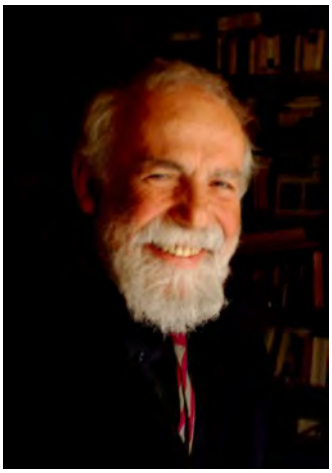
CELESTINO SODDU

Paper: **MUSICABLU. Generative Music Design software for increasing human creativity and generating unique and not-repeatable musical scores**



Topic: Generative Music

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[4]J.S.Bach, Art of Fugue and Goldberg Variations
[5]W.A.Mozart. Sonata in C major K545
[6]J.Coltrane, My favourite things, Bessy blues, Afro blues
[7]Beatles, Yesterday, Hey Judy, Imagine and others
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Following the generative approach that I developed in the last thirty years, I worked on a project of music design able to produce musical pieces and to record each result in a midi file with fifteen tracks, each one generated following a peculiar instrument and a peculiar and identifiable player. This was the main choice: it doesn't generate the sound but the musical score. These scores can be played using other programs and, if necessary, they can be upgraded with different instruments. More, they can also played and interpreted by an human orchestra.
Following that, the focus of the generative process is in the musical Idea and its structure and not in the sound, that belongs to the player's performance and to his subsequent interpretation. This approach mirrors what happened in the time of Bach and Mozart: The musician creates his music writing the score. Only in a second moment the composer plays his music or another player can interpret and performs the piece using this score.
I had developed this project starting from 2003. But until now it was in a starting phase. I only presented the live performance “Out of hours” at GA2005 interacting my generative music with a human jazz singer, Josette Marcial, the poetic text by Enrica Colabella and the live-generation of my woman portraits able to interact, in real time, with the music. But this year I suppose to have reached more advanced results and, for the first time, I am happy to present MusicaBlu at this Generative Art conference.
The aim was to create a generative software able to support the musical creativeness following the own cultural references and the own subjective preferences. This in tuning with my preceding experiences in generative design that involved different fields, from the visual art to the architecture, from the city design to the industrial objects: interpreting own imaginary references and creating transforming rules able to perform events in tune with our peculiar vision.
But the jazz approach was only the starting point.
The aim was to simultaneously acting on the various logical components of a musical composition. That works not limited to the interpretation and the progressive variations on a theme, as happens in Jazz but directly involving the music creation. So following the tradition, the generative software involves the generation of the riff, the melodic construction, the harmonic construction, the rhythm and the adjectives that identify it: “largo”, “adagio”, "andante", "allegro", "allegretto ma non troppo", “prestissimo”, and so on.
More, my aim was also to operate generative actions on the orchestra and on the management of the player group considered as different and identifiable soloists, rhythmic group and accompaniment group.
The more important and *hard* part was designing the algorithms able to generate the melodic construction. I tried to enlarge the field of melodic possibilities. Melodies are not only confined to "classical", “Jazz” and popular music but I have also experimented "numerical" melodies and dodecaphonic melodies, having as reference, in this last case, the structure proposed by Webern in its 1932-1933 famous conversations "Der Weg zur Neuen Muzik". This is my experience for experiment the borders of the generative approach in contemporary music.

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MUSICABLU

Generative Music Design software for increasing human creativity and generating unique and not-repeatable musical scores

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Premise

Following the generative approach that I developed in the last thirty years, I worked on a project of ***music design*** able to produce musical pieces and to record each result in a midi file with fifteen tracks, each one generated following a peculiar instrument and a peculiar and identifiable player. This was the main choice: ***to generate the musical score and not only the sound***. These scores can be played using other programs and, if necessary, they can be upgraded with different instruments. More, they can also be played and interpreted by an human orchestra.

