

Issues pertaining to the composing of “minimalist” loudspeaker music for home theater arrays

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Abstract

Loudspeaker music composed for home theater loudspeaker arrays is subject to a different set of aesthetic principles and production problems than is music (live or otherwise) prepared for concert presentation. Issues of scale, timing, dynamic range, spectral range, sonic materials, reverberance, the treatment of spatial issues and listener expectations will all be discussed.

A Note About the Aesthetics Underlying This Musical Genre

Loudspeaker Music

Loudspeaker music, as a private domestic experience not subject to the constraints and tribal rituals of concert performances, can be much more expansive, meditative, relaxed, informal and playful than live performances. Because the realization of this music is mechanical, length is only subject to (a) limits of the storage medium and (b) demands on the time constraints, patience and attention of the listener(s).

Because it is now possible to easily and economically incorporate a complex surround array of phase-locked loudspeakers into domestic spaces, it is possible to create complex musical interactions between loudspeakers (as solid sources) and also to create complex artificial sonic environments, ambiances and sonic immersion in ways that have not been possible until the past twenty years. In turn, these sonic environments can be extremely satisfying for domestic listening, as a primary listening experience, as background music for reading and other domestic activities, as music in support of meditation and as music in support of healing.

To date, not much has been made of these capabilities and potentials. It is important to recognize that they are extremely idiomatic for loudspeaker performance and they have the potential to generate musical experiences of great beauty, power and nuance.

Machine Music

“Machine music” is my term for music that is based on the realization of more or less complex mechanical patterns, both rhythmic ones and larger physical cycles. A fugue might be characterized as machine music. In the early 20th Century, considerable music was written that used this idea as a primary organizational element. Stravinsky’s “Le Sacre du Printemps” is an excellent and quite familiar example of machine music.

Loudspeaker music is particularly well-suited and idiomatic for machine music. The processes we use for the production of loudspeaker music lend themselves to the generation and resolution of mechanical patterns that are both fascinating and beautiful to behold. In particular, I find the processes of reverberance, and the tension/resolution qualities of complex phase shifting of disparate artifacts vis-à-vis each other to be fascinating natural processes.

Minimalism

“Minimalism” refers to a stylistic movement initiated by a group of painters, sculptors and composers working from the mid 1960s to date. A key feature of the minimalist style is the use of extremely simple materials and structures, often in extensive repetition. In music, Steve Reich and Alvin Lucier are well known for their minimalist work.

I have found more inspiration, however, in the work of sculptor Donald Judd¹, whose work usually consists of extremely simple structures in repetition that have come to represent, for me, “visual phase shift.” Other sculptors whose works have been inspirational are Michael Heizer² and Ingvar Cronhammar, who create extremely large, simple shapes or voids, shapes that often can never be fully perceived or examined. In Cronhammar’s case [Elia]³, the sculpture may interact with nature in ways that are both violent and potentially dangerous. Much of the interest and quality of these works lies in their mystery (and danger potential) as well as in the texture of the materials themselves of the objects or of the envelopes of the voids.

Several key aesthetic features pertain to such work:

- an extremely large scale
- simple shapes, often in multiple iterations
- slight variations in each iteration
- juxtaposition of iterations so that variation in light, texture and color are revealed, and change as a function of viewer perspective.

Comments about the work being presented at this conference

In this paper, I will discuss the specific issues raised by the piece of music I am presenting at tomorrow’s presentation, Composed Spaces Loudspeaker Concert.

Power Chords, Polyphonic Trains and Plain Old Phase is a minimalist work for loudspeaker array that was composed with the several of the above principles in mind. It was composed as a study pertaining to research for a larger compositional project I have been working on.

The work consists of what I think of as a large dynamic frame or bowl of reverberant sonic textures preceded by an introduction and followed by a coda. Within that bowl are numerous musical episodes that follow the dynamics of the bowl.

There is no programmatic intent – the work is entirely abstract.

Sonic materials

Sine waves and square waves

I created a library of sine waves ranging over seven octaves, tuned to a just Aeolian mode based on A. In addition, I generated a much smaller family of square waves, also tuned to that just Aeolian mode. These very simple materials constitute the primary materials used for the piece.

Interestingly, we seldom use “itches” above 2.1 kHz. (C above high C). In this work, there are sinusoidal pitches as high as 10 kHz., and it turns out that they have interesting and quite

powerful emotional qualities for listeners, representing a fundamentally different quality of pitch than we encounter with acoustic instruments.

Power Chord

I used the attack of a generic recorded electric guitar “power chord” to create the structural frame or bowl of the work.

