MANIFOLD COMPOSITIONS
A (SUPER)COMPUTER-ASSISTED COMPOSITION EXPERIMENT IN PROGRESS

Sever Tipei
Computer Music Project
School of Music, University of Illinois

ABSTRACT

Manifold Compositions are defined, similarities and differences between classes of compositions and **Manifolds** are discussed, and previous attempts at producing multiple variants of a computer-assisted composition are listed. The current status of the system on which **Manifolds** are generated is presented, followed by a description of developments contemplated in the future.

The term **Manifold Composition** is proposed to define all actual and potential variants of a musical work generated by a computer which:

a) runs a comprehensive program containing elements of indeterminacy and
b) reads essentially the same data for each variant.

Since each member of the **Manifold** (variant of the piece) has a unique character and since, theoretically, an unlimited number of them can be created, a variant may not be presented in public more than once.

A computer-assisted composition program is comprehensive if, once it starts running, it does not require the composer's intervention to produce the final output. Once the process (the program's run) is set in motion, it acquires a life of its own, independent of its creator's will and, by distancing the composer from the details of the musical object, enhance the artist's opportunities to set up "thought experiments" (Dietrich 1987). Such programs are especially useful when the composers' goals are, as in the present case, of a speculative and experimental nature: the computer becomes a "black box" which provides ways for testing the imaginary or parallel reality proposed by the composer (Tipei 1989). In order to obtain a variety of individual pieces (**Manifold** members) the program has to include also stochastic or chance music -like features responsive to minor modifications of data such as the changing of the seed for the random number generator from variant to variant or the extracting of parts out of a larger ensemble by altering the time limits within which parts are active.

There are similarities between the concept of **Manifold** and that of "class of compositions". The latter was introduced by composers of aleatory music and designates all possible works resulting from the interpretation by the performer(s) of instructions and symbols offered in lieu of a traditionally notated score. Umberto Eco defines it as "the actualization of a series of consequences whose premises are firmly rooted in the original data provided by the author" (Eco 1979). In both cases all possible variants are equally valid realizations either of an abstract blueprint or of a process. The indeterminacy present in both instances allows a certain detachment of the composer

from the actual version of the piece. Both challenge the common view of the work as a static product, an art object given once for all, as well as the common understanding of what craftsmanship is. A strong bias toward what is called "open work" (Eco 1979) is created by both these concepts.

Some of the differences between **Manifolds** and classes of compositions are: While the author of a composition class invites the performer to display his/her own artistic, cultural and social conditionments, the former avoids them; similar to the traditionally notated chance music of John Cage, each **Manifold** member represents a frozen image of a performer- independent random process. The **Manifold** relies on the possibility of mass- producing its members (variants of the piece). Because of this, because of the relative speed with which variant is both computed and notated/printed, and because of the fact that a random number generator is employed, the **Manifolds** are an idiomatic way of using computers in composition. The preference for not presenting a **Manifold** member more than once stresses the ephemeral nature of the contact between audiences and any temporal art works. **Manifolds** become then collections of "throw-away" pieces except that, in stead of acquiring thus a pejorative quality, they reinforce the idea of alternative or parallel realities. Unlike successive performances of an aleatory piece, these alternative realities do not add up to a more complete, more general archetype but increase the open quality of the **Manifold** as a whole. On a more practical side, another consequence of the **Manifold** concept is that publishers become at least dispensable if not obsolete.

Previous attempts at computer generating multiple variants of the same work could be illustrated by the "*ST/...*" pieces of Iannis Xenakis, by Lejaren Hiller's "*Algorithms*", by Gotfried Michael Koenig's "*Ubung fur Klavier*" and "*Segmente*", and by Larry Austin's "*Protoforms: Fractals for Computer Band*". None of them have attempted, however, to mass-produce such variants and none is stipulating the uniqueness of each **Manifold** member. Moreover, the "*ST/...*" group uses rather divergent sets of data for each piece and a program which is not comprehensive; for Hiller's "*Algorithms*", more drastic adjustments of data than just modifying seed numbers are involved; Koenig presents all the variants as a collection of movements (or variations) to be performed in sequence, not alternatively.