Following that, the focus of this generative process is in the musical Idea and its structure and not only in the sound, that belongs also to the player's performance and to his subsequent interpretation. This approach try to mirror what happened in the time of Bach and Mozart: The musician creates his music writing the score. Only in a second moment the composer plays his music or another player can interpret and performs the piece using this score.

I had developed this project starting from 2003. But until now it was in a starting phase. I only presented the live performance "*Out of hours*" at GA2005. It was performed by interacting my generative music with a human jazz singer, Josette Marcial, the poetic text by Enrica Colabella and the live-generation of my woman portraits able to interact, in real time, with the music. This year I suppose to have reached more advanced (also if not "final") results and, for the first time, I am happy to present MusicaBlu at this Generative Art conference.

The aim was to *create a generative software able to support the musician creativeness by following the own cultural references and own subjective preferences*. This approach is in tuning with my preceding experiences of generative design that involved different fields, from the visual art to the architecture, from the city design to the industrial objects. **This generative structure is based on the interpretation of my own peculiar imaginary references and works by creating**

a set of transforming rules (algorithms) able to perform events in tune with own peculiar vision.

So I used this approach also in the music field. My generative software ***MusicaBlu*** is based on my subjective vision, and particularly on my experience as jazz player in the sixties. By the way, this experience was at the base of the generative approach that I have developed in all my experimented creative fields.

As in a jam sessions, the main elements are:

1. the composition of a melody, and/or of a motif;
2. the subjective structure of riffs able to identify own musical character;
3. the creation of an harmonic and rhythmical structure;
4. the improvisation and the subjective interpretation as transforming process;
5. the harmonic and melodic interpretation;
6. the use of the cultural references in the field of the music, but not only;
7. the possibility to interact with the other soloists during the dynamic evolution of the musical session. And to develop together unpredictable musical events.

In order to clarify, and to specify my adopted references, most of all related to baroque and to the sixties and seventies, my main references were: Bach, particularly the Fugues, Mozart, the Modern Jazz Quartet, Miles Davis, Coltrane, the Whether Report and the Beatles.
I have built in progress the software *Musicablu* by actively interpreting these references.

But the jazz approach was *only the starting point*.

The aim was to ***simultaneously act on the various logical components of a musical composition*** not limiting me to the interpretation and the progressive variations on a theme, as happens in Jazz, but directly involving the music creation. These logical fields are the *generation of the riff*, the *melodic construction*, the *harmonic construction*, the *rhythm* and the *adjectives* that identify a piece of music: “*largo*”, “*adagio*”, "*andante*", "*allegro*", "*allegretto ma non troppo*", “*prestissimo*”, and so on.

More, my aim was also to operate generative actions on the orchestra and on the management of the players group considered as different and identifiable soloists, and also the rhythmic group and the accompaniment group.

