Infinite Length Pieces: A User's Guide

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Abstract :-

Imagine some future Stockhausen expounding at great length to an audience:

Dearest Listeners, I shall begin by explaining some facets of the composition you are about to hear. A few schemes and themes to listen out for. We might have a brief break to stretch our ears and complete our toilet. Then I'll press play and we'll listen till the end of the universe. Watch out for a particular mark of my genius in 43920 AD.

To go to infinity with gentle naivety, set a realtime composition machine in motion and leave it running forever without a qualm for when the first true repeat will appear. It is easy to proscribe a piece to be of infinite length. It is far harder to make sure that it has the capacity for variation without repetition within a given time scale. The technical part of this discussion is on these issues of variability. Even though the parameter space may be too large to mathematically repeat (compared to some astronomical time), the human can spot very quickly the qualities that an algorithm produces.

Issues surrounding the production of infinite length pieces are expounded and conjectured. Some existing Very Long Pieces are singled out. That we can discuss infinite length phenomena without experiencing them is a credit to the cleverness of the human mind.

Key-Words :- infinite, very long, length, duration

NOTE: It is predicted that these futuristic predictions will be proven false within ten years of their writing, leaving the floor open to new and improved predictions.

1. Getting Longer

Let us brush up on the history of long pieces.

Skip Wagnerian opera and begin at the beginning of last century with Satie [1], who found the quick minimalist way to infinity with the *Perpetual Tango*. Jump forwards to American radicalism. Note in passing that JC already claimed an infinite near silence of accidental noise with his *:':"*. Other artists gained similar quick infinities as the poetic conceptual scores of 50s and 60s experimentalism confronted piece duration. La Monte Young's *Poem for Chairs, Tables, and Benches, Etc., or Other Sound Sources* can be scaled to any time duration [2]. More pertinent yet are Young's later works; take the iteratively infinite *Well-Tuned Piano* that accumulates new material at each performance and is currently around the seven hour mark, or the Dream House [3] Manhattan loft performances that clocked a continuous six years playing in the early eighties, and give or forgive a few blackouts are on about eight years of this writing. The former work is limited by storage media and most critically by human performance restrictions unless it can somehow be automated or made a team effort with sleep breaks. The second work currently consists of an enormous title explaining continuous eternal sine tones. It may be a beautiful shard of eternalism, but to the standards of this paper is simply winning an endurance record with material that could fill a much smaller time.

The other big piece to play in our very long duration arena is Jem Finer's *LongPlayer* [4], running on a Mac in Docklands for well over two years now. Designed to play till the next millennium, Mac operating system updates allowing, this thousand year piece bumps up the time scale stakes with an important factor. Following a deterministic formula for phasing of multiple audio streams it is calculated to avoid exact repetition during that whole time.

Other projects in massive duration are bound to be brewing around the planet. We shall, or rather, our descendants shall, see what survives the tests of time.

2. Do We Really Mean Infinite?

The limiting case for us is to construct infinite length pieces that aim to avoid repetition. In practice, when we talk naively about the infinite, we are more sensibly talking in terms of astronomical time. The age of the universe is calculated to be about 12 billion years, so a billion years would be an exceptional target duration. For

LongPlayer and up, piece length is very long compared to a single human lifetime.
Having an infinite length piece realised necessarily involves the creator constructing an agency that can play on beyond themselves. We have a pure sense here where the composer must create algorithms rather than through composition. There are no apologies for involving computers in this discussion, as ubiquitous information processors suited to these tasks.

There is nothing to stop the design of a piece working to an infinity time scale, even if the universe may conspire to stop the whole piece playing. Since the universe could turn out to be expanding, you never know how much time is left.

3. Big Parameter Spaces

Imagine our goal is to avoid repetition across a massive time span. Then the combinatorial nature of music leaps to mind. There are estimated to be 10^{76} atoms in the (observable) universe [5]. If we use 76 independent parameters, each with at least 10 perceptually distinct settings, the total state space of the artwork will just have exceeded a huge astronomical figure. Programmers can't check every state of their programs, even if they are for aircraft safety systems. They only test a representative sample and trust that the inbetweens are well behaved, with no nasty nascent chaotic behaviour. The same goes for the massive compositional parameter spaces of our long pieces. We immediately have a design assumption; that in testing, the composition has revealed any quirks.