"*Many Worlds*", for percussion players is an example of **Manifold**. Variants for three, five, or eight performers could be obtained by simply modifying the time interval during which individual players are active. A unlimited number of variants for each set of performers could be produced just by changing the seed number used. Moreover, each active percussion part is associated with a possible non-musical "peculiar event" to which a very low probability of occurrence is assigned. Consequently, some variants will include less such events than active parts, some variants will include a number of peculiar events equal to the number of active parts, and some variants will include none. This way, the differences between members of the **Manifold** are enhanced.

In "*Many Worlds*" all percussionists employ sets of identical types of instruments (although the choice of actual instruments is left to the individual performers) and all parts are generated by copies of the same data set with the exception of the dominant subdivisions of the rhythmic pulse (1:2; 1:3; 1:5) which vary from part to part. The result is a **Manifold** whose members are similar and unique at the same time due to the many levels at which they may manifest their identities (number of performers, sequence of random numbers, peculiar events, choice of actual instruments). These differences are non-existent or minimal ta the beginning of the piece and become more and more accentuated toward the end. During the piece itself, the parts drift further and further apart with the passing of time. The title is a reference to the "Many-Worlds Interpretation of

Quantum Mechanics" proposed three decades ago by Hugh Everett, III (DeWit and Graham 1973).

Presently, **Manifolds** are produced with **MP1** (Tipei 1975, 1981, 1985, 1989) which is implemented on the CRAY X-MP supercomputer of the National Center for Supercomputing Applications of the University of Illinois. A variant of "*Many Worlds*", for eight percussionists playing a total of at least 176 instruments and with a duration of 21 minutes, takes less than four minutes of CRAY X-MP cpu time to compute. The **Orpheus** program, under development at the School of Music's Computer Music Project, is used to transcribe automatically the output and to plot a score. Duration, pitch and dynamics are handled by **Orpheus** in its present form; it is expected that in the near future it will be able to accommodate composer designed symbols referring to other parameters as well. Fragments of the piece could be tested during its conception with the help of the CMP MIDI equipment allowing the composer to receive a prompt feed-back which is useful in spite of the coarseness of the audio results.

As mentioned elsewhere, **MP1** can deal with situations which could be described through Rene Thom's catastrophe theory (Tipei 1989): they are characterized by conflicting attractors which pull the music in different directions. Even if they can coexist for a while, the balance will eventually be upset and the music will abruptly change its character. (Aurel Stroe is a composer who has used extensively the catastrophe theory in his works during the last ten years). Among further **MP1** developments being contemplated is a greater emphasis on non-linear effects and on catastrophe theory as to produce variants which are even more distinct from one another. Together with the future inclusion of elements of game theory (games for $n > 2$ players) as a way to involve performers in compositional decisions without relying on their preconceptions, it will underscore the **Manifolds'** openness.

Finally, since the CRAY can easily accommodate treal time production of pieces for acoustic instruments or voices, a work and its score could be produced during the performance and a variety of factors unrelated to music could be made to influence the output: audience reactions, temperature, humidity, amount of light, time of the day, etc. It is also conceivable that real time sound synthesis could also be attempted in this context if the program is allowed to run on a dedicated queue.

REFERENCES :

Dietrich,F. 1987. "The Computer: A Tool for Thought-Experiments", LEONARDO 20(4)

Eco,U. 1979. "The Role Of The Reader" Bloomington: Indiana University Press.

Tipei,S. 1975. "MP1 - A Computer Program For Music Composition", Beauchamp,J. and Melby,J. eds. Proceedings of the Second Annual Music Computation Conference, Urbana: University of Illinois at Urbana-Champaign. 1975.

Tipei,S. 1981. "Solving Specific Compositional Problems With MP1", Austin,L. ed. Proceedings of the 1981 ICMC. Denton: North Texas State University.

Tipei,S. 1985. "MAIDEN VOYAGES - A Score Produced With MP1", Computer Music Journal 11(2).

Tipei,S. 1989. "The Computer, A Composer's Collaborator", LEONARDO 22(2).

DeWitt,B. and Graham,N. eds. 1973. "The Many-Worlds Interpretation of Quantum Mechanics". Princeton: Princeton University Press.

MUSICAL EXAMPLES

A set of 5 variants and a set of 3 variants of the same bars (265 - 275) of a **Manifold.** The music is similar in density, general activity, variety of elements (durations, pitches, dynamics, mallet changes, etc.) and, at the same time, each variant (member of the **Manifold**) is different.