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Interactive Electroacoustic Performance Transactional Composition

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Abstract—This paper describes the hardware and software components and strategies for a composing environment that has been tentatively called "TransActional Composition" (TAC). The environment requires a Buchla Thunder, a Korg Wavestation A/D, a Roland CP 40, and a Macintosh computer running MAX and Voice Navigator. The paper details the background leading up to TAC and the TAC systems' architecture. A video presentation was appended to demonstrate some of the systems' capabilities.

Keywords—Electroacoustic performance, Transactional composition, MAX, MIDI, Electronic music, Performance environment, Computer music.

1. INTRODUCTION

Interactive live performance of electroacoustic music is now into its fourth decade and has a varied history of innovative performance schemes based on a diverse representation of technologies and instrumentation. I have been involved in live electroacoustic performance since the late 1960's. Many of my compositions, e.g., "Residue I," for cello, piano, and electronics, "Residue II," for multiple instruments, amplified chorus, solo soprano, tape and live processing, and "Graphos," for piano, percussion, and electronics, involve the processing of acoustic instruments during live performance. The basic format for these early pieces required one or more acoustic instrumental sources, stored information on analog tape (real-time recording and/or pre-prepared tapes), and analog real-time modular processing. With the development of high speed digitally-controlled synthetic instruments and a variety of alternative controllers, the potential for live electroacoustic (EA) performance has become remarkably enhanced.

2. TRANSACTIONAL COMPOSITION

I have tentatively named the interactive performance/composition environment TransActional Composition (TAC). TAC is an environment that intends to integrate predetermined composition materials with real-time improvisation.

The basis of TransActional Composition is a MAX program called *Quartseq*, that provides ways in which performers can interact with a composer-conductor. In its simplest form the performer generates music information that is transmitted to the program and the composer-conductor determines what kinds of actions will be invoked. The composition is developed by the performers reacting to the immediate present, by contributing prescribed information or "new" improvised information. This is further modified by the composer-conductor who may also invoke

other actions of the program. The TransAction becomes dialog between the prescribed and the personal.

The current format for TAC involves three performers and a composer-conductor. Two of the performers play acoustic instruments, and the third plays the Buchla Thunder (Thunder). All performers have varying degrees of freedom that depend on individual choices. The composer-conductor directs the activities of incoming information via *Quartseq* and electronic processing. All three instruments are provided with prestructured (composed) pitch and rhythm material, or unstructured (constrained random) pitch material to be shaped through and elaborated by improvisation.

The acoustic performers in this environment can play in at least three distinct ways:

(1) playing prescribed music (a score),
(2) improvising new music (based on instructions and models), and
(3) providing information that would modulate another performer's music.

The Thunder performer also has three ways of playing:

(1) playing MAX tables,
(2) playing stored Thunder information, and
(3) playing "new music" via random functions.

Thunder has more interaction with the prescribed or precomposed information than the acoustic instruments because, as a MIDI controller, it has direct access to *Quartseq*.

In its final form, this environment will sustain an interactive performance involving acoustic and electronic instruments with real-time electronic processing of sound and compositional elements.

TAC extends the notion of performance freedoms in works like Stockhausen's "Klavierstuck XI," Boulez' "Third Piano Sonata," and Bo Nilsson's "Zwansig Gruppen." These pieces allow for varying degrees of local ordering by the performer. In choosing an order, prescribed tempi, dynamics, and articulation are fixed with each choice, and in the case of "Zwansig Gruppen" (for three instruments), phraseology is affected by the combinational reactions between performers. In every case the composed phrase structures are subject to the performer's choice of ordering and rules are invoked governing other aspects of the performance.

3. HARDWARE

The hardware system requirements are two acoustic instruments (voice and clarinet) with Roland CP-40 pitch-to-MIDI converters, the Buchla Thunder, the Korg Wavestation A/D (WSAD), an Ensoniq DP4 (an effects processor), a MIDI interface, and a Macintosh running MAX and Voice Navigator. The architecture of the system facilitates bidirectional communication of MIDI information between the Buchla Thunder and the Macintosh. Unidirectional communication of the voice and clarinet MIDI processors provide MIDI information for the MAX program, while acoustic information is sent to the WSAD or DP4 for either signal modulation or effects processing and/or amplification (see Figure 1).

