil$, where nil denotes the total absence of musical substance (i.e. not even "silence", but "what comes next in the piece", i.e. typically, the beginning of a new system). The inner organization of truncated square systems can be codified as $2 \times 2 - 1$.

5.4 Pentadic systems

Pentadic systems (i.e. systems formed of 5 morphological elements) are, in practice, very common in music. However, this is not in contradiction with the use of a square model. Indeed, pentadic systems can be reduced to a square system (*stem*) enriched by the insertion of an additional element (which we call *affix*). The affix can be either the (near-)repetition of one element of the system, or the importation (usually in 4th position) of a completely new element, before the actual contrast.

Table III inventories the typologies of pentadic systems and figure 5 illustrates S&C networks for a few of them.

Configuration	Contrastive form	Shape codification
Prefix	$x_{00}\ x_{00}\ x_{01}\ x_{10}\ z$	$1 + 2 \times 2$
Suffix	$x_{00}\ x_{01}\ x_{10}\ \ z\ \ z$	$2 \times 2 + 1$
Delayed contrast	$x_{00}\ x_{01}\ x_{10}\ x_{11}\ z$	$2 \times 2\ :\ 1$
Redundant infix	$x_{00}\ x_{01}\ x_{10}\ x_{10}\ z$ $x_{00}\ x_{01}\ x_{01}\ x_{10}\ z$	$2 \times 2\ \&\ 1r$
Extraneous infix	$x_{00}\ \ x_{01}\ x_{10}\ \ y\ \ z$	$2 \times 2\ \&\ 1e$

Table III : inventory of contrastive configurations of pentadic system (derived from square stems)

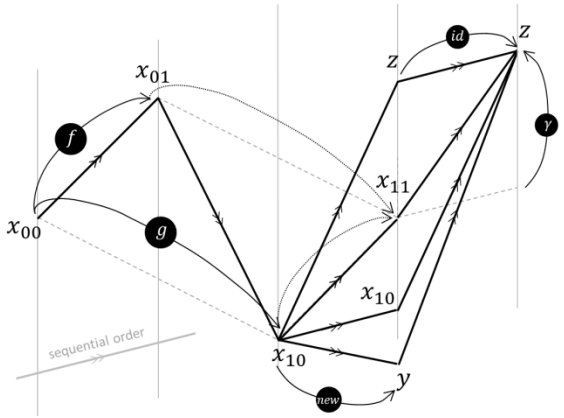


Figure 5 : diagram illustrating the S&C network corresponding to the most frequent pentadic systems

5.5 Hexadic systems

In their general form, hexadic systems are defined on the basis of 3 syntagmatic functions *f*, *g* and *h*, and they can be viewed as *rectangular* rather than square. Two categories of rectangular carrier systems must be distinguished depending on which way they decompose, but some other hexadic forms are better explained as a square S&C in which a double infix is nested, itself forming an independent dyadic system ($b\ h(b)$) (see table IV).

Formalization	Shape
$a\ f(a)\ g(a)\ h(a)\ f\big(h(a)\big)\ g\big(h(a)\big)$	2×3
$a\ f(a)\ g(a)\ f\big(g(a)\big)\ h(a)\ f\big(h(a)\big)$	3×2
$a\ \ f(a)\ \ g(a)\ \ b\ \ h(b)\ \ f\big(g(a)\big)$	$2 \times 2\ \&\ (1 \times 2)$

Table IV : S&C formalization of hexadic carrier systems

5.6 Larger systems

Heptadic segments can be analyzed as various affixed versions of square or rectangular systems : 2×3 & 1, 3×2 & 1, 2×2 & (1×3), 2×2 & $(2 \times 2 - 1)$,…

Quite naturally, octadic (cubic) and nonadic systems usually shape as $2 \times 2 \times 2$ and 3×3 respectively, the former being quite common, while the latter, very rare.

6. CONCLUSIONS

The S&C model offers a powerful formalism for defining and characterizing structural segments. It accommodates the diversity of musical substance with *versatility* and shows *polymorphism* by being able to explain a wide variety of morphological forms under a unified framework.

The S&C model is used as one of the key concepts to produce structural annotations of a database of 500 music pieces (segment boundaries *and* labels) [9] : in [5], we illustrate how the detection of a multi-layer network of syntagmatic functions constitutes a decisive cue for identifying segment boundaries, and how the distinctive properties of two S&C offer a relevant criterion for the determination of segment labels.

