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NonTonalAnalysis: a different approach to the analysis of atonal chords: achieving a clearly perceivable directional logic in atonal harmony

1. Introduction

When the musical system of tonality has been left aside, we have also abandoned a certainty, a commonly accepted system that ensured the possibility to build chord sequences that surely were to sound logical and consequent. Now, a standard method to ensure a feeling of consequentiality (and then a feeling of Sense, of proceeding towards a Destiny) does not exist any more; on the contrary, the need to make the listeners perceive in what direction a music will go on has become more and more attenuated in many composers, in my opinion proceeding side by side with a loss of clarity about the sense and direction of the life itself, so typical of the present age. Besides, also in the domain of the contemporary music a tendency to the creation of static, repetitive, hypnotic atmospheres has been spreading all about us in the last years, partly owing to the influence of certain vaguely Oriental conceptions. Facing all this, I have been concerned, since fifteen years ago, with doing some research to find a solution to what seemed a problem to me. I simply tried to start from the observation of reality: that is, I sometimes felt that a given succession of two atonal chords sounded more logical and more consequent than other ones, and I started to wonder why it was so. I wondered: how does the atonal harmony work when we feel that "it works", that is when it has an appropriate and clear effect? What is it lacking in it when, on the contrary, we feel that "it doesn't work" properly? In other words, I tried to do some research on the hypothetical rules that could govern a system of atonal chords, to order them in logical and consequent successions, just in the way that chord sequences based on tonality used to sound logical and consequent. I tried to obtain something that could work as a common shared technical basis, so that classical European music will not be obliged to put aside something that has always been one of its essential features: a feeling of consequentiality, indeed, a feeling of being proceeding towards a ultimate final goal, a sense given by its directionality, by the presence of a clearly perceivable thread in the music. We shall therefore begin this short paper asking some questions that probably many of you have already examined many times trying to answer them in many ways, especially those of you that are composers or musicologists: if we consider two atonal chords of any kind, which is the most dissonant one? And how much? Do they have a dissonant effect for the same reasons or for different ones? How will I build another chord having a degree of dissonance placed between those two, to connect them without perceivable disparities? And which of the two chords is more similar to a given third chord, in its sound and therefore in its structure? How could I obtain the complete list of certain chords that fulfil some given precise characteristics with regard to interval composition and range? To what extent some given chords that a composer imagines recall the traditional world of tonality? What are the right chords to put under a given atonal melody? I, too, have wondered about these and many other similar questions since the period in which I was composing my first pieces, and I have pondered much on the methods to follow to answer them, through many trials, until I reached - by now - some convictions that led to the development of the first public version of the software with which this paper deals. "NonTonalAnalysis" (that from now on we shall often call "NTA") is a simple computer program developed since 1995 by the author of these words, to analyze atonal music chords (and, in the future, also chord sequences and atonal melodies) It is conceived as a practical tool for a frequent and daily use, for composers, musicologists, performers that want to understand deeply the pieces they play, and music students. It is not based on ideas borrowed by serialism or dodecaphony, but, on the contrary, it rather uses concepts like the calculation of the dissonance level of each chord

and the classification of the atonal chords in families according to their interval structure (and therefore to their sonority). All the parameters of the program can be customized by the user, that can in this way define in details what is to be considered "dissonant" or "tensive", or, on the contrary, consonant and smooth.

The approach of this program of mine, NonTonalAnalysis, can be described as follows:

1) Given two atonal chords of any kind and of any number of notes:

- find a method to decide which one is the most dissonant or the most consonant.
- find a method to decide which one has the richest and most complex sound.
- find a method to build among them a third chord to connect them without perceivable disparities.

2) Given three atonal chords of any kind and of any number of notes, find if the first of them is closer to the second one or to the third one in its sound and sonority.

Of course, it depends on the intervals they contain.

The purpose of all this is to discuss whether we can build sequences of atonal chords having a clearly perceivable directional logic, e.g. from the most consonant one to the most dissonant one, or from the one that has the poorest sound to the richest one, in order to achieve a feeling of consequent development in the music (so that a listener can follow it better), like the one that we can hear in tonality-based music, but this time doing so in a completely atonal piece. I think it would be important for composers to exchange ideas with others who really think that these problems may be important in contemporary music, and I would help people to rediscover the importance of a narrative thread and directionality in music and moreover in atonal music.

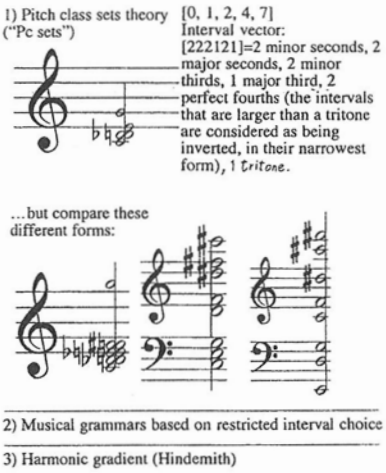
So, to begin with, I believe that graduating attentively the perception of dissonance and consonance (in a word: beatings) is the best way a composer of atonal music can choose to build passages, chord sequences, melodies and tone colours that sound as logical, natural and consequential as the tonality-based passages used to sound, so that the listener follows the music, feeling that its development is completely natural and consequential. Other means that NTA has to help obtaining this goal are the possibility to classify atonal chords in families according to their tone-colour (and therefore to their structure) and the possibility to measure the richness of the chords' sonority in order to graduate this parameter or to set apart chords with a poor and simple sonority, distinguishing them from the chords with a rich and complex one.

2. Chord and timbre

As it is well known, starting as early as in the time of Debussy (but even earlier, with Satie) the western classical music started to use chords that were still those of the tonality-based tradition, but were not connected according to the habits and rules of the classical harmony. That is, they were still elements of the tonality-based vocabulary, but the rules according to which they were connected to each other were no more based on tonality. In this way they form structures in which a chord is not important for the reason that it represents a certain tonality region (tonic, subdominant, dominant) in a harmonic cadence, but for the reason that it produces a tone colour, a given timbre or sonority. The interval structure, therefore, causes the formation of a particular tone colour, that, if we keep the notes in the central compass and if we play each note with the same dynamics, does not change when the chord is transposed on other notes. It is easy to realize, for instance, that many pieces by Debussy, by Satie, like some by Bartok, by the early Schoenberg and many others are marked by the presence of precise orders of particular timbre areas in a well defined succession, and that these timbrical areas are in their turn marked by the use of certain precise chords, that are actually used as tone colours, timbres. As a matter of fact, the coincidence between chord and timbre is fully confirmed by acoustics: the tone colour of a sound is mainly due to the composition of its acoustical spectrum (not mentioning its dynamic envelope), that is to the reciprocal ratios of the intensities of the different harmonics that form this spectrum, or of the different formants. In their turn, harmonics and peak frequencies of the formants are precise pitches, like the notes of a chord. We can therefore regard any timbre as a chord, a non tempered one, of course, and any chord can vice-versa be viewed as a timbre.

3. Summary of some previous methods for the study of atonal harmony

There are three methods of study, analysis and use of atonal harmony, different from NTA, which will be recalled here very shortly (see Figure 1):



3.1 The"pc sets": success and limitations

We do not have the space here to describe in a proper way the important analytical method of the pitch class sets (pc sets) elaborated by Allen Forte in various work in the Sixties and Seventies (and particularly in Forte, 1973), a method based on concepts borrowed from the mathematical set theory and specifically conceived for atonal music (a short description of the method can be found in Bent, 1980 and in Cook, 1987). However, we must notice that in this method a chord or note set is always reduced in its most narrow form, so that the distance between its lowest note and its highest not is as little as possible, and its inversions are always assimilated to this narrowest form and considered equivalent to it (please keep in mind this fact while we are going on, because, on the contrary, NTA behaves differently on this point), then its notes or pitches are represented by numbers according to the habits of the mathematical set theory, with a unit corresponding to one semitone, always starting from the lowest note of the narrowest form of the chord to measure intervals. For example the chord C, Db, D, E, G (or also C#, D, D#, E#, G#, because transpositions have no importance) is indicated as [0, 1, 2, 4, 7]. One can also give this group of notes (pitch class set o pc set) a code of six numbers that indicates its interval composition (Interval vector): in our example it will be [222121] because our note group contains two minor seconds, two major seconds, two minor thirds, one major third, two perfect fourths (the intervals that are larger than a tritone are considered as being inverted, in their narrowest form), and one tritone. Any possible group of notes has thus its identification code. Some different pc sets exist that have the same interval vector (they are called Z-related). The analyses made with the pc sets method consider the groups of pitches as sets, for instance searching for common subsets shared by different sets, or for relationships between complementary sets (in which each set contains exactly the pitches that the other one lacks) with important functions in the piece, or larger groups called "set complexes", trying to individuate the basic structures of an atonal composition. Many computer programs have been developed that find and analyze pc sets, for example RowBrowser, SetBrowser, Setmaker, Atonal Analyzer, GetSet, RECREL and Patchwork, and some specialized Internet sites are entirely dedicated to them. The pc sets method has reached a great success and it has become almost a standard among the musicologists. It has nevertheless undergone severe and sharp critic opinions, particularly with regard to the lack of objectivity of the exact individuation of the pitch sets on a musical score, and the criteria of their separation from the preceding and following ones when analyzing a piece. This method has also many other evident limitations: for example, it does not consider in any way the register of the instruments, their dynamics, and moreover their timbre. In my opinion two enormous limitations are also the fact that it ignores completely the difference in musical effect between the vertical arrangement (that is, in chords)