Parameter space analysis will be a critical part of setting up a long running piece. The mathematical explosion is tempered against the limitations of human hearing- parameter changes only work to the discrimination of the observer. Sensation spaces must be constructed that guarantee that all state changes are psychoacoustically discrete.

Yet the above discussion has skipped a cruel fact; why should the combination of putatively independent parameters give rise to perceptually distinct combined compositional states? When we put together the final music with our algorithm listeners can quickly hone in on the character of the output. They can do this because whatever the minutiae of the detail, the overall timbre and texture is also an experiential space. Listen to *LongPlayer* for a short while and you'll feel you know the sort of things it will do for the next thousand years, even though you can't predict its exact form at any one minute.

The different categorisation levels available to the critical human listener are the composer's enemy. As we discuss later, the piece itself would probably require autonomous evolutionary capability to get around some of these issues. We can design very complex algorithms, but end up with something that in analysis doesn't exactly repeat, but quickly reveals its secrets.

Setting up special events and paradigm shifts on long time scales is a way around this, but the level of time that must be invested in coding is growing very quickly. It takes games programmers man-years to write a new adventure that an avid player can rip through in two days.

If we allow a vein of pessimism, suppose that brutal listeners only judge pieces on three levels, harmony, rhythm and instrumentation. Then our optimistic 10^{76} point parameter space has reduced to size x^3, where x is the number of resolvable states of each parameter. To reach the number of atoms in the observable universe, we now need $x=10^{(76/3)} \cong 10^{25}$ distinct states in each parameter. Definitely not so easy to achieve.

With the perceptual levels of human cognition, one may need to leave detailed instructions near the piece on what features the listener should concentrate upon.

Whatever the provisos, the composer will be aiming to test his work as thoroughly as possible, so that a bad combination doesn't turn up during his funeral wake when the machine is finally left to its own devices.

4. Listening to Very Long Pieces

Even if a piece lasts a human lifetime with constant novelty, no human could possibly sit there and listen to it every day all day, missing sleep. In personal stereo playing of an infinite piece, random access would be helpful. Is this facility likely to be available?

For *LongPlayer*, such random access could be contrived, because of the fully deterministic schema. In general, computability is against us. Most recursive processes have no n stage solution ready at hand. It follows that most programs will need to be actually run to determine their state in the 803^{rd} year from now.
But here, where above we were concerned about human ability to discern the 'character' of general output, here that restriction could come to our aid.

In most cases, the type of output, if not its final exact form, should be available by the substitution of sensible starting values for year 803. These values would be known to the composer through testing. Further, if there are many stages of the composition, we can always access those like new levels in a game. So assuming that year specific environmental factors aren't critically involved, auditors can access the wrong year and try out the form, if not the final run, of future output. Past output is of course accessible from the constantly expanding server housing the artwork in the Infinite Piece Foundation.

We have kept referring to these long durationed artefacts as algorithms. The composer may distribute their composition in a source form, where tinkerers can maintain it through the ages with varying degrees of hacking. Sanitised easy interface versions for whatever the current computing trend is can be sent to homes where fast forward buttons allow an escape from the ignominy of the present day.

The aesthetics of long duration pieces are tied to the aesthetics of appreciation of algorithms. The critical point is that human minds have the capacity to understand infinite operations without having to step through every stage themselves. We can develop a sense of what an algorithm should do, though this is usually in combination with the experimental methodology of try it and see. For unrepeating masterworks that confound our 'kind of' coarse categorisation abilities, a human lifetime is enough to a solitary listener. Yet an aesthetic appreciation of a design grander than your own lifespan is still quite plausible; how else could one compose such algorithms intelligently in the first place? So what if a few consequences of your actions have later repercussions to world peace?

Our imaginations have begun to wander, so let us allow them to wander a little further.

5. Composing and Listening Cults

Extra options are offered by longevity through reproduction. Extend a composer family, be it Couperin, Bach or NewMusicComposer on a colony ship across uncharted territories of compositional dedication. If nepotism is not to be trusted, establish a sect of dedicated composers, a school of Pythagoras say, and a symbiotic cult of dedicated listeners to appreciate the work. composers teach listeners in an eternal cycle of hero worship.