In automatic MIR, the S&C model is expected to lead to new algorithms for automatic structure extraction. It is also bound to be a base for the design of new music language models, which would model separately the morphological elements and the syntagmatic networks, thus providing powerful generalization capabilities.

Beyond MIR, the S&C model may also exhibit great potential in computer-assisted musical creation and composition, as well as in music education and teaching.

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[8] William E. Caplin : Classical Form : A Theory of Formal Functions for the Instrumental Music of Haydn, Mozart, and Beethoven. Oxford University Press, New York, 1998 (pp. 9-12).

Acknowledgements

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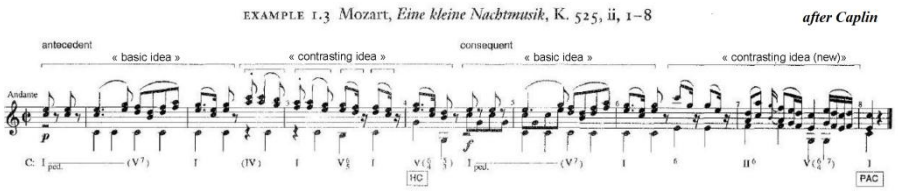
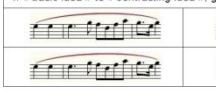
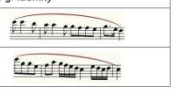
MUSICAL EXAMPLES

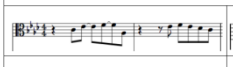
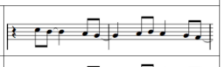
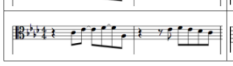
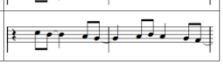


Harmony for each downbeat: [a b a c], system with contrast. *f: new, g: identity*	
I - I - V7 - I	IV - I - V I - V (half cadence)
I - I - V7 - I	I - II - V - I (perfect authentic cadence)

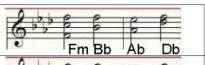
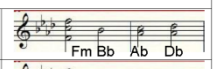
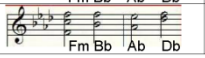
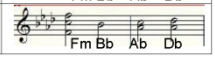
Melodic pattern: [a b a c], system with contrast. *f: « basic idea » to « contrasting idea », g: identity*	
	

EXAMPLE II Nirvana, *Smells like Teen Spirit* ("Nevermind", Mobile Fidelity Sound Lab 1991), first verse (00:33-00:50)

Rhymes: [a a b b], system without contrast. *f: identity, g: new*	
« ... your friends »	« ... pretend »
« … assured »	« ... word »

Vocal line: [a b a b], system without contrast. *f: new, g: identity*	
	
	

Drum loop: [a a a b], system with contrast. *f: identity, g: identity*	
	
	

Corr. perfect chords: [a a' a a'], system without contrast. *f: identity, g: identity*	
	
	

EXAMPLE III Sean Kingston, *Take you there* ("Sean Kingston", Epic International 2007), first verse (00:16-00:33)

Rhymes: [a b c b], system with contrast.	
« We can go to the tropics Sip piña coladas »	« Shorty I could take you there »
« Or we can go to the slums Where killas get hung »	« Shorty I could take you there »

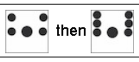
Vocal layout: [a a b c], system with contrast. *f: identity, g: addition of two top layers*	
	
	

Figure 6 : examples of S&C analyzed and represented as contrast tables
from three pieces of various music genres

In these examples, various systems co-exist on several musical layers at a time and they participate to the morpho-syntagmatic consistency of the segment. Ex. 1 mainly exhibits an *abac* system on the melodic and harmonic layers. Ex. 2 is based on the superposition of three carrier systems *aabb* (rhymes), *abab* (vocal line) and *aaaa* (chords), while the drum loops forms the sole contrastive system : *aaab*. Ex. 3 illustrates a case where the contrast is produced by the vocal layout (schematically represented on the right-hand side of the contrast table) while all other musical layers (melodic line, harmony, etc…) are non-contrastive at that timescale. Note however that the lyrics (left-hand side of the contrast table) form an *abcb* pattern which can be viewed as a secondary form of S&C.