and the horizontal arrangement (that is in "melodic" lines) of the same notes, and moreover the idea - borrowed by traditional harmony - that leads to regard as completely equivalent a given group of notes (or chord) and its inversions, when classifying and naming them. If used unrestrictedly, this approach can lead to deeply abstract results that are far away from the real musical meaning of passage that we analyze. The main point is, in my opinion, that, while in the tonal harmony a chord has always a root tone, so that also when it appears in one of its inversions we can always individuate that particular root note and say, for instance, that C, E, G and E, G, G are both C major triads, if we consider a chord from a really atonal point of view, in my personal opinion that is not shared by some, simply it does not have any root tone and, owing to the fact that normally the harmonic content of a chord depends mainly on its lowest notes, we should absolutely take into account the real, concrete arrangement of the notes in lower or higher notes to classify that chord in a way that takes into the proper consideration its real musical effect. It's unlikely, for example, to imagine that many people will not perceive a serious gap between the real musical effect and the analysis data of they classify in the same way the chord C, C#, D, D#, E, F, F#, G (with G a minor ninth above F#), the chord C, E, G, F, C#, D# (a ninth above C#), F#, D and the chord E, D, G, C, F, D#, C#, F#, owing to the fact that, though they are formed by the same notes, the first one is arranged mainly by minor seconds and minor ninth, in the second one the thirds have a great importance, and in the third one the perfect fourths prevail, with very different musical effects. Without claiming to be the only way to do it, NTA tries to go beyond these serious limitations that are so typical of the pc sets method. Actually, musicologists have praised NTA mainly for its capability (not present in the standard pc sets method) of taking into consideration the greater influence that the lowest notes of a chord have in establishing its total sonority.

3.2 Musical grammars based on a restricted interval choice

A second approach, sometimes used as a complement to the first one, is expressed by the musical grammars based on a restricted interval choice. An example of this method is the software called R.I.C.E. (Restricted Interval Counterpoint Engine) by Jirrah Walker, but similar results can be obtained with Patchwork, or Bol Processor by Bernard Bel, or Max, for instance (programs that, of course, have also many other functions). Generating a grammar based on a restricted interval choice is probably what the most part of the contemporary composers of atonal music do: in a few words, it means to define some intervals as preferred if compared to others and to generate note sequences that contain them in a prearranged order or with prearranged precise limitations: for example, a given interval must appear only before or after another one, or only in a certain compass, or only in the original form and not in the inverted one, or only with certain note durations or with certain dynamics, or it must always be excluded or, on the contrary, it must appear with a statistically higher frequency than others, and so on. In this way some well defined syntax rules are established, that can generate a potentially very high number of note sequences that follow them, that will constitute in a second phase the materials from which the composers will choose while composing the real and final piece, like a painter who chooses from its palette after having prepared all the colors that he thinks he could need. This method has led to the creation of countless compositions and has an enormous diffusion, and it has the unquestionable merit of allowing a rather precise control on contrapuntal structures. Many people have nevertheless noticed many problems in it: for, instance, some composers that follow this approach have the habit of - once again - underestimate the practical difference in their effect between a vertical arrangement (in chords) and a horizontal arrangement (in "melodic" lines) of the generated notes, usually resulting in a worse capability of controlling in a really refined way the harmonic effects of chords. Besides all this, let me describe my perplexity towards what I consider a debatable use of this method. I think, in other words, that sometimes people may use it to generate some note sequences (that will be used as their materials) having as their only purpose to avoid always some particular interval relationships they don't like, thus obtaining a cheap interval and harmonic coherence, but with the detrimental side effect of a probably too high degree of randomness and uniformity: they do not seek a method to build in details what they think necessary, but only a method to exclude what can generate problems: in this way, once they have avoided the problematic intervals, the criteria used in building each passage may also be chosen at random, without

being regulated by a method. If you let me make an extra-musical comparison, it's like to forbid wrong behaviours without trying to focus on the good ones. If this method is used in this way, the excessive randomness prevents the listener to perceive harmony as a means to create tension or relaxation in his mind, moment after moment, thus helping him to perceive the form of a piece or of a passage. This can even be a desirable situation for some people and a matter of no importance for others, but my point of view, of course not shared by some other people, is that I find something that is deeply unmusical in this approach. NTA has indeed been created also to help a composer in using a completely atonal harmony in a way that is functional to the definition of a musical form, and to the creation of tension and distension arches, both in a passage made of a few notes and, as well, in a long musical form.

3.3 The harmonic gradient: hypotheses in the causes of a long period of disregard

A third approach that shall be recalled here is the one defined by Hindemith (Hindemith, 1937). He used well-defined theoretical bases to classify all the harmonic intervals according to their degree of dissonance. A pair of notes played together can therefore have a high degree of consonance (perfect fifths, major thirds), a high degree of dissonance (minor seconds), or can have a middle position (for instance minor sevenths). A composer can therefore build his musical phrases graduating the perception of consonance and dissonance through a wise and calibrated use of the different harmonic intervals and their proper positioning, thus obtaining chords having a low, middle or high degree of dissonance and in this way gaining the control on the development of form and structure in a musical phrase, by orienting it as he wants towards an increase or a reduction of tension. For the first time a theoretical work introduced again the old concept of tension and distension, or dissonance and consonance, stating its necessity and from this point of view explicitly recalling the past tradition and tonality, but giving a method to control these parameters that in itself was not completely based on the traditional rules of tonality (examples of passages composed with this or a similar method can be found for instance in Hindemith, 1937, in De La Motte, 1976, in Smith Brindle, 1992 and in Toť, 1997). After a first period of curiosity, the method used by Hindemith was not followed by many composers and was viewed with skepticism or even almost ignored by the musicologists: sometimes they said that it generated always too similar and uniform musical structures, that they were too much predictable, or that, also when one was following its theoretical directions, nevertheless some incoherent passages were obtained that were not working properly when tested in practice. Perhaps this method of the "harmonic gradient", in my opinion not enough explored yet, has been overwhelmed by vogues and prejudices, perhaps it has been almost forsaken on account of the new dodecaphonic concepts according to which the vertical (harmonic) and horizontal (melodic or linear) dimensions should no more be separated, so typical of the serialist and post-serialist approach, sometimes until our days. In front of such innovations, the concept of "non tonal rules for harmony" has probably been considered out-of-date and moreover useless. In my opinion, on the contrary, the theory of harmonic gradient is still nowadays one of the most provoking ideas to help us understand the problems of contemporary music and also of its relationship with the audience, especially if it is an audience of European cultural background (sometimes I dare wonder: do they have abandoned it because it deals with unresolved subjects?), and I think that some incoherencies noticed by some musicologists in the practical examples are probably due to the extremely frequent use in Hindemith's works of triads and chords that, considered one at a time, were borrowed by the tonal tradition and could therefore, sometimes also unconsciously, generate chord successions and hidden logical processes based on the traditional tonality, sometimes also contrasting with the stated logic structure based on the harmonic gradient and with the tension or distension changes in the passages as predicted by Hindemith's theory. This situation was partly unavoidable: Hindemith - and on this point I do not agree with him - believed that all the possible chords should always have a root tone, and so his approach remained, at least in part, really tonal and involved as ordinary means the use of techniques linked to tonality. On the contrary, I think that his work may appear in all its importance only if we reinterpret and adapt it in the context of a completely atonal musical system, that is a system in which we measure the degree of dissonance of the chords without depending on a pretended determination of a root tone in them.

4 The birth of NonTonalAnalysis

4.1 Versions 1.0 and 1.1 (1995-1996)

In 1995, after many reading, analyses and experiments, and with the main purpose to satisfy my own needs as a composer, I created the first version of NonTonalAnalysis (NTA), version 1.0, soon corrected into version 1.1 with the addition of a manual. It was not an stand-alone application, but a set of documents written in a strange mixture of Italian and English, including:

- a database of analysis data for 3-notes and 2-notes chords,
- a spreadsheet to find by interpolation the correct data for 4 to 12-notes chords on the basis of the 3-notes chords that they contain,
- a second database to store these new data and
- a second spreadsheet to analyze atonal melodies note by note.