6. A Stable Home in Space

Imagine now a post-apocalyptic society which has weaved its fragile stability around the only remaining cultural artefact of the old world- Fem Jiner's *SuperLongPlayer*. The high priests of the culture are the only ones allowed into the inner sanctum to tend to the great machine, but the middle temple, equipped with the only super surround system in working order, buzzes with initiates worshipping the great music.
The city of More is a harsh dictatorship where the slightest doubt about the claims to eternity of sonic art are met with summary sentence of deafness. In this cruel regime there springs an underground organisation, dedicated to the overthrow of the long running performance which has ruined all that is good and natural in society. The revolutionaries plot the suicide bomb run that will free the land of the despotic SuperCollider 7 and all who run on her.

Imagine also a less crazy scenario where future sonic activists have made the new art into the destruction of all old art. These piece killers seek out and hunt down any long running instance of the discredited old cultural hegemony.

Perhaps the best protection for a long piece would be a space probe, free of future civil unrest, until it crashes into a stellar phenomena ten million years into its flight. That is, if alien music lovers don't intercept the artwork and judge it by an inappropriate set of aesthetic criteria. But even a million years would certainly beat LaMonte's eight.

7. How to Make Very Long Pieces- The State of the Art in X Years Time

The only really infinite pieces could be adaptable AIs, autonomous composer robots that live forever and adapt to the society they find themselves within. AIs could make good guardians, though there are some dangers. Programmed to love what they create, they could become self indulgent. Programmed to keep being innovative they may find themselves in a post modernist quandary. Programmed to keep improving themselves they may evolve to a sort of perfect silence for ten thousand years before making a single bleep outside the range of even canine hearing.

All these strange factors would no doubt be blessed by the original creator of the Sonic Artist

Mk 2d, who would take out a patent on all future works.

Generations of AIs may be born and die in the pursuit of ever lasting Bach. Robot listeners and composers were unleashed in coevolving populations until the post post post integral serialist orthodoxy was established for a thousand years.

To get back to humankind, the future composer will of course factor in the psychoacoustic constraints of human auditors with the help of the handy Humaniser plugin to their software of choice. Evolution has hopefully stalled but if not, the software will keep up to date with any changes in human physiology and neurology. This will not contradict earlier stages of the long playing composition if previous ear model adaptation is also kept in line.

8. Don't Look Back

You know how it will be, you've just invested a considerable amount of time preparing your magnum opus to pass down to later generations and you press go. The random number generator takes the current time as seed, and you get a bad starting configuration that disturbs the premiere. The cruel critics pan the work before it has really had a chance to get rolling.

Should you revise your long playing composition once its started? You can improve your later infinite works, as you make bigger and better long players. Mind you, since your lifetime is kind of short compared to eternity there's nothing wrong with starting the piece again while you're around. If your great compositional rival started a day after you though, there may be some pressure to keep infinitesimally ahead claiming you thought of it all first.

As for guaranteeing the safety of your compositional baby through the ages, the safest bet might be a thought experiment destined to live forever. Whilst it may be below the threshold of hearing, for my composition I'll take the splooshing of liquid in the semicircular canals of the inner ear as the source material. Perhaps my composition will run for the length of time alloted to humanity.

Finally, before some mathematical philosopher brings it up, why not transfinite music? This may be an appropriate place to end the essay before we begin placing abstracted sets of musical objects in one-one correspondence with each other.

Composers I exhort you: go and create infinite length pieces, and lots of them! And if you'll excuse me for the rest of my life, I have to begin writing the listener's guide to my infinite magnum opus.

References :-

[1] Whiting, S.B., *Satie the Bohemian*, Oxford University Press, 1999

[2] Nyman, Michael., *Experimental Music: Cage and Beyond*, Cambridge University Press, 1999

Web Links checked Feb 2001
[3] La Monte Young's Dream House- http://melafoundation.org/main.htm

[4] Long Player- http://www.longplayer.org/

[5] The number of atoms in the universe- http://www.sciencenet.org.uk/database /Physics/0107/p01539d.html