Processes

Reverberance

Reverberance, in the physical world, is the decay of sonic energy in a reverberant space over time. Aesthetically, reverberance is an extremely powerful and emotion-laden sonic perfume (based, I believe, on safety cues for survival) that provides us with much of our very satisfying sense of envelopment, particularly in a surround sound environment. Electronically, reverberance becomes a highly flexible and versatile sound treatment that can provide us with resonant pitch, spectrally changing texture and spatial dynamism of a sound. Further, in our multichannel environment and with just intonation, reverberance can be used as an agent of what might be called “liquification,” allowing us to immerse ourselves in an active soundfield that is no longer separate or transient but instead becomes the auditory manifestation of the air in which we live and breathe. I find the sensation extremely pleasant, and unique to loudspeaker music.

In my work, the very slow decay of reverberance is a key element. When the reverberation time is several minutes or more, reverberation stops being the transient energy residue of an event and becomes instead, a continuum of sonic energy. And because it is dynamic and constantly changing as a function of its existence, it is of far greater interest to us than are the sonic materials from which it descends.

Beating and rhythms

Beating arises as amplitude modulation derived from sub-audio difference frequencies. When using very simple sine wave intervals, beating rates can be easily controlled. In reverberant fields, beating arising from simple just intervals, especially dissonances (1.250:1.333 or 1.875:2 – both are just half-steps, for instance), comparative low pitches yield very beautiful, ambiguous and constantly evolving reverberant pitch classes in addition to the shimmering rhythmic periodicity of the beat rates themselves.

In addition, in this work, I am using quintalets (groups of five), based on the horizontal plane of loudspeakers as a primary rhythmic elements, interspersed with the occasional sextalet (a group of six – which includes the overhead speaker as an accent). More about this below under hockets.

Intonation and modality

Tempered tuning based on the twelfth root of 2 is inherently if only slightly out of tune for all intervals except the octave. This means that all tempered musical intervals will generate beating, and in complex chromatic music that beating will be substantial. At the same time, the consistency of quality of the various tempered intervals more than makes up for the deficiencies caused by beating, particularly when there is little reverberance and a high crest factor in the music.

In my sort of minimalist work, however, where the crest factor has been significantly reduced and reverberance maintains the sonic continuum, tempered intonation proves to be comparatively ugly and disquieting, while more pure and stable musical interval ratios provide a very solid and satisfying set of modal pitch classes.

Power Chords, Polyphonic Trains and Plain Old Phase is modal, based on A and the Aeolian mode (all “white notes” on a musical keyboard). Root and fifth are quite obvious (to me, anyway), and the modal stability of the work over time is an essential ingredient of the work’s character. There are no other pitches than those in the mode, except for the quite complex spectral structure of the power chords.

Hockets

Hockets are a common (and ancient) musical device consisting of staccato rhythmic and/or melodic elements alternating among a group of instruments or sound sources. Hockets are extremely idiomatic for loudspeaker music (the “bouncing” tape echo loop that moves in time among speakers in an array, for instance, is both a cliché AND a hocket). In my piece, hocketing is a primary musical process, and almost all melodic sequences are also hockets, in that they “bounce” note by note from speaker to speaker in clearly defined rhythmic patterns.

The technique is extremely rich in potential for complex rhythmic and polyrhythmic patterns as well as quite interesting contrapuntal lines emerging and moving in both space and time. Hocketing permits the mechanical loudspeaker to have an inherently powerful rhythmic drive and pulse as a function of its technology, a potential that to date has been only partially developed.

Canons

The canon is another traditional polyphonic technique that is extremely idiomatic for loudspeaker music. The “copy and paste” facility of virtually all audio workstations today permit easy generation of canons, while pitch shifting and time compression/expansion permit canons that imitate in augmentation, diminution and modulation to be created easily and in great profusion. I use the technique at numerous points in the work, most audibly in augmentation (the imitations grow longer in time) in the coda.

Other related techniques, not used here

Below are some other techniques (but not all) that I have been working with and developing for this sort of music.

Numerological and physical organizations

The sorts of compositional approaches that I have described also lend themselves to the working out of numerological and physical processes. For instance, in one work I am currently finishing, the convergence of the Fibonacci series with the Golden Section provides the basis for rhythm, meter and a great deal of pitch selection (I use Fibonacci to model the overtone series, for instance).

Similarly, slow physical processes (such as the movement of sunlight) can be realized, where change is not perceptible on an instantaneous basis but is very clear and quite powerful over time. These processes can be dynamic, spectral, temporal and spatial, or complex combinations of some or all of these.

Comb-filter pitches

The derivation of pitch from recombined delayed iterations of noise (for instance, delaying a pink noise signal by 22.73 ms. and recombining it with its undelayed predecessor at unity gain will yield a comb-filtered pitch of A 440) results in some fascinating and quite beautiful and moving timbres. I am beginning to study the effects of these sounds in “choirs” of harmonic arrays.

Musical Dither

Musical dither consists of low level musical content (generally at between -70 and -50 dBFS), usually heavily processed, which serves as a “sonic noise floor” to establish continuity for the piece and as a masking agent to conceal undesirable low-level artifacts that sometimes occur in production. The choice of source for the dither and also its treatment have a profound if subtle effect on the mood and character of the work.