All the documents were designed to work under the well-known application ClarisWorks 2.1 and were linked together by macros that selected, copied, calculated and transferred data automatically from one module to another.

The method used to find D-index was completely different from the one used in the later versions, because it was based on different concepts. Any 3-notes chord was considered as built from the main two - not three - intervals that it contained, and tables (corresponding to the future NTA 2.0 Chord Families) were created in which the chords were arranged in columns and rows (representing these two main intervals) that indicated which voices were forming the main intervals, so that chords could be classified and ordered according to their position in the tables. This was very interesting and gave good results. (See Figure 2).

The mark " ' " written after a note indicates that it forms a ninth with the preceding note.
MB means "Middle note and Bass note",
SB means "Soprano (=uppermost note) and Bass note,
SM means "Soprano and Middle note".
7m/9M means "minor seventh or major ninth".
2Mdir means "real" major second.
"Combinazione impossibile" means "impossible combination".
LPN is the Linear Progression Number, a number directly related to the final D-index of a chord. Although, this number is **not** the D-index itself, but only a generic basis on which many important corrections are applied to find the real D-index, according to methods that cannot be explained here.
TG is the Tensive Ground, a value shared by all the chords that belong to the same table, that indicates the minimum dissonance index that can be assigned to a chord of that table. It is obtained with a particular method that, too, cannot be explained here. All this is completely explained and described **in Italian** in the NTA1.1 Manual. You can purchase it from the Author.

(Title translation: "Example: the Chord Field table tr/2M")
Esempio: il
quadro tr/2M.
TG=34

tr ↑	7m/9M	2Mdir SM	2Mdir MB
MB	LPN=36 F,B,G F,B,C#'	LPN=37 F,B,C#	LPN=38 combinazione impossibile
SB	LPN=35 F,Eb,B F,C#,B	LPN=36 F,A,B	LPN=37 F,G,B
SM	LPN=34 F,C#,G F,G',C#	LPN=35 combinazione impossibile	LPN=36 F,G,C#

All this is completely explained and described in Italian in the NTA1.1 Manual.

The database for two or three notes chords gave meaningful results, but the data could not be modified in any way and moreover it was not really an analysis software: it did not analyze anything, since it only reported the results of previously made analyses made by the author with unmodifiable criteria chosen by himself. The melody analyzer, too, came out to be too much complicated to use. In 1996 Claris distributed the version 4 of ClarisWorks, in which macros where no more compatible with NTA1.1, having a slightly different format. All these facts persuaded me to begin the development of a new version of NTA, as a stand-alone application program, and a customizable one.

4.2 Version 2.0.1 (1997-1998)

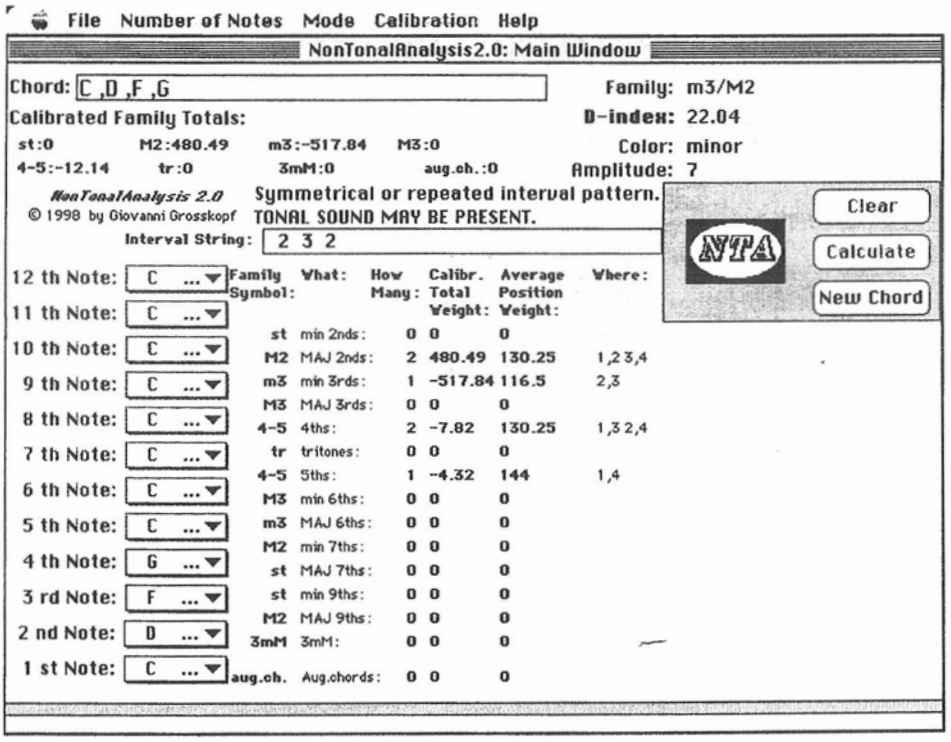
It is the first version created as a stand-alone application Macintosh program, publicly distributed and integrated with a complete manual in English, a FAQ (Frequently Answered Questions) file and a Version History file. The method used in the analysis of atonal chords has been completely changed from the one formerly used in version 1.1 and is described briefly in the following paragraphs. This version is a preliminary one and is the one that is still currently distributed over the Internet.

5 Analyzing an atonal chord with NonTonalAnalysis

5.1 An overview of the program.

This is NonTonalAnalysis in a nutshell (I deliberately do not include some important details in this description, for the sake of clarity):

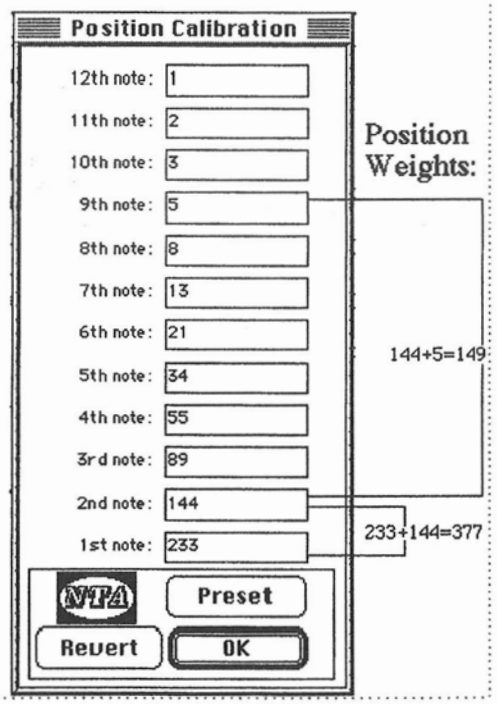
The chord data are shown all in one window. Of course, first the program shows the name of the notes that form the chord, selected by the user. The chord is then labelled with an Interval String, that is the sequence of the distances occurring between consecutive notes of the chord, expressed in semitones (for instance: 2 3 2 for C, D, F, G). (See Figure 3)



This is a sort of rudimentary identification code of every possible chord and it does not change if we transpose the chord on other notes: also according to NTA, indeed, the transposition of the chord does not change the result of its analysis, so all the transpositions of a given chord (but not its inversions!) are analyzed in the same way.

An emphasis number can be assigned to each note position (the lowermost, the second one, and so on through the uppermost, up to 12-notes chords), to indicate, generally, in which measure (if all the notes have the same dynamics) the lower notes give a greater contribute to the overall sound of the chord than the upper notes. This operation is called Position Calibration. In other words: every note, of course, occupies a precise position within a chord. There is the lowermost note, the second one, the third one and so on up to the uppermost note, that, in the case of chords made of twelve notes is the twelfth note. The overall sonority of a chord depends on the intervals that these note form with each other, of course, but an interval can be more or less perceivable depending on the fact that it may be formed by the two lowest notes of the chord, or by the two