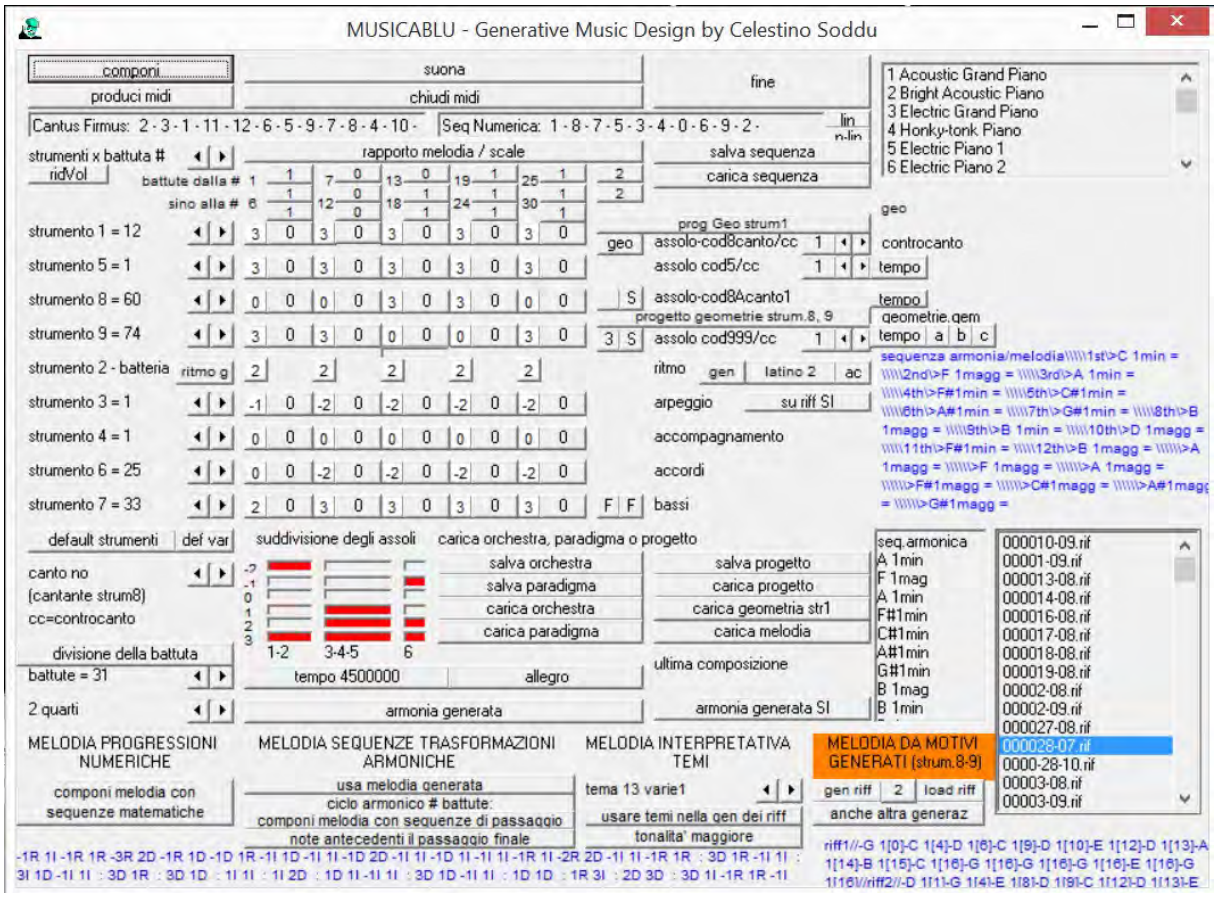
The most important and hard part was designing algorithms able to *generate the melodic construction*. I tried to enlarge the field of melodic possibilities. Melodies are not confined to "classical", “Jazz” and “popular” music, but I have also experimented "numerical" melodies and dodecaphonic melodies, having as reference, in this last case, the structure proposed by Webern in his 1932-1933 famous conversations "*Der Weg zur Neuen Muzi*k".

The structure of *MusicaBlu*

As well as in all my experiments of Generative Art, this generative software is structured in two parts: *the first part* for managing the piece, concretely for creating and managing the paradigm of possible results, and the *second part* able to manage the music generation by using parallel transforming devices and their reciprocal contamination and interactions.

The **structure of the paradigm** is based on the possibility to choose the orchestra and the schedule of each player. Together with the character and the possible instrument of each player. This orchestra can be created and used in different generative paths. The paradigm of the orchestra is the basic choice since the beginning of each generative process. The paradigm doesn't have inside generative algorithms but only requests of specific characters and “constraints” able to control, in progress, the music generation.

The second part is a **set of generative devices** structured as a not linear system. These devices work in parallel and are focused on different fields: the generation of riffs, of melodies, of the progression of harmony, of rhythms, of time geometry inside each bar and each bar sequence, of various symmetries among notes, riffs and melodies.



Screen-dump of MusicaBlu interface.