The system being reported on today only demonstrates an interim stage of development which includes the Thunder, the WSAD, and the Macintosh. The Thunder is a MIDI controller that relies on the WSAD as its sound source. Thunder is a programmable MIDI controller that is based on Buchla's long standing design successes with touch sensitive membrane control surfaces. The architecture of Thunder provides both programmable discreet and multiple function keys with full implementation of MIDI control features. Keys may be programmed for individual pitches, for velocity based on location, pressure and impact, and a full range of controller information. Keys may also be programmed to transpose, loop, fade, in either fixed increments or a variety of random choices. Keys may be flagged to activate or deactivate other keys and may be programmed to generate sequences that Buchla calls Effects or Riffs. An Effect is a preset string of commands that operate from an initial pitch. A Riff is a prerecorded gesture.

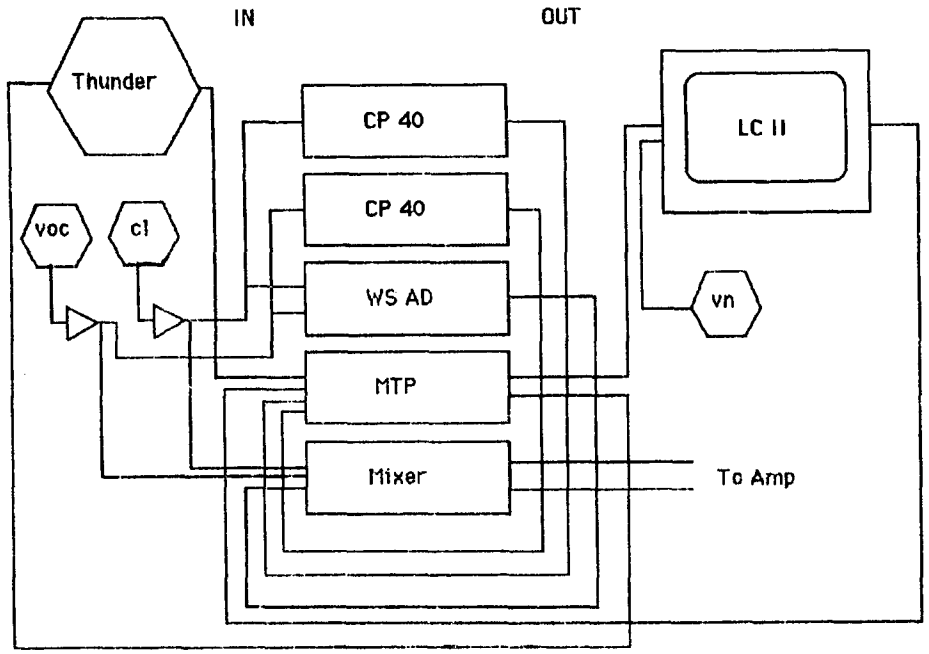

Figure 1.

One of Thunder's more attractive attributes is the generation of MIDI information by key impact, pressure, or location. By linking two keys, extremely subtle musical results are possible. In its current state, Thunder is programmed to access first stream information of recomposed MAX tables or second stream information generated from constrained random keys on the instrument itself. The Thunderpot (a large lateral control surface) is programmed to increment or decrement the stepping speed of the MAX tables. This looks at table addresses and allows the choice of either serial stepped table information or permutations of a table's information.

The WSAD is a digital synthesizer that may be controlled by either the Thunder or the Macintosh. The WSAD is completely programmable and has the capability of processing external audio signals. The WSAD uses advanced vector synthesis and wave sequencing with PCM-encoded wave forms to synthesize its timbres. Vector synthesis allows up to four wave sequences to be mixed or cross faded in real time. Wave sequencing is similar to granular synthesis with wave samples operating at either the wave form or event levels. For this demonstration, factory wave sequences are used, but special wave sequences are being developed for each performance-composition.

The WSAD has two effects processors that may be configured in parallel or in series allowing for multiple effects, including selective equalization and panning. The WSAD has two stereo vocoders included and an array of MIDI mapping and remapping. The WSAD was chosen primarily for its ability to perform analog-to-digital conversion for real-time processing and for its very high quality vocoders. The DP4 provides additional processing and mixing facilities.

4. THE SOFTWARE

The Macintosh computer runs the MAX program *Quartseq* that can modify musical information and constrain and direct the evolution of formal aspects of this information. Four voices have been chosen for Thunder-controlled instruments. *Quartseq* is divided into four independently controlled processing modules. Each *Quartseq* processing module begins with a sequencer/recorder followed by time expansion/contraction (tempo multiplier), time delay, transposer, independent volume and pitch bend control, looping, repetition, and finally, the pitch filter. The four processing modules are mapped to WSAD instruments and under control of the composer-conductor.