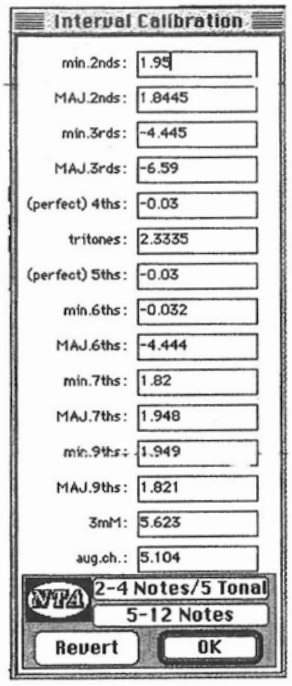
uppermost ones, or by notes positioned within the middle of the chord, or by others. NTA has a very simple way to cop with this problem: the Position Calibration. The user indicates directly the "weight" or importance that each position shall have (the lowest note position, the second note position, the third note position and so on till the uppermost note position), and, from this point of view, it does not matter which particular note will occupy that position. There is also a set of preset emphasis numbers for this. I would be happy to contact other people who know the results of other researches on this subject. Strangely enough, the set of values that in my tests seem to work better has come out to correspond (from the uppermost note down to the lowest one) to the Fibonacci series, that is to the numerical series discovered by the medieval mathematician Leonardo Fibonacci in which each term results from the sum of the two preceding ones: 1, 2, 3, 5, 8, 13, 21, 34, and so on, ending with a value of 233, twelfth term of the series, for the lowest notes of chords made of twelve notes. For example, with the preset values that can be recalled NTA gives a value of 233 for the position of the lowermost note, a value of 144 for the position of the second note and a value of 5 for the position of the ninth note. Let's suppose, now, that we have a chord made of ten notes and containing, among the other intervals, a tritone. This tritone is obviously formed by two notes. It will therefore perceived in a different way if it is formed by the two lowest notes (thus having a "Position Weight" of $233+144=377$) or by the second and ninth note (Position Weight $144+5=149$). The preset values have of course been fixed according to the fact that most people think that the sound of a chord is chiefly due to its lowest notes: the lower a note, the more important and perceivable. (See Figure 4)



Preset values indicate also that the difference in importance between notes that are in different positions seem to be smaller in the chords that are made of a few notes, and larger in the chords made of many notes. For instance, in a chord made of three notes the lowermost note and the uppermost one have a ratio of their "Position Weight" that is equal to 89/233, while in a chord of 12 notes this ratio is 1/233. This means that the uppermost notes of a chord (and it does not matter which notes are they) are usually less perceivable (if all the notes have the same dynamics and timbre) in the chords that are made of many notes than in those that are made of a few ones. The preset values reflect this general opinion, but they are however modifiable at will by the user and all the changes can be memorized in the program.

An emphasis number can be assigned to each kind of interval, to indicate that, in any chord, the presence of some kind of intervals (e.g. seconds) can be noticed more easily than the presence of others (e.g. major sixths). That is, in the Interval Calibration window one can specify how much

any particular interval (minor second, major second, minor third and so on up to the major ninth) shall be regarded as important in forming the overall sonority of the chord, during the analysis, not depending on its low or high position. For example, if the user believes that the presence of a minor second, just in itself, will be perceived within a chord three times more easily than the presence of a major sixth, in this window he will write 3 beside the title indicating the minor second and 1 besides the title that indicates the major sixth. Besides the harmonic intervals (all the combination of two notes from the minor second up to the major ninth, octaves excluded) the program evaluates also two peculiar combinations of three notes that NTA finds automatically, so that the user can give a value also to them: one is the augmented triad, the other one is the so-called "conflict of thirds" (also called by some "Strawinsky's thirds"), identified by the label "3mM", that indicates all those situations in which a major third (or minor sixth) and a minor third (or major sixth) share a common note without however forming a triad, but on the contrary forming a dissonant combination (for instance C, Eb, E, or C, Eb, Cb). The user can recall a group of preset values also here for this purpose. The preset values are in any case modifiable by the user and all the changes can be stored into the program. This operation is called Interval Calibration. Also with regard to this point my tests have revealed a peculiar fact, that is that most probably chords made of more than 5 notes (approximately) are analyzed by the human ear in a different way than the smaller ones: to obtain coherent values I have actually been obliged to fix two different sets of values, to be used the first set with chords made of no more than four notes (excluding the most dissonant four-notes chords) and with the most consonant five-notes chords (see Figure 5), and the other one with all the remaining chords of five or more notes and with the most dissonant four-notes chords (see Figure 6).



Interval Calibration Window, 1st setup:
suitable for all the chords with 2 or 3 notes, for the great part of the 4-notes chords and for the most consonant 5-notes chords

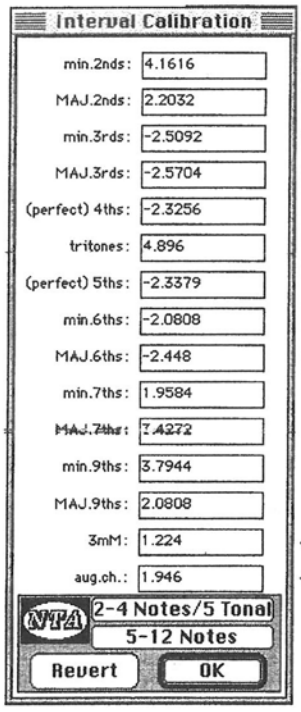
<- (Conflict of thirds, as in C,Eb,E or C,Eb,Cb)

<- (Augmented triad)

Also with regard to this problem I would be glad to contact people that know the results of other researches about this. After all, if we reflect a while, all this is not completely new. In the classical harmony, indeed, we generally use chords made of no more than five notes (the chords of ninth) and all the chords that should be formed by a larger number of notes are generally used omitting some notes in them: this coincidence may not be an accident.

The user introduces the notes of the chord, starting with the lowest one upwards. The program accepts any chord from two to twelve notes, but, by now, programming limitations do not allow the user to introduce octaves and do not allow to surpass the distance of one major ninth between two consecutive notes.

Once we have introduce the desired notes that form the desired chord, the analysis process starts simply by clicking on the button "Calculate".



Interval Calibration Window, 2nd setup:
suitable for the most dissonant 4-notes chords and for all the chords with 5 or more notes (excepted the most consonant 5-notes chords)

(Values of NTA version 1.1)

<- (Conflict of thirds, as in C,Eb,E or C,Eb,Cb)

<- (Augmented triad)

The program finds any interval formed by any pair of notes in the chord (and, as explained, also some particular combination formed by three notes) and indicates the total quantity of appearances for each kind of interval and the position in which each interval appears. If the chord chosen by the user contains major or minor triads or other note combinations typical of the traditional tonal harmony (like diminished sevenths) or chords that may recall it (for example a perfect fifth formed by the two lowest notes), the program recognizes them and warns he user, who is then free to go on, to change the notes he has chosen or to display a partially customizable help window.

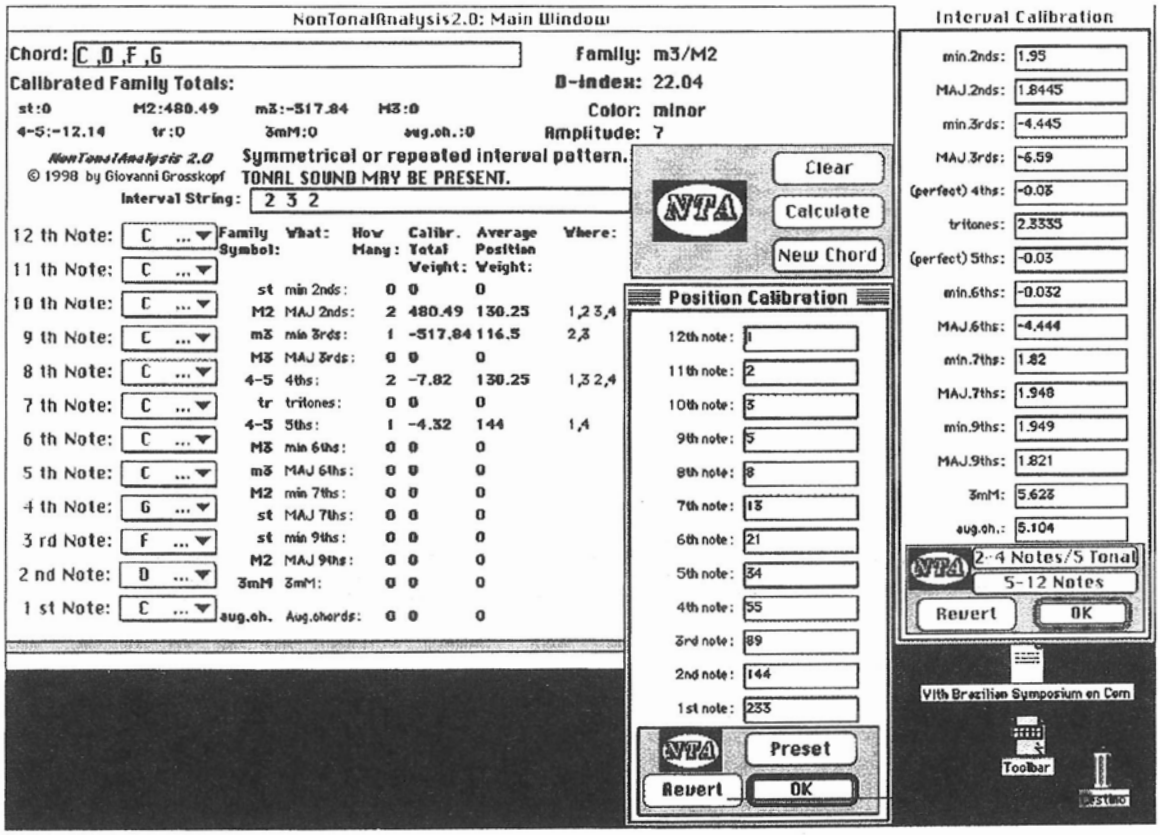
Through a simple algorithm based on all the above values, the program finds the Calibrated Total Weight of each interval and of each Interval Family (an Interval Family is composed by an interval and its inversions, e.g. minor 2nds, major 7ths and minor 9ths form an Interval Family, the 'st' family, short for 'semitone'). The Calibrated Total Weight is the total contribution of each interval or of each Interval Family to the formation of the global sonority of the given chord, taking into account how many times that interval appears (Quantity), the fact that it appears in low, medium or high positions (Position Calibration) and the fact that in itself it may be more or less perceivable than other different intervals (Interval Calibration). The calculation is performed in the following way: the Quantity of occurrences of an interval is multiplied by the user-defined number corresponding to that interval in the Interval Calibration window, then the result is multiplied by the average of the Position Weights corresponding to the positions in which that interval occurs.

