

COMPOSING WITH TIME-SHIFTED ENVIRONMENTAL SOUND

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ABSTRACT

The author describes the compositional process involved in using sampled environmental sounds as the sole source material for his works *Pacific (1990)*, *Dominion (1991)*, *Basilica (1992)* and *Song of Songs (1992)*. All sounds are heard at their original pitch but are processed using a time stretching technique implemented in his software for real-time granular synthesis. In terms of timbral composition, the technique increases the perceived volume or magnitude of the sound. Such magnification allows the inner 'voices' of such sounds to be explored and their imagery and symbolism to be brought into the compositional process. As such the work may be seen as an extension of the "soundscape composition".

Since 1986 I have been working with the technique of granular synthesis (Roads 1978, 1988, 1991) and since 1987 with the granulation of sampled sound in real-time (Truax 1988) using the microprogrammable DMX-1000 Digital Signal Processor (Wallraff 1979). Briefly, this technique produces complex sounds by the generation of high densities (e.g. 100 - 2000 events/sec) of small "grains" on the order of magnitude of 10 - 50 ms duration. The content of the grain itself can be a fixed waveform, simple FM, or sampled sound, with a hierarchy of control parameters directing the density, frequency range and temporal evolution of the synthesized sound textures. With sampled sound as a source, particularly rich textures may result from extremely small fragments of source material. Since 1989, I have also been developing a technique that stretches the sound, in a manner I call variable rate time shifting. The technique leaves the original pitch intact, or alternatively, transposes the sound in each grain by a different frequency ratio. Compositional experience using the technique has been particularly rewarding [Truax, 1990, 1992b], and we are currently implementing the technique on a microprocessor controlled board with the Motorola 56001 DSP chip and a 68000 controller [Truax & Bartoo, 1992].

Briefly, the technique works by controlling the rate at which new samples enter the signal processor's memory from which the grains are taken. The lack of any pitch change stems from the fact that the samples in each grain appear in exactly the same sequence as in the original sample; however, successive or overlapping grains may be repetitions of the same material, hence the time extension. In these works, sound densities ranging up to 2000 events/second per stereo pair of channels were recorded on 8-track tape and mixed down in the Sonic Research Studio at Simon Fraser University.

In terms of timbral composition, the technique increases the *perceived volume* or *magnitude* of the sound without necessarily altering its pitch or loudness. First, there is the increase of spectral richness by the superposition of 12 versions (or 'voices') of the source per stereo pair of tracks. Such overlays intensify bands of spectral energy whether those of resonances or noise elements. Secondly, the simultaneous voices are normally not phase coherent with respect to each other because of the randomness of synchronization created by the variable duration of the grains and the delay between them. This temporal independence of voices (in the range of phasing and reverberation effects, viz. less than 50 ms) also results in an apparent increase in the volume of the composite sound. Finally, the time-stretching technique adds a third dimension to the perceived magnitude, namely spectra that are normally brief instants in time

can now occupy virtually any time span. The result is that even noise-like spectra (such as water or percussion sounds) have their momentary resonances prolonged and magnified and thus are perceived as having larger-than-life vocal characteristics.

Composing with real-time granular sound (Truax 1990) has opened up not only a new sonic world but it has also challenged some very fundamental ideas about what composition is. Whereas instrumental music models assume the note as the smallest compositional unit, granular synthesis works at the micro-level of the grain. Composition means working within the sound as much as it does creating larger structural units. In fact, in this technique sound and structure are extremely closely intertwined. The conventional distinctions, found even in computer music systems, of score and orchestra, or in MIDI between note commands and arbitrary synthesizer patches, are obliterated in a more integrated, even organic process. Moreover, the issue of compositional control which has been already challenged by the use of aleatoric processes must be rethought in terms of the complex interaction of parallel processes found in a real-time granular synthesis system. Deterministic and linear thinking are clearly inappropriate if not impossible; the composer is constantly being challenged by new concepts of sound and its organization and if for no other reason than that, the technique may resist widespread commercialization.

My first two works based on the granulation of sampled sound, *The Wings of Nike* (1987), for computer images by Theo Goldberg and two soundtracks, and *Tongues of Angels* (1988), for oboe d'amore, English horn and four soundtracks, use very short fixed samples of recorded material. In the first work, these samples are male and female phonemes, and in the second piece the samples are derived from the live instruments. Despite the brevity of the source material, very rich textures and complex rhythmic patterns can be obtained from it. The pitch and timbre of the resulting sound are determined by the source material unless the grain duration is too short and a broad-band spectrum results. However, the overlay of up to 20 simultaneous versions of such sound per stereo pair of tracks, each with its own variations, produces a "magnification" of the original sound, as well as the possibility of gradual or rapid movement through its micro-level characteristics.

The degree of magnification involved can be appreciated when it is realized that three of the four movements of *The Wings of Nike*, lasting approximately 12 minutes, were derived from only two phonemes, each about 170 ms long! The stereo tape is a mixdown from an eight-track original which includes four stereo pairs of the granular material, and therefore the vertical densities of sound are around 80 at any one moment, and the horizontal densities range from quite sparse through to 8,000 events per second at the very end.

