References

[1] Kirkpatrick S., C.D. Gelatt Jr. and M.P. Vecchi. "Optimization by simulated annealng", *Science*, 220, pp. 671-680, 1983.

[2] Roads, Curtis, "Interview with Marvin Minsk", *Computer Music Journal*, 4 (3), 1980.

[3] Ames, Charles, "Protocol: Motivation, Design, and Production of a Composition for Solo Piano", Interface, 11, pp. 213-238, 1982.

[4] Schottstaedt, W. "Automatic Counterpoint", *Currents Directions in Computer Music Research*, Max Mathews and John Pierce (Eds.). Cambridge: The MIT Press, 1989.

[5] Puckett, M., D. Zicarelli, *MAX - An Interactive Graphic Programming Environment*, Opcode Systems, Menlo Park, CA, 1990.

[6] Mitra, D., Romeo, F., Sangiovanni-Vicentinelli, Alberto, "Convergence and Finite-Time Behavior of Simulated Annealing", *Advanced Applied Probability*, 18, pp. 747-771, 1986.

AREM2: a composition tool

Francisco Kröpfl, Miguel Calzón
Laboratorio de Investigación y Producción Musical (LIPM)
Junín 1930 - (1113) Buenos Aires, Argentina
fk@morfo.filo.uba.ar
mcalzon@cnea.edu.ar

Abstract

In recent years an interactive software named AREM the goal of which is to produce reinterpretation in real time of sequences input through a MIDI interface was developed. This software is based on a specific composition methodology by Francisco Kröpfl implemented by Miguel Calzón. AREM2, a non interactive program, takes the same starting point and it is oriented towards the organization of musical structures including pitch, rhythm, syntactic units and texture. Both programs are complementary and may be used simultaneously.

1. Introduction

This paper introduces AREM 2, a program that creates musical structures which are reinterpreted successively with regard to their qualities of pitch, rhythm, texture and syntax. It is based on a composition methodology designed and taught by Francisco Kröpfl (described in Kröpfl 1987).

This paper will cover three areas: firstly the relationship between AREM1 and AREM2, secondly the way in which AREM2 produces musical sequences, and thirdly how both programs are applied in different fields of music.

2. AREM 2 and its precursor AREM 1

AREM - *Algoritmos para la Reinterpretacion de Estructuras Musicales* - **or ARMS** - *Algorhythms for the Reinterpretation of Musical Structures* (described in Calzón 1992 and 1993) is an interactive program which allows the transformation of the structure of the musical input by a performer or composer. From now on we will refer to this program as **AREM 1.**

AREM 2, by contrast, is **not** interactive. It consists of a group of patches that produce musical sequences following patterns derived from the subjacent methodology of composition. Each patch generates information on pitch, intensity or duration of notes, while the articulation

remains unaltered. Each patch is activated by either the computer keyboard or by MIDI switches. The modularity within the program allows for the programming of new generators according to the needs of the user. The generators can operate successively or simultaneously, as well as working while AREM 1 is running.

AREM 1 and **AREM 2** complement each other. The idea behind writing this second program was to develop more complex structures than those that an instrument performer is able to carry out, as well as a tailored computer aid for the design of structures. Because of the modularity of its conception, the user can personalize the program within the possibilities allowed by the underlying method of composition, by rewriting the tables the usage of which is described below.

3. Groups and phrasing in AREM 2

As far as syntax is concerned, **AREM 2** offers at least two levels of generation: the group (a sequence of few notes whose construction function is to act as motif cells) and the phrase (a sequence of several groups). The group is a motif element that controls micromodes, pitch networks and accent prototypes. The separating and linking factors relate the groups to each other.

In the version of **AREM 2** we are describing there are five modules:
1) Sequences composed of groups of four elements.
2) Sequences composed of groups of two, three and four elements.
3) Uniform rhythm in an ample pitch register: uniform durations within each group, which produce the neutralization of the agogic factor; the scope of the pitch register is over an octave and a half.
4) Uniform rhythms in a narrow pitch register: the same usage of the uniform field of durations as explained in the case above but in a pitch register not wider than two octaves at the most.
5) Groups whose trajectory show a strong direction (melodic arc) produced by a periodic variation in their translation values that positions the groups in the pitch register.

Each group uses tables containing a selection of micromode permutations to determine the relevant pitches, which are arrived at by either random selection or by following predetermined rules for their sequence. The agogic or dynamic accentuation is arrived at in much the same way, by selection of the accentual prototypes which are applied to the relative duration and intensity. The restrictions or laxity allowed the elements of the three tables will have important consequences in the ensuing phrases.