Let's make an example of "average of the Position Weights": suppose we are analyzing with the preset values the chord C, D, F, G. The program will immediately find that there are two major seconds in the positions first note-second note and third-note fourth note, then there is a minor third in the position second note-third note, then there is a perfect fifth in the position first note-fourth note and there are two perfect fourths in the positions first note-third note and second note-fourth note. Let's consider the major seconds: one of them shall have a Position Weight of 233+144=377, the other one shall have a Position Weight of 89+55=144. We obtain the average of the Position Weights having (377+144) divided by the number of involved positions, that is 4 (four different positions are indeed involved: the first, the second, the third and the fourth note). The result is 130.25. (This method has been chosen because it works well also when analyzing three-notes combinations like the augmented triads or the combination called "conflict of thirds", combinations that are normally analyzed by the program. The Calibrated Total Weight of the major seconds in this chord is therefore obtained by multiplying 2 (because there are two major

seconds) by 130.25 and then multiplying the result by the number we have written in the Interval Calibration Window related to major seconds.

Having the Calibrated Total Weight as a basis, NTA finds then many other interesting data: the parameters called Chord Family, Color, D-index and Amplitude, that I will now briefly explain (see Figure 7):

A first result is the classification of atonal chords in families. Once it has detected the two



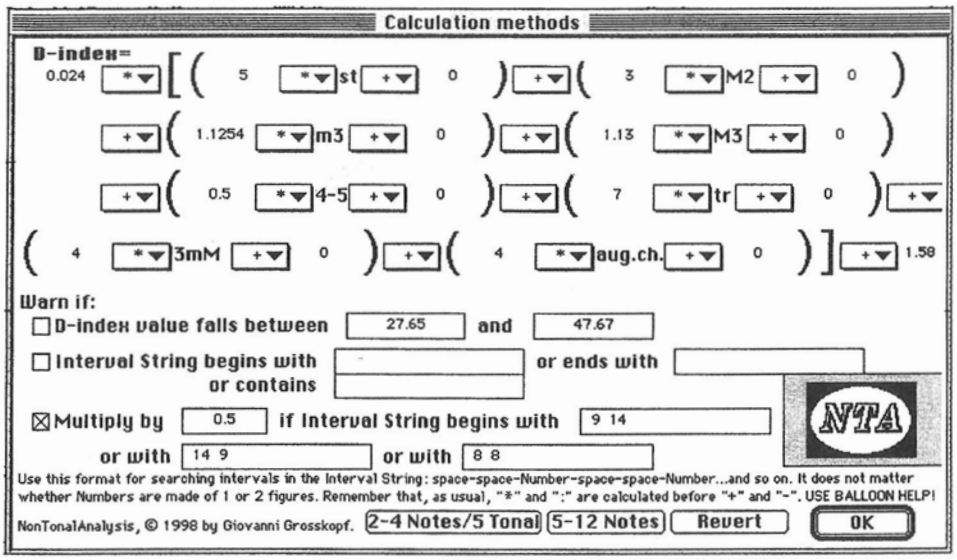
most significant intervals in the chord, their names are chosen to form the name of the Family to which it belongs, and it has been noticed that chords that belong to the same Family have a very similar sonority. The Chord Family is actually a term formed by the name of the two Interval Families that contribute more than others to its overall sound. All the chords belonging to the same Chord Family share something in common in their sound. E.g. the chord C,D,F,G belongs to the Chord Family m3/M2 (minor 3rds/Major 2nds) (this may seem obvious, but it is much less obvious with complicated 10-notes chords, and NTA works also in any complex case!). For instance, the chord C, D#, A, B, D, Bb, C# will belong to the family "st/m3", that is it will have as its most important intervals the "semitones" (in the broad meaning of the word, that is minor seconds or major sevenths or minor ninths) and minor thirds (or major sixths).

The program can then detect the so-called "Color" of a chord. The Color indicates the more or less evident presence of thirds and sixths, intervals that are very important in our musical culture, as everybody knows, and indicates also their nature. It is calculated simply by checking if the name of the Chord Family includes M3 (the Interval Family formed by Major thirds and minor sixths) or m3 (the Interval Family formed by minor thirds and Major sixths), or none of them. Four Colors are possible: Major (M3 prevailing), minor (m3 prevailing), neutral (no thirds nor sixths in important positions, or 3mM (this is the special dissonant case called "conflict of thirds", like in the chord C,Eb,E). The program assumes that this is a dissonance scale, that is that Major is the most consonant Color and 3mM the most dissonant one. This is a first approximate way of measuring the dissonance of a chord in NTA.

The D-index, short for Dissonance index, is of course a number that increases if the chord is

more dissonant and decreases if it is more consonant. It is calculated by a default formula that the user can customize in the Calculation Methods Window, based on emphasizing the Calibrated Total Weight values of the dissonant Interval Families by multiplying them by great numbers and de-emphasizing the Calibrated Total Weight values of the consonant Interval Families by multiplying them by small numbers, and than calculating the overall sum (actually it is slightly more complicated than this, but this gives a good idea). This is the second and more precise way to measure dissonance in NTA. (See Figure 8)

The Amplitude value (see again the previous Figure 7) indicates the distance between the



lowest and the uppermost note of the chord, in semitones.

All the preset values and default formulas are practically derived from hundreds of simple empirical tests on hundreds of chords, made by me. I like very much to proceed empirically.

To build sequences that go from the poorest chord to the richest one, you check a parameter called Complexity or Richness, resulting from a weighted average of the Calibrated Total Weights of the Interval Families in each chord, according to a precise formula. This parameter will be calculated automatically in version 2.1 of NTA. It indicates if the sound of a chord is caused by the presence of many various different intervals (rich) or of a few overwhelming ones (poor) and is completely independent of the dissonance level of the chord.

The program warns the user if it finds chords with internal symmetries or regular interval patterns, for instance C, D, F, Ab, Bb (central symmetry due to the fact that the intervals repeat themselves backwards as in a mirror with respect to the centre of the chord) or also C, A, D, B, E (presence of major sixths and perfect fourths alternated regularly).

In the present preliminary version of the program (2.0.1) there is also a database document included with NTA ('NTA SmallChords.DB') and distributed with it, that is very much useful. In a few words, it is a database containing all the analysis values corresponding to all the possible chords of three notes, already calculated and stored (that can however be modified). Through it is for example possible to show all the chords ordered by increasing D-index, or for instance by increasing Amplitude, that do not contain tritones, that contain major seconds, that have a D-index limited within two given values, that are not larger than a given value in semitones and so on and also to show which chords have all these features at the same time - this is only an example. This database will be surpassed in the next version of the program, that will be able to save the analysis data in a format that will be readable by any database program or spreadsheet program.