The first work to use the time-stretching technique was a mixed-media performance piece for both children and adults called *Beauty and The Beast* (1989), a collaboration with Theo Goldberg's computer graphic images. The work also includes a soloist using English horn and oboe d'amore (Lawrence Cherney, who commissioned the work with the assistance of the Canada Council) who acts as the storyteller using his instrument. The narrative text of the story is embedded within the computer graphics as well as heard as verbal dialogue on the accompanying tape. This dialogue proved to be effective source material for variable rate granulation and, except for some use of the instrumental sounds for continuity during interludes, was the only source material I needed to create the soundscape that accompanies the graphics. The compact nature of speech, incorporating as it does many acoustic elements (e.g. pitch, noise, formants) in a short space of time, makes it a particularly rich source material for time extension.

My most recent work, *Song of Songs* (1992), for the same combination of elements as *Beauty*, uses male and female spoken voices reciting the Biblical text of the title, plus environmental recordings of birdsong from France, and cicadas, crickets and a monk singing along with a

monastery bell, recorded in Italy. Besides the time shifting, used to modify the rhythm of the spoken text subtly and make it more songlike as well as to prolong the sounds into sustained timbral textures, multiple pitch shifting is also used, implemented with the harmonizing technique described above. This enrichment allows a more complex timbral construction to be derived from the original that is emphasized even further by the time shifting. Moreover, the amount of time shifting was modified during the recording of certain tracks in response to others already present, thereby creating a constant interaction of all the material.

Time shifting of environmental sound is the main technique in three other recent works *Pacific* (1990), *Dominion* (1991), and *Basilica* (1992). For *Pacific* I used one sequence of sounds for each of four movements. The materials are recordings I made of Canadian West Coast environmental sounds, namely ocean waves on the west coast of Vancouver Island, boathorns in Vancouver harbour on New Year's Eve, Vancouver harbour ambience with seagulls, and the Dragon Dance in Vancouver's Chinatown celebrating the Chinese New Year. In *Dominion* the materials are recordings of Canadian "soundmarks" such as bells, whistles, foghorns, cannons, etc. as recorded by the World Soundscape Project during a cross-country tour in 1973. These materials are presented in an east to west direction with at least one sound from each province, suggesting a journey from "sea to sea". The work is divided into four sections, each depicting a region of the country and starting with a unique soundmark that signals high noon (the noonday gun in St. John's, Newfoundland, the Westminster chime and hour bell from the Peace Tower in Ottawa, a noon siren from a small town in Alberta, and the O Canada horn sounded daily in Vancouver). The Ottawa bell is played out in counterpoint with the bells of the Basilica in Quebec City, whose sounds were processed further in the tape solo piece *Basilica*. In this newer piece, the three bells are heard at their original pitch, as well as an octave lower and a twelfth higher, but all of these versions are stretched, often to more than twenty times their original duration. The extended versions allow the listener to hear out the inner harmonics inside the bells, and in moving inside the sound it seems as if we are entering the large volume of the church itself.

The technique of granular time-stretching which I have described provides a unique way to experience the inner structure of timbre, hence to reveal its deeper imagery (Truax 1992b). For instance, each movement of *Pacific* is based on the imagery inherent in the environmental sound used as its material. Moreover, in the composition of each movement, a metaphor is established that connects the sound to a deeper sense of cultural symbolism. All of this symbolism is designed to involve the listener strongly in the musical process, by presenting a larger than life image of sounds that are strangely familiar. Whereas a simple collage of the material would provoke recognition of it only as sound effects, the time-stretching draws the listener into the sound and evokes its imagery and associations, much in the same way as does the soundscape composition (Truax, 1984). The process results in what I have described as a music of complexity (Truax 1992a), a music that is strongly contextualized, in contrast to music composed according to the dominant paradigm, in which sounds are related only to each other, thereby creating completely abstract works of art. My aim is to relate the inner complexity of the sound to the outer complexity of the real world, such that the two are integrated (Truax, 1992c).

A music of complexity finds its basis in the unique contexts of the real world. These include its physical attributes (space and time, acoustics and environmental character), its social situations (specific individuals, groups, institutions, and cultural heritages), and also its psychological realities (emotions, archetypes, imagery, metaphors, myths and symbols). The composition and performance of a music of complexity cannot exist without specific reference to some or all of these aspects of reality. In other words, it is not simply a matter of analyzing the music with reference to these terms; the music is created in response to them as well. Hence its complexity derives not only from internal relations, as works in the Western classical tradition are usually analyzed, but from its external relations as well. This simultaneous motion

inward and outward provides a way of integrating sound and structure, the separation of which has been a hallmark of the instrumental music tradition. The abstract work of art grows out of a similar division between art and context. In short, a music of complexity allows not only the rift between sound and structure to be healed, where the two are inextricable, but also the division between music and context. Both art and environment have deteriorated with their separation, and a reunion cannot come too soon.

The dominant electroacoustic music techniques today that deal with pre-recorded sound material, in both commercial and art music, involve digital signal processing as 'post production enhancement' and digital samplers whose musical usage may be termed 'composing with sound'. The compositional thinking found in works such as *Pacific* and *Dominion* proposes a different approach that may be termed 'composing through sound'. In this approach, processing techniques are used to reveal the inner levels of meaning and symbolism contained within the timbres of familiar sounds. Instead of 'using' the sounds, one is 'used' by them, in the sense that their inner character informs the resulting music. By reversing the imperative of the domination of nature, which leads only to its destruction, we may be able to create models of a more balanced relationship between ourselves and the environment.

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