The Melody

Going in deep about the melody generation, I have designed the generative algorithms for *four different generative devices* for fitting a range of four possibilities related to the structure of the melody. These four sets of algorithms create four parallel devices able to work together, interacting among them and managing reciprocal contaminations.

The Melody generative device #1 - Numerical sequences

The first melody generative device uses the ***structure of numerical sequences*** as the *Prime* numbers, the sequence of *Fibonacci*, the sequence of the *squares*, the sequence of *Hailstone* numbers and the sequence of *Alcuin,* but also it is used a calibrated mix of these sequences. This mix is structured following a similarity with a sequence of different accords inside the structure of harmony. For example, the first numbers of Fibonacci seems more closed to a major accord when the Prime numbers seems closed to a fifth diminished accord. So it was possible to manage the moving from different numerical sequences as well as the moving from an accord to the next one.

These numerical references are used for ***creating the base of each small sequence of notes***, from two to a maximum of 9 notes, that will fit the generated harmony sliding the starting point to the tonic and, sometimes, to the 5th dominant.

The character of this generation belongs, obviously, to the 12-tone chromatic scale. But the parallel generation of the harmonic sequence will also interact with the numeric sequence by applying a subsequent transforming action involving the notes. This could be done by increasing or decreasing each note of an half-tone; by enlarging the time of the notes in a way that it will fit the harmony; or by decreasing the time when it don't fit the used scale and accord. For example, a possible feedback from the generated sequence of notes and the parallel generation of harmony is to move to a minor accord if the generated notes is the 3rd minor, and so on.

The Melody generative device #2 - Dynamic structured passages

The second melody generative device works through the ***generation of notes of passage among notes distant each other from three to seven half-tones***, with few exceptions. This possibility was created for interpreting the possible structures of the *catchy songs and* of the catchy motifs.

"**How**" the motif *begins*, how the motif *runs in the movement from one accord to the subsequent one,* how *the last three, two or one notes are structured before the final note*, and so on, were considered and interpreted with generative algorithms.

The aim was to create, interacting with the parallel generation of harmony and rhythms, generated **riffs** that could fit the character of a catchy motif. The results

were interesting but, as normally happens in music composition, not all the variations fit this quality at the best.

This generative device can also work applying these "*passages*" to the motifs generated by the other parallel devices, in a way that it's possible to increase quality and character to the musical piece.

The Melody generative device #3 - Imaginary structured references

The third set of melody generative algorithms uses a ***structure of references*** from Bach to Coltrane from the Beatles to Mozart. These references are ***logically interpreted as progressive dynamics*** and as relationship among norm and exception. The algorithms produces a progressive sequences of notes.

This third possibility works as the previous one, but the structure of the passages are constructed starting by the interpretation of well identified references, well identified melodies.

The possibility to quote own references but *not to excerpt a copy* is based on the structure of subsequent transformations managed by the generative algorithms. *The own imaginary interpretation operates by identifying one of the possible sequence of few notes inside the melody and* ***focusing only a peculiar aspect of the geometric structure*** *of a sequence*.

In a second step the sequence will interact with a generated geometry able to redefine the time sequence. More, each sequence will be transformed, upgraded and structured through the concomitant generation of harmony and rhythm.

The aim was to reach the construction of possible variations; and to reach results where the reference will be not so explicit and cannot be easily recognized. But the generated music will be able to communicate a recognizable feeling, as happens when we appreciate the improvisation of a jazz player.

In other terms this set *doesn't use a database of melodic references but uses logical possible interpretations of passage sequences from one note to another*, trying to identify a dynamic structure able to perform a recognizable feeling.