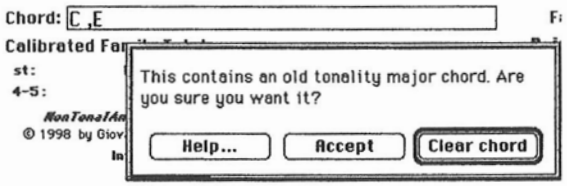
The program warns the user also when it finds traditional triads or various other chords that may recall the world of tonality. In NTA, when the user inserts traditional triads of many other chords that may clearly recall the traditional world of tonality (like diminished sevenths, incomplete dominant sevenths or all the chords that have a perfect fifth formed by the two lowest notes), a warning message appears on the screen, that warns the user of the presence of that chord, also when the

notes that form it are note immediately one after the other and are mixed with other different notes. This feature has been praised as a useful one by many users, because we often do not realize that complex atonal chords of many notes include hidden traditional triads and hidden traditional chords, that nevertheless affect the overall sonority of harmony also when we do not notice them. I personally find this feature also amusing, if we consider it as a sort of revenge on all the prohibitions and restrictions written on the traditional tonal harmony handbooks, I find amusing the fact that, when you insert a note that forms a traditional triad, a message appears an ironical message such as 'This contains and old tonality major chord. Are you sure you want it?' as actually happens in NTA. The user has in any case the possibility of accepting this triad or traditional chord without any problem going on in his work. In the new version of NTA this will even be the default choice. The presence of these warnings and of this discrimination regarding tonality-based chords in NTA has raised at the beginning some perplexity among some users, that wrote me asking the reason of this. I actually go on thinking that these cautions should be maintained. I partly agree with these users when they say that traditional chords are not tonal by themselves and that it is the context in which they appear that makes them tonal or working according to the rules of tonality, so that most of them could as well work also as atonal chords and be inserted with good results also in an atonal chord, but nevertheless I think that it is really very much wise to warn the user about the possibility that such chords could work as tonality-based ones, thus producing hidden effects the origin of which is tonality, a fact that, if not planned consciously and well controlled, can surely cause serious problems in an atonal composition. For example, in some situations, if a chord like B, F, G (rather dissonant according to NTA) is used in an atonal piece with the precise purpose of increasing the tension, it may also fail in doing this, owing to the fact that we, almost unconsciously, recognize a very familiar chord of seventh in it, and a similar problem could arise sometimes if we would plan to use with the same purpose a chord that is very dissonant but has his two lowest notes forming a perfect fifth. Another example: suppose we have a not traditional atonal chord made of seven notes, that however contains a perfect C major triad formed by notes that are one immediately close to the other (that is, containing C, E, G). If the chord that precedes it contains a G, or a B, or both, and they are in evidence because they are the uppermost or the lowermost notes, we could certainly perceive a feeling of consequent logic in the enchainment of these two chords when played one after another, but perhaps without realizing that it would be probably caused by a hidden tonality-based process rather than by an accurate arrangement of atonal features, like, for instance, an attentive graduation of dissonance. We could make other countless examples with regard to this point. (See Figures 9 and 10)

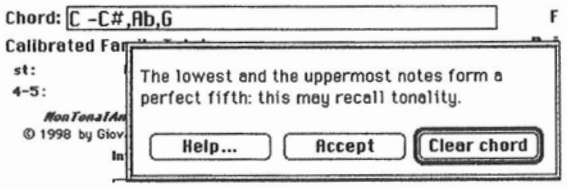
Besides this, I personally consider a too easy surrender to recur to the use of tonality-based

Warnings concerning chords that may recall tonality
- Part 1 -

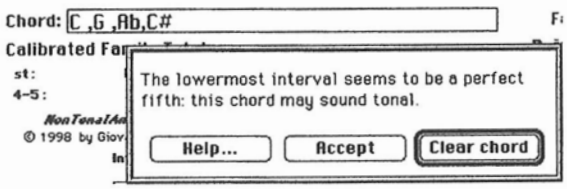
1) Trying to insert a G...



2) Look at the first and last notes

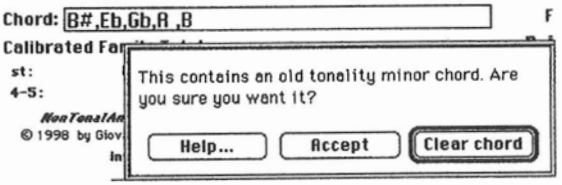


3) Look at the two lowest notes

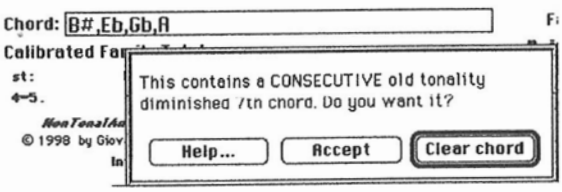


Warnings concerning chords that may recall tonality
- Part 2 -

4) Trying to insert an E: NTA finds the minor triad formed with B#(=C, enarmonically) and A, that are two distant notes



5) NTA finds also complex traditional chords, also enarmonically



traditional chords when one does not understand immediately what is the right atonal chord that should be inserted in a passage. In any case, I do not think that it should be always right to eliminate any chord that belongs to the tonal tradition from an atonal composition. In music, of course, a composer should be free. However he should also be well aware of what he is doing. Besides, NTA in itself is not a musical composition. It is, as the Macintosh users use to say, a "desktop accessory" for composers, an educational software for people who, once they have discovered atonality, would understand how it works, and so it needs precise criteria to determine if certain effects are due to tonality-based processes or not. I believe, owing to my practical experience, that in this sort of work great precision and accuracy are required. Then we will be able to compose what we wish (and sometimes we may certainly desire to insert tonality-based processes in a piece, intentionally), but we should do so only when we know with the best possible accuracy what we are doing and why. Of course, not all the chords that cause the appearance of a warning in NTA will also really cause tonality-based effects (some suggestions about this problem are also contained in the Help window of the program), but, at least, in this way the user is compelled to think about this possibility. And I believe that this is necessary in this sort of software. Simply, if we want to discover how successions of chords based only on strictly atonal relationships work, we should first seek them deliberately and we should isolate them from other kinds of chordal successions.

All what we have dealt with is explained in details in the user's manual, included with the program.

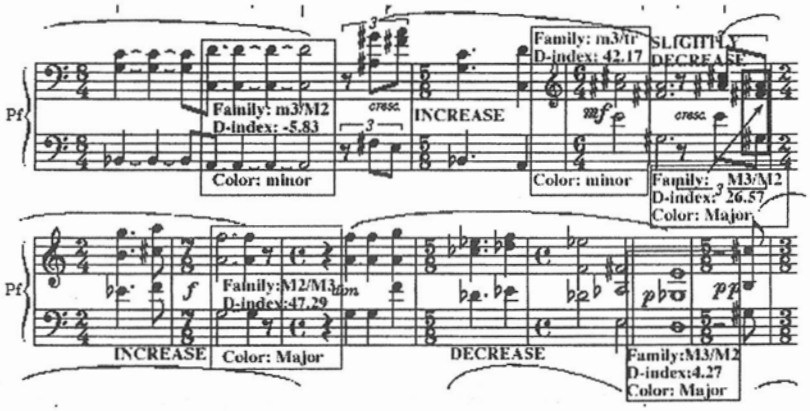
5.2 Building chord sequences having a clearly perceivable directionality

Let's come now to what is probably the most important and main function of the program. With NonTonalAnalysis you may build chord sequences, e.g. from the less dissonant chord to the most dissonant: the hypothesis, that seem to work well from my experiments, is that, for acceptable results, in this case the first chord must give more consonant values than the second chord *both in color AND in d-index*, and certain corrections in values are necessary if there are common notes between two consecutive chords, or perceivable octave relationships, or chromatic movements in the same direction of all the voices. Also with regard to this point some users have objected that the feeling of consequence in a chord succession should depend only on the context in which they appear, and that, in a suitable context, any chord sequence might sound as a logical and consequential one. I personally believe that a feeling of consequence depends surely on a context, but that means exactly that the problem is to create a precise and clear context. The problem is precisely that the criteria according to which we select and connect chords must be objective and clear enough to let us create a precise context, in which those chords will be perceived as logical and consequent. For this reason I believe that any language must have a natural foundation that justifies and validates it in part, certainly not in its entirety, but however to such a large extent to let us understand it (see the text by Moles on the theory of information quoted in the Bibliography: it states that any signal, to be intelligible, must be transmitted with a minimum respect of the characteristics of our perceiving sensory apparatus and tries to establish what exactly is this minimum). Over the natural foundation many artificial conventions are created, that constitute a very large part of any language. But a well conceived language needs, most probably, to observe the right balance between these two components. It is just as they were a carrier wave (the natural foundation of a musical language) and a modulation wave (the artificial conventions superimposed to it, to which the ear gets accustomed). The system of tonality had the harmonic series as its carrier wave, as it natural foundation. Now, in my opinion, the problem is to understand which is the most proper natural basis that we could use nowadays. One needs to choose a natural basis that should be adequate to our practical and cultural context. In my opinion it can just be, as already stated, the attentive graduation of dissonance and beatings, that are a natural phenomenon, or the attentive graduation of the tone colour complexity and richness: these are the lines along which I have worked. What I just cannot believe is the statement that our perception and our memory could get accustomed to anything. I think that the right method to make music will always depend on its object: that is sound, and the way it works, and the way our sensory apparatus works.