TAC provides interactive control over foreground (melodic and gestural material) and background (accompaniment and formal sectioning) along with the capability to perform operations on musical material in an action-response manner. Operations include recursion, reordering, transposition, variation, transformation of surface details, and shaping the dimensions and direction of sectional components.

Prescribed music information is stored in MAX tables or in "riffs" and "effects" in Thunder's memory. Randomization is accomplished in two ways:

(1) randomly accessing MAX tables, and
(2) interval constrained random pitch from Thunder.

Constrained random material is the randomization of original pitch material limited to elements within a predefined pitch interval.

TAC utilizes not only prescribed compositional determinants that function at both the local and the global levels, but also extends the choices of order by allowing phrase structures to be created and shaped in real time. Instrumental performers will generate local gestures; the composer-conductor will mediate and either store, modify (through variation or transformation), or provide direction and constraint to larger structural goals. Therefore, the instruments contribute local foreground material while the computer guides the development of texture and directs operations on material that determines background, foreground status. Structural goals, the dimensions of sections and their pitch goals are predetermined from table information and the pitch filters. Pitch filters are MAX modules that constrain pitch information overtime and direct incoming music information to a discrete pitch goal. The filters are designed not to lose information but to fold information outside the filter's operational band back into the band, thereby limiting the ambitus of music information. The filters may be programmed or controlled through intervention by the composer-conductor.

Each performance part splits into two streams that are individually chosen by the performer and based on an action-reaction paradigm. The two streams are:

(1) predetermined material, e.g., tables of pitches and rhythms, programmed gestures (Thunder effects or riffs), and formal sectional ambiti and goals, and
(2) free improvisation on constrained random (new) information.

The tables, therefore, are treated in two ways—in stream one, tables are stepped through in either serial order (each table component being performed) or in gapped serial order where table components may be skipped over. Stream two generates pitch information based on randomizing the MAX tables or generating constrained random gestures from Thunder directly.

The active-reactive play scheme is most like conversation or a dialogue between performers. Performers may choose, or later on, be informed of their active or reactive roles. This is very much like the relationship between solo and comping in jazz, or call and response forms in other styles of music. In this way TAC is a highly controlled form of improvisation that incorporates the ability to set both local and global aspects of form.

A performance sequence might be as follows: the Thunder performer generates a gesture either from stream one or two, and the composer-conductor may choose to record this with the same WSAD instrument or another instrument sequencer and store for later playback. As the piece progresses the composer-conductor may choose to play this sequence transposed by a perfect fifth and expanded by sixty percent of the original recording time. This then may be looped and faded with the sequencer recording a new gesture upon its completion.

5. THE TAC QUARTET

With the addition of the clarinet and the voice, more processing and sequencing modules will be added and new control modules are being developed for the modulation and effects processing

of the acoustic instruments. Because of the complexity of controlling all the MAX modules, we are testing the possibility of using Voice Navigator software/hardware to initiate or terminate commands in the program.

Voice Navigator (VN) is a hardware/software application that incorporates a voice recognition program that can be trained to recognize words and phrases that may be mapped to ASCII key codes. These in turn, may be mapped directly to MAX. VN was developed primarily to handle menu and command functions, but it also has the capability of handling continuous time functions like scrolling. VN requires teaching the recognition system with the operator's voice including background noise typical of the performing environment. We are currently testing a variety of microphones and placement and will eventually choose one that optimizes the voice level so as not to interfere with the performance environment.

We are presently running the program on a Macintosh LCII primarily because of the built-in sound synthesis firmware. This has resulted in a series of time-related execution problems. The final system will include a much faster Macintosh with considerably more RAM and the development of programming sequences that would minimize time delays.

In conclusion, I invite comments and criticism concerning the overall project direction. It is significant that the current version of both program and performance is in a developmental exploratory stage. The complete system for TransActional Composition will have the capability for storing and manipulating acoustic sound for later composition as in my earlier works. It is also designed to access MIDI information from other sources, e.g., dancers, graphics, and video. There are two other major additions that would bring TAC to completion:

(1) the addition of computer monitors for each performer displaying score information and directions concerning performance, and
(2) the development of a monitoring program that could learn attributes of previous performances providing another repertoire of performance opportunities.