The Melody generative device #4 - Riff generation and progressive transformations

The fourth possibility, that iI consider the **most productive melody generative device**, works through the complete generation of a "new" **riff**, a small and catchy motive that *will be interpreted by the other parallel generative structures for transforming it into a melody*. This is not in alternative with the previous three sets of algorithms. It performs a starting possibility that will be developed by the other three devices. The results of this algorithm, as completely new riffs, are used as reference

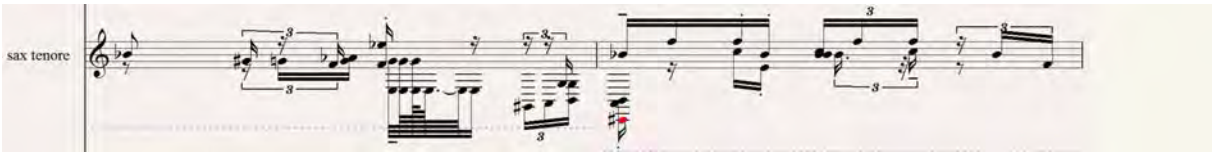
by the other devices and, sometimes, interact with them for increasing its possible quality.

More, each riff is directly generated as a set of several matrices able to perform notes, duration, accentuations, volume and characters and it contains several other parameters as the number of notes and the geometry of the bar.

A particular attention is focused on the downbeat or upbeat of each note, following a possible harmonic geometry.

Each riff is generated in *four parts*, where the first one is the main riff, the second, third and fourth are riffs directly contaminated by the first one but with more soft sequences, that means with more long notes and with different structure of time sequence. The reference was to the main motif of a song and to the variation used for composing an insert. This second associated riff, is generated completely different but with identifiable point of similitude with the main one. Each riff, when generated, is recorded in a separate file so that it can be used again, in another piece of generated music.

Two bars of sax solo generated through a riff generation:



But the riff is not the melody. For moving from the riff to the melody, the riffs must be used by the generative engine many times. Each time it will be transformed with the contamination of the other devices and with a set of transforming rules created following the concept of **counterpoint**. This works by using different symmetries and some mirroring possibilities. *Inverse canon* and/or *retrograde canon* are the two most used transforming rules in Musicablu. There are also inside the generative engines a set of other transformations, coming from my experience in 3D geometry. These are used in peculiar events.

The harmony

The generative device for the structure of the harmony was the more easy to design, in how a lot of explicit references exist. It's possible to follow these references for performing the sequences of accords and reach appreciable results. Also if some exceptions and peculiarities can be managed for reaching more rich results.

Also in the dodecaphonic music, called also twelve-tone composition, the structure of reference is able to be easily interpreted with algorithms working essentially with mathematical rules. The sequence of notes, for example, could be managed structuring a sequence of 12 notes, that might be called “cantus firmus”, where no

note will be repeated before starting a new sequence, as Webern said. An example of a possible Cantus Firmus might be: 8 - 4 - 2 - 11 - 5 - 10 - 7 - 9 - 12 - 3 - 6 - 1

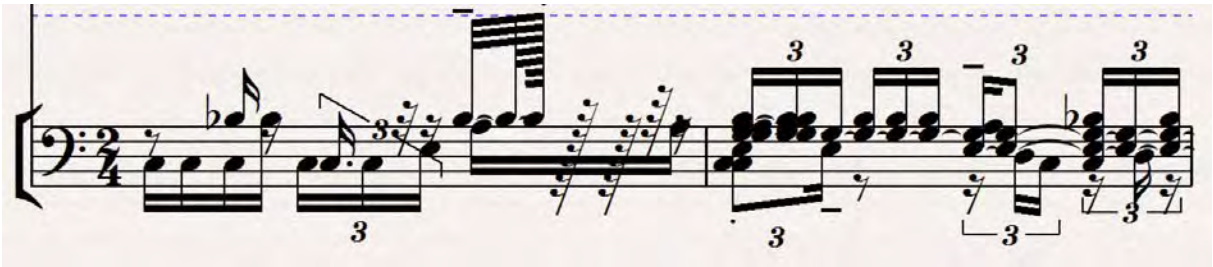
More, it's possible to opt for working with an harmony in the classical sequence of the 12 bars of the Blues or with four bars of the song in major or minor tone, and with other classic harmonic structures.