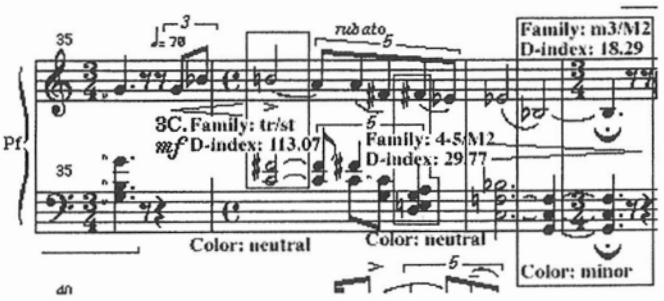
6. Practical examples, use in composition, analysis and educational courses

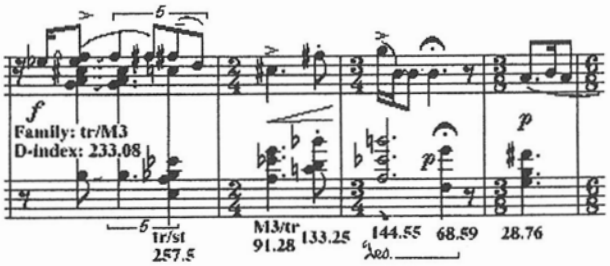
Experiments in using this program as a basic method of composition have given very much good and promising results, for instance producing very coherent chord sequences, or chord sequences ordered in a clearly perceivable direction from the one that has the poorest sonority to the richest one, or to the most consonant to the most dissonant one, that, though they remained completely outside the boundaries of tonality, gave without any doubt a perception of logical succession and consequence, comparable to the one given by tonality-based chord successions. I have prepared some sound and score examples with regard to this point. Please note that in all of them what really matters in order to give this result is that the consecutive chords must be consistent in both D-index AND Color in the same direction. That is, it does not work if, passing from one chord to the following one, the Color increases and the D-index decreases, or if the Color decreases and the D-index increases: in these cases the result would be an ambiguous enchainment and a feeling of uncertainty about which one of the two chords is the most dissonant or the most consonant, and we would not obtain a directional effect.

The following figure (Figure 11) represents a passage from my work "Tre Corali" (Three Chorales) for piano, in which are shown the changes of increasing or decreasing tension and the exact values corresponding to some selected chords.

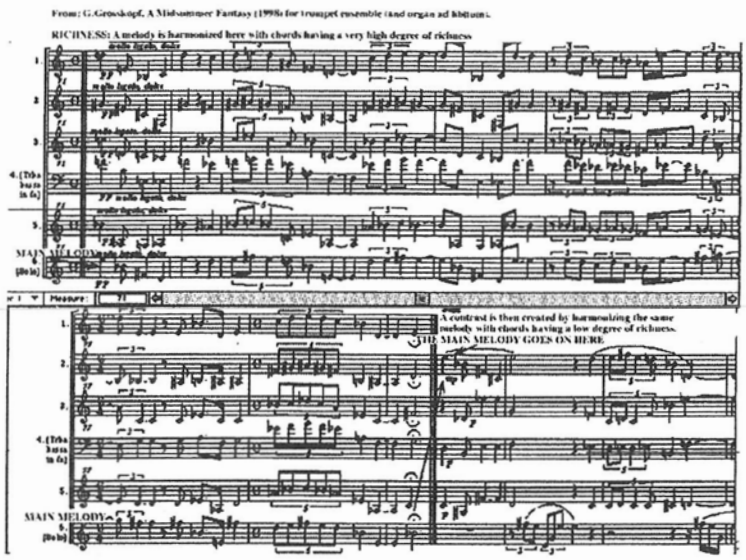


The following figures represent other passages from the same work, in which chords are arranged so that the tension decreases gradually from a very dissonant chord to a rather smooth one. (see Figures 12 and 13)





The figure that follows shows a larger passage from my composition "A Midsummer Fantasy", for trumpet ensemble (and organ ad libitum). In this passage a series of chords with a very rich sonority and a series of chords with a much poorer sonority are juxtaposed to form an effective contrast, harmonizing the same melody and, also here, the succession of the chords, and especially of the last ones in the audio examples, sounds logical and consequent . (Figure 14)

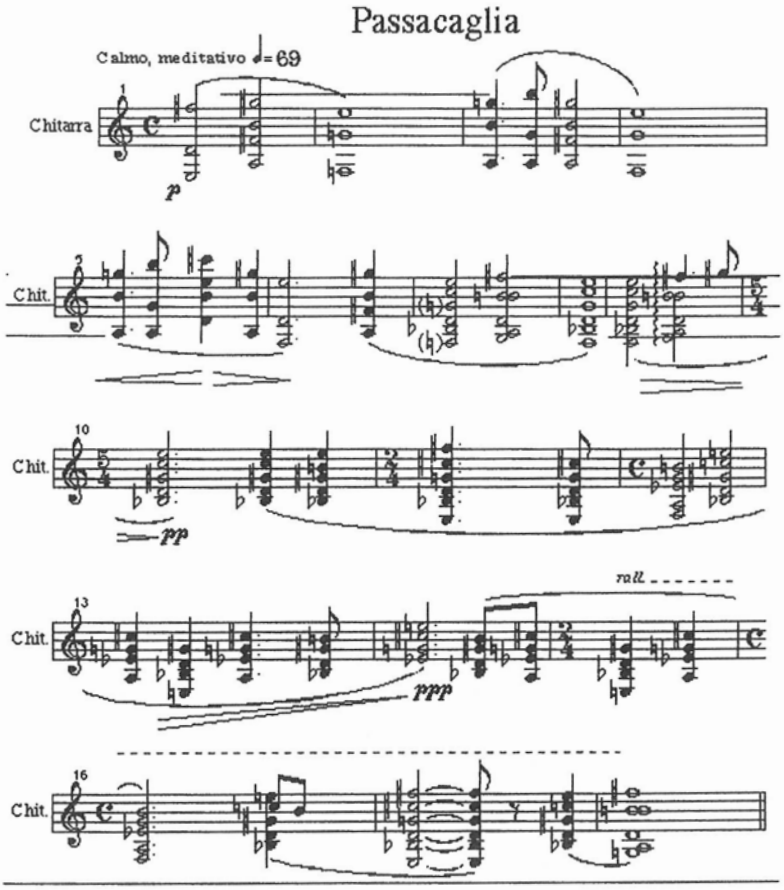


In the following audio example extracted from the same composition, another contrast can be heard, between chords with a very high D-index value (very dissonant) and chords with a very low D-index values (much more consonant) having the same rhythm, intentionally juxtaposed.

Also with regard to tape music, where no score exists, a usage of NonTonalAnalysis may be experienced as much useful. The following audio example is extracted from my composition "I Richiami della Grande Cascata" (The Calls of the Great Waterfall) for magnetic tape, from my tape music cycle "Voci dalle Terre Alte" (Voices from the Higher Lands). It shows a situation in which a very tense and anguished atmosphere, due to the presence of resonances forming chords with a high D-index value, is mitigated and transformed gradually in a few moments into a serene and majestic one, due to the presence of chords with a low D-index value. This passage, like the previous ones, has been built with the help of NonTonalAnalysis.

A last tape music example shows the powerful fascinating effect that a chord with a high Richness value has, used as a fixed magic background in the following passage of my composition "A Forest Tale", for magnetic tape, from the same tape music cycle "Voci dalle Terre Alte" (Voices from the Higher Lands).

As already stated above, normally the ordinary practice with NTA implies a strict control on the influence that a too evident presence of chords and note combinations recalling the traditional world of tonality may have on an atonal passage, often with negative effects and loose of control and balance, as well as it implies a strict control on the possible alterations of the analysis values given by NTA due to the presence of common notes or evident octave relationships between consecutive chords. Even when the composer chooses to relent his control on these factors and tolerates them more than what he usually does, the use of NTA can nevertheless be precious as well, to check that the chords used are enchained in a functional and logical way, with regard to the main parameters: D-index, Color and Richness. The following example, the initial theme from my guitar piece Passacaglia, shows a situation of this kind, in which the deliberated use of many open strings (that is, strings that are not touched by the left hand of the player) obliges to include in the passage some almost tonal chords and an almost pentatonic melody (I did not want to change the usual tuning of the guitar); nevertheless the strict control on Richness (the second part of the passage, starting from measure 10, is "richer"), Color and D-index ensures a feeling of coherence, so that one realizes that there is a directional logic in the succession of these chords, but that this logic, though evident, is not based on tonality, though in this particular case, owing to the peculiar situation, it may be slightly influenced by it in some details (see Figure 15).



I repeat again what I have already stated above: please note that in all the above examples what really matters is that the consecutive chords must be consistent in both D-index AND Color in the same direction: it does not work if, passing from one chord to the following one, the Color increases and the D-index decreases, or if the Color decreases and the D-index increases: in these cases the result would be an ambiguous enchainment and a feeling of uncertainty about which one of the two chords is the most dissonant or the most consonant, and we would not obtain a directional effect.

