An example of musical generation

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Introduction

In this brief description, we will be illustrating the music sequence production system implemented in the software S.Y.MU.S.[1]. This system is based on the use of a music series, intending it like as a module of twelve values not necessarily different between them. Additionally it is to say that the procedures here described are not the result of an abstract formalization. Instead, this is a description of some musical composition procedures, analyzing what this formal scheme has been underlines.

Generals terms

As we know, the four essential parameters to the definition of a musical note are:

- Duration
- Pitch
- Timbre
- Intensity

[1]This software can be downloading freely from the url: http://www.luiginegrettilanner.com/symus.htm

For each of these four parameters, a series of twelve values is introduced. Every series will include, therefore, twelve values of intensity or twelve values of duration, or of pitch, or of timbr. We will have therefore:

one duration serie $(d_1; .....d_{12})S$
one pitch serie $(p_1; .....a_{12})S$
one timbr serie $(t_1; .....t_{12})S$
one intensity serie $(i_1; .....i_{12})S$

These series are the module on which the program act, with different algorithms for each param. We define now the input of program that is constituted by a triple of integer positive numbers a, b, c by the four series D, P, T, I, and by the four algorithms $AlgD, AlgP, AlgT, AlgI$, and that return in output a sequence of serie D_n, P_n, T_n, I_n. in general, as it regards the series of durations and of pitch, the program functioning can be represent like follow:

$$S^1 = Alg((a, b, c); (j, k, l); S)$$

We describe now, the succession of steps necessary to the production of a complete sequence (or rather of the whole all the algorithms, that will return in output the musical "piece")

1. The length of the sequence is calculated $L = Max(a, b, c)$ it corresponds therefore, to the number of (D_n, P_n, T_n, I_n)

2. D, P, T, I is calulated, $D_1 = D, P_1 = P, T_1 = T$, $I_1 = I$ and, subsequently $D_{n+1}, P_{n+1}, T_{n+1}, I_{n+1}$, are calculated, through the calculation of a triple (j, k, l) of integer positive numbers, where $J \neq k$ and $k \neq l$

3. Is calculated The complete sequence. We now see in detail how a single series of musical values is produced, separately for each params.

1 - Algorithm $AlgD$ that generate a new durations serie

Is a, b, c and j, k, l as above, and $S = (d_1; ....d_{12})$, the input duration serie, and is besides w, x, y, z four constants each of it represent a duration value, and is O a random variable. The new series is calculated in this way:

$$S' = AlgD((a, b, c)(j, k, l)S) = (r'_1; ...r'_{12})$$

the operation of the algorithm can be schematized as it follows: It is first calculated a rhythmic value, and subsequently the subset I of $\{1; ....12\}$, and is finally added or subtract the value of O to the rhythmic values r_i, for $i \in I$, and are left unchanged the values r_i, for $i \notin I$

1.1 - Selection of a rhythmic case

We remember that we have introduced the four rhythmic constants w, x, y, z. In base of the values of b and c, two of theseone constants (u_1, u_2), are selected, in relation to the following rules:

	(couple u_1, u_2)
b even, c even	z, y
b even, c odd	z, x
b odd, c even	y, x
b odd, c odd	w, x

Therefore we have created a second couple of rhythmic values (v_1, v_2) according to the following rule:

if $c < b$ then $v_1 = u_1, v_2 = u_2$

if $c > b$ then $v_1 = u_2, v_2 = u_1$

The value of O is finally calculated in base of the couple $(v1, v2)$ and to the values of b, c, j, k, l.

1.2 - Calculation of O

If $c \leq \frac{N}{2} - 1$ then

$$O = \begin{cases} v_1 + \frac{j}{100} & if \quad |k-l| \leq N - c \\ \\ v_2 + \frac{j}{100} & if \quad |k-l| \geq N - (c+1) \end{cases}$$

If $c > \frac{N}{2} - 1$ then

$$O = \begin{cases} v_1 + \frac{j}{100} & if \qquad |k-l| \leq c \\ \\ v_2 + \frac{j}{100} & if \quad |k-l| \geq (c+1) \end{cases}$$

1.3 - Determination of subset I

If $k \leq \frac{N}{3}$ then $I = \{1, 4, 7, 10\}$

If $\frac{N}{3} \leq k \geq \frac{2N}{3}$ then $I = \{1, 2, 4, 5, 7, 8, 10, 11\}$

If $\frac{N}{3+1} \leq k$ then $I = \{1, 2, 3, ...12\}$

Finally, the new series $S' = \{r'_1; ...r'_{12}\}$
is calculated in base of the following rule:

$$r'_i = \begin{cases} r_i & if \quad i \notin I \\ \\ r_i + O & if \quad i \in I \quad and \quad l > k \\ \\ r_i - O & if \quad i \in I \quad and \quad l < k \end{cases}$$

The series is finally recombined in base to one of the counterpoint combinations that the program apply automatically during the score generation process. This combinations are:

retrogradazione a croce (nine combinations)
retrogrado (one combinations)
slittamento (eleven combinations)

2 - Algorithm $AlgP$ that generate the pitch series

The algorithm that produces the pitch series also responds to the rules described in the paragraphs 1.2 e 1.3 (pitch values must be substituted to the durations values). The pitch series are therefore elaborate adding or subtracting the random value O (see the calculation of O) to some or all the

values of the input series, according to the illustrated rule in the paragraph regarding the definition of the subset I (to see the paragraph regarding the determination of the subset I), and determining in this way the output series.

3 - Algorithm $AlgT$, relative to the timbre disposition

The sequence of timbre, treated as series of whole numbers, is determined by a function that depends on the value a of start triple a, b, c and from a random value, and that is the following:

- a is calculated
- A series of random values inclusive between 1 and a is formed

This operation takes place before the start of the code generation, every time that a new triple is introduced. The series of timbre is therefore a series of constant values.

4 - Algorithm AI that select the intensity values '

The intensities are selected on the base of ten inside groups to the algorithm, Each of which is characterized by a specific sequence of intensity values. These groups have been elaborate in the intention to apply "regions" of intensity, in relationship to a value, given in the start triple a, b, c. Among these ten groups, each of which it contains 12 values of intensity, one is assumed in relationship to the only value $|a - b|$. This value individualizes therefore the group of intensity to apply to the sequence of series. Simply, if $|a - b| = 5$, it will to be assumed group 5. This group contains 12 values of intensity, and is able to be represented as follows:

$$G = \left(\begin{array}{cccccccccccc} mp & mf & f & ff & fff & mp & mf & f & ff & fff & mp & mf \end{array} \right)$$

The single musical intensity is selected in base to the random value j. If, for example, $j = 7$, it will be selected as the seventh value of intensity present in the group (in this case the group 5). In reference to the current example, it is selected therefore the value mf.

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