But MusicaBlu is not limited to these possibilities. The generative approach was used to **produce, in real time, progressive dynamic sequences of accords** and to operate interactively in real time with the melodies produced by the parallel algorithms.

This last possibility is, for me, more interesting because the dynamic harmonic sequence runs following the different harmonic consolidated possibilities. But it is open to change, also in unexpected way, by following the melody just generated in real time. In the meantime the melody develops itself, following the interaction and contamination with the harmonic structure.

The main element able to manage these incoming unpredictable contaminations is the **character** of each virtual player. Each of the fifteen players has its own character but the interactions with the harmony is designed only for the **four soloists**. Normally each soloist plays alone but they can play also together in a progressive counter melody.

A sequence of accompanying Bass:



The Rhythm

The structure of the rhythm has two generative options.

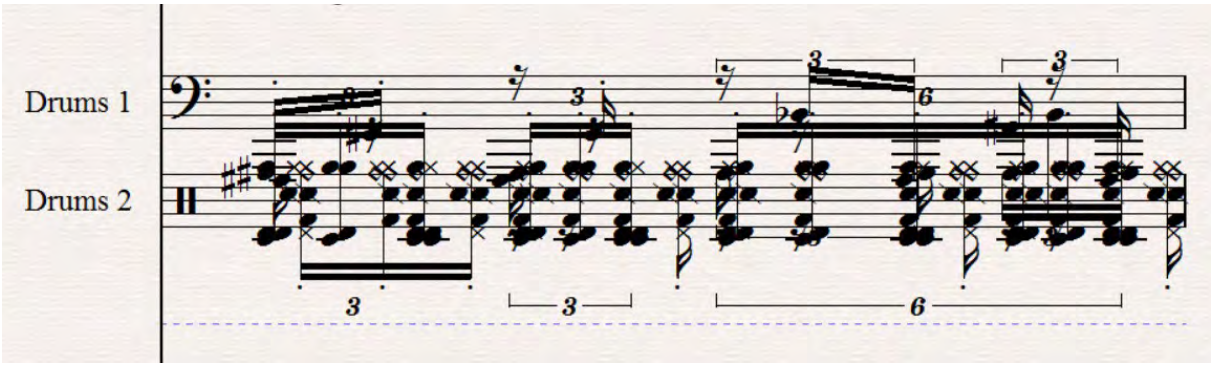
The *first* option was designed on the beginning of this experience and it is an **interpretation of several rhythmic structures**. These are the consolidated and used rhythms in jazz. The generative possibility that I developed in this first option is mainly based on the interpretation of the rhythmic section of the Modern Jazz Quartet. It was developed through the transforming codes able to represent the variations inside the swing operated by drums and bass. But this was only the first approach.

The *second* generative set of algorithms, instead, works directly on a rhythm generation based not only on my explicit references but, above all, on **the use of geometric variations able to structure the dynamics of the sequences and the timbre of the sounds.** This possibility was developed after the first opt and it is certainly more strong and *more generative* then the previous one. It was build reporting to my experience on the geometries and their variations that were developed in the generative software that I had designed for different fields.

This generative rhythm device works in two parallel paths, managing the contamination of their structures. The rhythm is generated by the different sound (no sound too) of each beat that follows the character of the geometric paradigm. The two parallel paths are similar to the two hands of a drums player.

The progressive contamination between rhythms and division of the bars, the number of beats, from 2/4 to 7/8 has allowed to generate rhythmic events sometime amazing but always belonging to my musical vision. In the same way, the interpolation and contamination among various percussion instruments and the relative sounds are designed to generate unpredictable rhythms.

An example of a bar with double generated drums sequence:



The evolution of Complexity, The counterpoint and the interactivity among parallel generations.

All this is, naturally, only the first step in the generation of a musical piece.