4. Separation and Linkage factors

Each group is articulated to the others by global registers that constitute the factors of separation and linkage which are responsible for their positioning within the register of the groups. The factors involved are:
1) Pitch register: a constant additive in the pitch field determines a translation of the tabulated interval structures (simple and complex micromodes).

2) Intensity register: a different additive constant in the intensity field carries the relative intensity values (agogic rhythm).
3) Speed register: a multiplying constant modifies the the relative duration values (agogic rhythm) varying the tempo or speed of the groups by contracting or dilating their durations. The numeric values which control these factors are selected randomly within a calibrated acceptable range.

5. Texture and Syntax

As occurs with AREM 1, this program also produces reinterpretations of texture and syntax.
As far as texture is concerned, the program produces monody (one active module) and polyphony (several active modules). It is also possible to create chords, the function of which is to add a new factor of accentuation by increasing the vertical density.
With regard to syntax, the program is able to control the reiterative or evolutionary nature of a structure according to which values have been selected from the tables that determine the material in each group.

6. Applications

The program may be used to assist in the composition of music, inasmuch as it enables the user to audibly check a priori configurations referring to pitch, rhythm, texture and syntax. Because of its complementary nature with AREM 1, it is applicable to live electronics. It can also be applied to assist in music teaching.

7.Aknowledgments

We would like to thank to Lorraine Smith for her help in preparing the English version of this paper.

8. Bibliography

Calzón, M.(1992). A program for the reinterpretation of musical input structures. *Proceedings of the International Computer Music Conference 1992 - San Jose*. The International Computer Music Association.
Calzón, M.(1992). AREM / ARMS - Reinterpretation of musical structures. *Proceedings of the International Computer Music Conference 1993 - Tokio*. The International Computer Music Association.
Kröpfl, F. (1987). Methodology of rhythm analysis. *National Convention of Musicology*, Buenos Aires, 1986. Centro Cultural Recoleta Edition, Buenos Aires, 1987.

SINAPSIS: A self-generating system of musical discourses.

Eleazar Garzón

Centro de Investigaciones de la Facultad de Filosofia y Humanidades (CIFFyH) de la Universidad Nacional de Córdoba.

Manuel Carles 3280. Poeta Lugones. Córdoba 5008 ARGENTINA.

ABSTRACT

SINAPSIS is a composition software whose more significant feature is its capability of "INTERACTION" with the user at the level of production of "Musical Discourses". For this purpouse, a setting similar to that of staging has been designed. On this basis, the system provides two structures: ACTORS and STAGE DIRECTORS.

By grouping and relating actors in networks, by asigning them to stage directors, and by overlaping and/or juxtaposing these latter, the user creates the structural plan of the work over which the system will generate (with each performance) a particular discourse (a SPECIMEN belonging to the universe of probabilities that such a model admits).

INTRODUCTION

The SINAPSIS programme appears in the same instant of creating a system of composition by means of a computer where this should have the decision in the preparation of the musical Discourse, but at the same time

this intervention should be userful in the development of the sonorous action in terms of UNITY AND DYNAMIC PROCESS of the discourse.

COMPOSITIONAL MODEL

Taking into account what has been expressed before a hypothesis of work was stated considering the development of a system simulating an analogous atmosphere to the one of a setting on the stage. In order to obtain this, two entities were created; the ACTORS and the DIRECTORS OF SCENE - the first ones are considered time sonorous structures and variables that determine potential margins of behaviour of themselves.

The second ones are in charge of selecting ACTORS, determine their behaviours (within the rank the actor admits) and conduct the sonorous flow.

ACTORS AND DIRECTORS OF SCENES

An ACTOR is:

- A list of temporary data and of MIDI messages.

- A set of variables that fix limits and characteristics of behaviour to the actor in:

- Time:

- Establishing if the temporary relationships between events should be kept constant or should admit modifications.

- Or determining if the speed in which the actor is played, will be altered in an increasing or decreasing way.

- Notes:

- Fixing the scale in which the actor is played. (Diatonic, pentatonic, chromatic, etc.).

- Establishing the measured transpose capacity in terms of interval (ascending and descending energy jump).

- And sonority: Determining the potential rank of modification of the amplitude for each actor's event.

It also has other properties:

- Behaving like mutant in the notes plane and timbre (procedure of cumulative selection).

- Establishing contacts with other actors or their own field.

- Autoinserting other lists.

With the capacity of mutating an actor as the possibility of establishing contacts among them (Markov Chaining), the system provides the user with the resource of a mechanism with theme evolution.

A DIRECTOR OF SCENE is a SELECTOR of ACTORS, their MODULATOR and the DIRECTOR of the temporary flow (sonorous action).