A Word About the Performance of This Work at an ASA Convention

The performance of this work at an ASA convention is “not what the composer intended.” Aside from issues of editing and channel reduction to meet the constraints imposed by the event organizers, the performance setting is entirely too closely related to “the concert hall” and too distant from “private listening for fun in a private space.”

The single most troubling technical issue is the one of audience size and listening position. As I noted in my other paper for this convention, the optimum listening area can seat only about nine listeners, seated so that the “time offset” and consequent rhythmic error between speakers is no greater than 10 ms. This means that, unless the attendance is quite poor, most of the listeners in the audience will not be able to hear a reasonably accurate rendition of the work.

The second troubling aspect (for me) is the ceremonial social time pressure inherent in such public performances, a pressure that constrains both time and attention. Concerts are highly ritualized and come with an elaborate overlay of expectations and demands for the attendees. In contrast, there is a luxurious and leisurely quality to “private listening for fun” that is almost impossible to obtain in a concert setting – a quality of free spaciousness and timelessness that is particularly pleasurable and valuable in our overly time-stressed world.

Therefore, the presentation here must be understood to be an out-of-context example of music that will have a great deal more effect and make a lot more sense when heard properly and in its own context.

Summary and Concluding Remarks

Power Chords, Polyphonic Trains and Plain Old Phase is a minimalist loudspeaker music composition that utilizes extremely simple sonic materials in a monochromatic modal structure that depends heavily on reverberance, patterns of phase shift and the sonic evolution of macrostructures. It is intended for private listening in a high-quality listening environment.

It needs for the following conditions to be true in order to be fully experienced:

- the listeners are at leisure and present at their pleasure and convenience, and they have essentially unrestricted and uninterrupted time;

- the listening room is quiet and has a comparatively short decay time;
- the seating is extremely comfortable and within 11' radius listening zone;
- the loudspeakers have very low distortion, high output capability, matched level and (extended) frequency response and are approximately equidistant from the listeners.

It is worth noting, in closing, something about the exhibition conditions and problems that the minimalist sculptors I have referred to encountered and struggled with. In Judd's case, he came to feel that the conventional museum or gallery context was incapable of fairly representing his work, due to its own constraints in terms of light, space and (I assume) noise and social turbulence. Judd's solution was to acquire a decommissioned Army base in west Texas and to convert the base warehouses into buildings of appropriate size and ambience to house his work.

Michael Heizer has taken over a remote desert valley in Nevada and is sculpting it in monumental scale (it is not yet open to the public), a scale so large that it can probably never be fully perceived by any but the most dedicated viewer, willing to spend days or weeks, on foot and by air.

Cronhammar's Elia (a large alien-appearing black steel monolith) is in a difficult and constrained placement on the edge of an art park and residential area near a small city (Herning) in rural Denmark. Given its singular monolithic quality and direct engagement with nature (it attracts lightning by design and also erupts flame volcanically, randomly, perhaps once a month on average), it seriously calls for a more spacious and remote placement.

From this, it seems clear to me that minimalism in general demands a very large frame, an outsize context, and through the presence of that frame reveals to us much of what minimalism has to offer, which is a revelation of scale, spectral and dynamic depth and complexity, and a non-egocentric vision of our relationship to the nearly infinite universe in which we exist.

Interestingly and fortuitously, I have found that a high-quality surround listening space with its home theatre array of loudspeakers coupled with the loudspeaker music genre may be, in comparison, an extremely compact, inexpensive, accessible and powerful vehicle for expressing these things. It certainly can be beautiful.

¹ Donald Judd, Nicholas Serota, ed., Distributed Art Publishers, New York, 2004

² Dia:Beacon museum in Beacon, NY houses numerous examples of works by Judd and Heizer, in addition to several other minimalists. More information can be found at: <http://www.diacenter.org/bindex.html>

³ Elia url http://www.elia.dk/engelsk/index_eng.html

Related ASA papers available for download at moultonlabs.com

The loudspeaker as musical instrument: an examination of the issues surrounding loudspeaker performance of music in typical rooms, by David Moulton, presented in Nashville, April, 2003. Available gratis as a PDF from the author at www.moultonlabs.com.

A new loudspeaker design: a case study of an effort to more fully integrate the loudspeaker into the playback room in a musical way, by David Moulton, presented in Nashville, April, 2003. Available gratis as a PDF from the author at www.moultonlabs.com.

Loudspeaker array as a musical composition genre, by David Moulton, presented in San Diego, November 2004. Available gratis as a PDF from the author at www.moultonlabs.com.

Design considerations for an idealized domestic surround sound listening space, by David Moulton, presented in Providence, June, 2006. Available gratis as a PDF from the author at www.moultonlabs.com.

For a fairly comprehensive history of the development process for the BeoLab 5 loudspeaker, see the Boston Audio Society Newsletter (The BAS Speaker), Volume 26, #3, available from the Boston Audio Society (www.bostonaudiosociety.org)