To reach a richness and acceptable complexity, the generative program ***MusicaBlu*** operates both on the orchestra, both on the interactions among instruments, and on the possible *counter melody* and *counterpoint* among parallel musical sequences.

This happens:

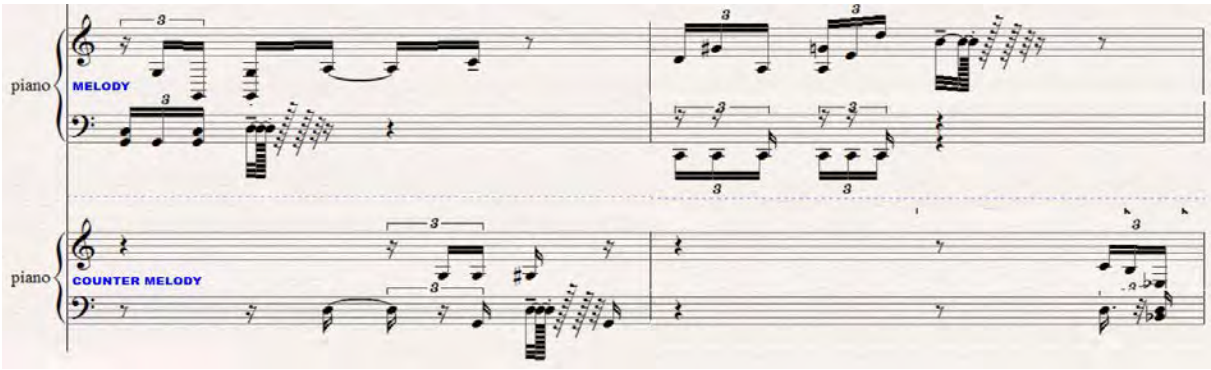
First, adopting the **counterpoint variations proper of the Fugues of Bach inside the transformation of the riffs**, small sequence of a motif, when this motif becomes

the structure of a melody. The used counterpoints are, as I already said, the inverse canon and the retrograde one, and, in least part, also others proper of the Fugues of Bach or belonging to a geometric interpretations of possible symmetries and of the variation of points of view.

A really interesting possibility is the **variation of the point of view**, that is the change of the reference harmony or the change of the geometry of the time schedule, or the change of other characters. These variations of the points of view transform, *as well as a possible unpredictable subjective interpretation*, the music in progress and give to the piece a range of unusual possibilities.

This use of different points of view is also used in managing the structure of the *counter melody*. Some instruments have this possibility and, in front of each sequence of notes, a counter melody is produced and performed by another or by the same instrument.

An example of counter melody generated for a piano. The generated counter melody, in this case, is played by a piano too.



Second. The “players” themselves have, each one, a **peculiar character**: They are musically identified with *specific subjective attributes*. These characters are not related to the instrument, that, by the way, could be changed. They belong to a peculiar feeling that should suggest us to think to a soloist with a recognizable identity of his music.

Naturally these "soloist" are interpretations of the musicians belonging to my musical background. I could call them Milt Jackson, Miles Davis, John Coltrane, John Lennon, J.S. Bach, W.A. Mozart... The philosophy of this generative approach is constructed in a way that **each reference has its own peculiar identity but these identities are managed through generative interpretations for constructing the own subjective vision**. As happens when, in the history of art, each artist made own artworks by redrawing his masters: Picasso done it with Velasquez, Francis Bacon done it with Van Gogh, The Modern Jazz Quartet done it with Bach, quoting only some examples. And it's clear that the results were not copies but creative interpretations following and expressing the strong subjective visions of each artist.

These are the first results of Musicablu. It's clear that the steps for reaching real recognizable, harmonic and melodic results, are really *hard*. The walking is in progress toward new codes.

References

J.S.Bach, Art of Fugue and Goldberg Variations
W.A.Mozart. Sonata in C major K545
J.Coltrane, My favourite things, Bessy blues, Afro blues
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