As selector he performs a recurrent activity calling the same actor or a different one each time, belonging to an associated field to this director.

As Modulator his activity consists of:

- Awakening the actor's behaviour concerning temporary in tone (transpose) and sonority, deciding what magnitude should be applied on each stage.

- Make an instrumental selection (selection of MIDI channel).

- Decide in case of an actor's insertion and/or fragmentation of the same. Establish in case of the application of an operation of deformation in the scale associated to it.

The selection of the actor, modelating instrumentation and deformation of scales is done in a probabilistic way.

As conductor orientates the dynamic tendencies of the discourse in the following levels:

- Space:

    1- Tendency to the high sound.

    2- Tendency to the low sound.

    3- Browning movement (each transpose ascending or descending transpose of the tone is done on the previous step).

The chosen percentage for the two first operations will determinate the strength of the tendency.

- Amplitude:

    - Progressive increase of the sonority itself.

    - Progresive decrease of the sonority.

    - Fluctuation between opposite terms.

- Time:

    - Progresive increase of lineal density (acceleration).

    - Progresive decrease of lineal density (desacceleration).

METHODOLOGY OF COMPOSITION

The methodology of composition with Sinapsis can be sinthesized as a set of steps consisting in:

1. Construction of actors (list of data time and MIDI) and establish their potential behaviour.

2. Grouping in actors' fields.

3. Construction of the directors of scenes establishing:

    - Temporary fluctuation margins.

    - General sonority.

    - Register.

    - Basic tone.

    - MIDI channel on which timbric selections could be made.

    - Types of dynamic conduction in time, sonority and space.

By means of the superposition and/or juxtaposition of Directors of scenes, the User can create a STRUCTURED PLAN where the system creates generates (in each performance) a particular discourse, A SPECIMEN that will belong to the universe of probabilities admited by that model.

Simultaneously to the process of elaboration of this the computer will activate the generators of sounds connected to the system and store the information in the form of a data list time and MIDI in the memmory zone for a further edition performance of the version of the storage in file (EGM or MIDI).

IMPLEMENTATION

Sinapsis was conceived as a Pascal Turbo language 5.5 to be run in a PC AT 386 or following using an interface MIDI, CPU-401 as a means of communication with peripheral generators.

Data MIDI sending of messages, including those for the Yamaha line (DX7, TX81Z, TG55 and TG77 have been implemented in Sinapsis together with the remote activation (messages of exclusive system).

CONCLUSIONS

A lot of experiments have been carried out, some of them have been oriented to the development of a complete composition, others have been oriented to generate partial fragments, having been observed that the system is apt to guarantee its efficiency as regards dynamic process and unity of discourse. In spite of that Sinapsis is very far to be in position to replace the creative role of the composer. Its possibilitties are limited to make contributions to a structural plan, a multiplicity of constructive proposals (simulations), some of them will be able to be used in due time.

REFERENCES

Bolognesi Tommaso. Automatic Composition: Experiments with Self-similar Music. Computer Music Journal. Vol. 7 N° 1. p 25-36.

Cuevas Agustin Gonzalo. Teoria de la Información, Codificación y Lenguaje. Ed. SEPA. 1986.

Dawkins R. El Relojero Ciego. Ed. LABOR. 1989.

Dewdney A.K. Un Relojero Ciego Supervisa el País de los Biomorfos. Investigación y Ciencia. Abril 1988 N° 139. p 88-92.

Holtzman S.R. Using Generative Grammars for Music Composition. Computer Music Journal. Vol. 5 N° 1. p 51-63.

Englert Giuseppe. Automated Composition and Composed Automation. Computer Music Journal. p 30-35.

Eigen Manfred. Cuasiespecies Viricas. Investigación y Ciencia. Septiembre 1993. N° 204. p 14-22.

Jones Kevin. Compositional Applications of Stochastic Processes. Computer Music Journal. Vol. 5 N° 2. p 45-61.

Lorrain D. A Panoply of Stochastic "Cannons". Computer Music Journal. Vol. 4 N° 1. p 53-81.

McAdams Stephen and Bergman Albert. Hearing Musical Stream. Computer Musical Journal. Vol. 3 N° 4. p 26-60.

Prata Stephen. Vida Artificial. Ed. ANAYA. 1994.

Rock Irving y Palmer Stephen. El Legado de la Psicologia de la Forma. Investigación y Ciencia. Febrero 1991 N° 173. p 50-57.

Roads C. Grammars as Representations for Music. Computer Music Journal. Vol. 3. N° 1. p 48-55.

Sumner Richard A. Patter in Music From B Kleinmuntz ed. Formal Representation of Human Judmen. New York. WILEY. 1968. p 327-343.