These are only a few examples, but a good amount of music has already been written or analyzed with the help of NTA.

The program has been greeted positively by composers and musicologists and the future versions will certainly have more and more compositional and also analytical and educational applications.

7. Recent and future developments and improvements: what will be new in the next versions

One should admit that NonTonalAnalysis is obtaining a good success and is well distributed over the Internet. Some very interesting facts have indeed happened since I uploaded the preliminary version (2.0.1) of NTA on the first server:

NonTonalAnalysis has been added on the official Web site of the Music Conservatory of Queensland, Australia. The Centre for the Promotion of Contemporary Composers, one of the most important organizations in our branch, decided to add to its Web pages some links that lead to the NTA-related sites. Many musicians wrote me and go on writing me more and more often to express their interest for this project: I received letters from the U.S.A., Australia, Italy, Austria, Brazil, Lithuania... NonTonalAnalysis has been published on CD-ROM by the computer magazines 'M-Macintosh Magazine' and 'MacOnly'. The number of the people that have downloaded NonTonalAnalysis from the Internet according to my approximations is over 1600 since now (April 1999). I have been invited last summer to speak on NonTonalAnalysis within the National Congress of Electronic Music entitled 'La Terra Fertile' at L'Aquila, Italy. Now, of course, I have been invited to speak about this program of mine here, in Lithuania.

With regard to the next versions of the program, the present version 2.0.1 is only a preliminary one and, as I have already stated, does not support MIDI yet: the reason for this is that the implementation of MIDI in the programming language that I have used has been optimized for the Macintosh Operating System 7.5 and can therefore have problems with the System 8 now commonly used. I am now working on the following version (2.1 and then 2.2), that will eliminate some problems and defects and will include some very interesting developments: it will be much easier to use, it will calculate new useful and interesting parameters such as the tone colour Richness, it will have new optimized and more coherent preset values, it will perform all the necessary calculations in a completely automatic way selecting automatically the proper preset values, according to new criteria I have studied, and it will be able to save data regarding chord sequences or chord lists in a format readable with any common word processor, database application or spreadsheet application, so as to maintain a list of already calculated values corresponding to any chord that has already been analyzed at least once, with the possibility of producing graphs indicating the variations of the dissonance index or of the tone colour richness over time in a chord sequence, for instance. The program will also be able to save and load user defined configurations that will store and recall his choices. Registered users of the present version will receive the new one for free. It will be distributed not later than October 1999.

This project has also the purpose to create a sort of international network of musicians interested to this subject. A public discussion web page also exists, that is dedicated to the atonal harmony and to NonTonalAnalysis. I must therefore thank many people that have expressed their praise for this work and moreover those who are keeping in contact with me to develop the future versions of the program. Thanks to them, I am also continuously updating a new FAQ (FrequentlyAnsweredQuestions) file, that will be added to the present one. Also, thanks to them many ideas have been elaborated regarding the future developments of the program, some regarding only the improvement of the present approach, other with very complex aspects, like the idea of a collaboration with some psychoacoustics experts, or the idea of going outside the tempered system and try to analyze the peak frequencies of the formants of an audio sample with the same approach to calculate similar values, of course with the proper modifications. The most interesting opportunity is the contact that has been started with Mr.Didier Guigue, a French researcher working in Brazil at the CNPQ - Music Department - Federal University of Para"ba. He has developed in the Patchwork environment some algorithms that calculate various parameters of the chords of atonal music (like the Register, Harmonicity, Density, Linearity), according to criteria that are in a certain way similar to mine, but not the same. I could say that our works are complementary, so our intention would be now to develop and than distribute a further version (3.0) of the program (after the one I am already working on) using Patchwork or OpenMusic or more probably Max (so as to save the work as a stand-alone self running application program), a version that will have full MIDI support and will join in one program all the best features of my work and of his work, together. This project has the collaboration of the GMT - Grupo de Pesquisas em Musica, Musicologia e Tecnologia Aplicada, (Group for Researches in Music, Musicology and Applied Technology), a Brazilian association. A synthesis of the work done by mister Guigue can be found online at the following addresses:

http://www.ircam.fr/equipes/repmus/jim96/actes/guigue/guigue.html

http://mediatheque.ircam.fr/articles/textes/Guigue96a/note.html

Besides this, I cannot exclude in the future an involvement of AGON, an electronic music studio with which I work, one of the most important in Italy and a member of the IRCAM Forum, and I finally want to thank Mr.Ken Moore, for the interesting exchanges of ideas that we have.

8. System requirements

To use NonTonalAnalysis2.0.1 you need a Macintosh computer with a 68030 processor or better or a PowerMacintosh, running the operating system version 7.1 or better (7.5 suggested, full compatibility with the system 8), 2050K of free RAM, 1.8MB free on your hard disk, and a 14" monitor at least.

9. NTA on the Internet

A list of the Web sites from which you can presently download NonTonalAnalysis includes: http://space.tin.it/musica/ggrossko/ (the Author's site, with complete references in English); http://www.liaa.ch.ufpb.br/~gmt/ (the site of GMT, Group for Researches in Music, Musicology and Applied Technology, which carries on the NTA project); http://www.liaa.ch.ufpb.br/~gmt/Grossk/GKpapers/LITPIC.htm (including the expanded version of this presentation online); http://www.hitsquad.com/smm/programs/NonTonalAnalysis_mac/ (This is the NonTonalAnalysis Web Page on which you can read or leave public messages in English on this topic, thus forming a sort of discussion page on atonal harmony, probably the first one on this subject);

http://www.zdnet.com/cgi-bin/texis/swlib/mac/infomac.html (USA, ZDnet);

http://apollo.qcm.gu.edu.au/MA/Macintosh/ (Australia, Conservatory of Queensland);

http://hyperarchive.lcs.mit.edu/HyperArchive/Archive/gst/snd/nonton-alanaly sis-20.hqx (USA, MIT);

http://hyperarchive.lcs.mit.edu/cgi-bin/NewSearch?key=NonTonalAnalysis (USA, MIT); ftp://cis.utovrm.it/Info-Mac/_Graphic_%26_Sound_Tool/snd/ (Italy,TorVergata University in Rome);

http://www.regsoft.com/ (RegSoft);

ftp://ftp.ulaval.ca/mac/info-mac/gst/snd/nonton-alanalysis-20.hqx (Canada);

ftp://ftp.uoknor.edu/info-mac/gst/snd/nonton-alanalysis-20.hqx(USA);

ftp://ftp.doc.ic.ac.uk/Mirrors/info-mac.org/gst/snd/nonton-alanalysis-20.hqx(Great Britain).

There are surely many others, since this preliminary version of the program is now hosted on many chains of software archives like InfoMac, ZDnet, SharewareMusicMachine and RegSoft and can therefore be copied, distributed, published on a CD-ROM and put online freely. The authors, G.Grosskopf (ggrossk@tin.it) and D.Guigue at GMT (gmt@liaa.ch.ufpb.br) are at your disposal for any explanations or collaborations. In any case, the directory (or folder) which you download from the Internet includes a complete manual, which should be read attentively.

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Summary

Giovanni Grosskopf

NonTonalAnalysis: a Different Approach to the Analysis of Atonal Chords: Achieving a Clearly Perceivable Directional Logic in Atonal Harmony

NonTonalAnalysis", of which the author of this text is the creator, is a program for the classification and analysis of the atonal music chords, according to a method that is alternative to the "pitch class sets" method and is more and more used and distributed worldwide on the Internet. According to user-defined criteria, it gives the "level of dissonance" of atonal chords, their classification in families, and puts in evidence the relationships between a given chord and other ones having a similar tone colour. A help for composers, musicologists and music students that allows to develop precise ideas in the maze of sound combinations not classified by traditional tonality-based harmony, permitting the comparison between two non-traditional chords of any kind so as to decide which one is the most dissonant or which of them is closer to a third one. It can help to be aware of the characteristics of atonal chords and to regulate the perception of dissonance. It is suitable for professional and private use among composers and musicologists, but also for educational purposes in music schools. Its purpose is to demonstrate that we can build sequences of atonal chords having a clearly perceivable directional logic, e.g. from the most consonant one to the most dissonant one, or from the one that has the poorest sound to the richest one, in order to achieve a feeling of consequent development in the music (so that a listener can follow it better), like the one that we can hear in tonality-based music, but this time doing so in a completely atonal piece, rediscovering the importance of a narrative thread and directionality in atonal music. Atonal harmony problems, historical and compositional background and considerations about compositional problems that originated this new approach. Former studies by others in the same direction. Finally, a short description of the way it works and how it could be used.