

This article confronts notions of impossible music; music that wants to play with the limits of human physiology and cognition, music that engages with the singularities and ultimate questions of physics and philosophy, music that denies its own auditioning or brings to the audio range phenomena that would not otherwise be accessible to our auditory system.

I provide a draft taxonomy of characters of impossible music, to separate the impossible from the impractical, the unrealisable from the simulatable. These are higher level simplifications; the practical parameters would number many more for each case, and there would be some overlap of categories. Those parameters given here are meant to show some independence; a piece of impossible music might be computable but unauditionable, outside our current technology and unresourceable. It is by no means an attempt to be exhaustive, but provides a first draft of the scope composers might lift from limits and impossibility. Indeed, it would be odd to believe one could classify impossibility exactly since that requires full understanding of every limit of the universe...

Much inspiration was lifted from John Barrows book reviewing impossibility (Barrows 1998). He points out such aspects as the economic viability of projects, computability, and the growth of technological capability. Barrow also examines the mysteries surrounding the limits on scientific theories, and awkward situations where the exact form of boundaries remain unknown because we're constrained by those same bounds in the first place. We may not reach beyond them to look back and draw the barrier.

## Performance Ability

Music history is littered with the challenges of composers and the ripostes of performers, 'you can't write that, it's unplayable!' exclaimed Rubenstein to Tchaikovsky before the pianist worked up the first piano concerto. John Cage's Freeman Etudes were thought to verge on the

humanly impossible until Irvine Arditti did enough practice.

Yet some music is constructed to be too difficult for a human to perform faithfully. Composers like Nancarrow or Ligeti have written for mechanical instruments like the player piano or barrel organ. Computer automation allowed the flourishing of such styles as electronic dance music, with its inhuman rigidity of tempo.

Limits are not fixed but mobile, and there is an unsolvable question over their ultimate bounds complicated by drugs, cybernetics and slower moving evolution. Psychoacoustic studies, however, have honed our knowledge of the limits of human physiology and psychology for music performance and cognition (Collins 2002a has a large list of sources and further discussion), from which we can predict asymptotes. This growing body of information is a brilliant source for composers who wish to explore the ambiguous border between human and inhuman.

## Simulation, Computation

Computer simulation allows the construction of sound where our physical size or craftsmanship denies us access. Impossible instruments can be constructed, that exist only virtually. David Jaffe's string the size of the Golden Gate Bridge is built by changing a couple of parameters to his delay line physical model. Where practical matters block the composer, simulation gives a way around: whilst zero-gravity instruments are not high on the European Space Agency's priorities, they could be tried out in physical modelling software. Which is not to deny that seemingly impossible instruments have been built in the flesh; see Barrow pp 135, fig 5.5 for the world's smallest functioning guitar, sculpted out of silicon, magnitudes removed from even the playacted fiddle that sarcastic sympathisers bow.

I was very disappointed as a teenager to discover a Pet Shop Boys b-side, 'The Sound of an Atom Splitting' that wasn't authentically

recorded, but merely poetic license. Research work into sonification (Sturm 2001, Delatour 2000) shows researcher-composers trying to grasp previously unheard of delights. The domain from cosmology to particle physics is up for grabs to the modern computer musician. Still, why be held back by the rules of physics in our particular observable universe, when the space of mathematics encompasses so much more? Create sounds in alien media, lifted from inaccessible realms. To satisfy the ultimate Godly ambitions of the composer, create a new string theoretic universe in which your musical laws are physically valid. I hear they'll soon be turning them out by the blackhole load in laboratories worldwide.

Time for a computational proviso. Not all tasks that are conceived by humans can be solved by computer, either because the calculations are impractical, the classic drawback being taking longer than the age of the universe to terminate, or more fundamentally because the theory of computability tells us that certain questions have no general algorithmic solution. (Barrow 1998 pp226 fig 8.2) gives a finer classification of difficulties of computer problems in terms of time and space constraints.

An example of a work tackling this is a computer music composition whose pauses are determined by some facet of the halting problem; if a given randomly generated program terminates, play a note. You will never know if this composition is stuck in an infinite cycle of silence or not. Note that the composition can be implemented, it is just at the mercy of an unsolvable problem in its domain when running.

## Logistics, Economics, Interest

Whilst some projects are easily managed, others are unresourceable, due to the intractability of organisation, of available funding or just human priority. Imagine having every other person in the world as characters in a relatively large scale operetta. I can only imagine the premiere for when humanity is really bored, or has collapsed back to a population of two opera companies...

One might suspect some scale of achievability based on the number of human connections; tasks become exponentially harder the more people who get involved. I can't begin to list all the factors that might thwart large scale heroic projects, but with a little administration, the sound of ten million simultaneously stamping their feet may begin an artful earthquake.

## Realisation, Technology

The ballpark is constantly shifting, as we map out new territory, or alternatively, forget or suppress information. Scientific knowledge has massively increased over the last century, though future trends cannot be predicted; research could slow, reverse, or maintain its rapid pace. When tasks are within our current means they are well explored. When they are at the forefront of research, the pioneers are the compositional vanguard. It is possible to conceive of pieces that cannot be instantiated within current technology, even that are impossible according to current theory but may become possible at some future point due to a twist in scientific understanding.

Here's one that's almost certainly impossible to implement: Omniscient music; 'the sum of all sounds at every point in the universe' (likely resultant- white noise that blows your eardrums). Restrictions on information gathering prohibit the piece. You can't discount the possibility that some way around Heisenberg and Einstein will turn up; but you can take it as a pretty long shot. Even live networking between laptop musicians in different solar systems may not prove feasible, give or take a quantum entanglement.

Realisability has a social consequence for composition. Just because something is beyond current practise or technology doesn't mean it will always be out of reach. Composers often wrote for piano keys that hadn't been delivered yet.

There'll be those who'll argue that a composer should struggle to achieve what is tantalising in reach at the current moment. If you'd prefer to be obstreperous, lay down any number of dotty far reaching conceptions you

have no intention of implementing: spend a lifetime composing awkward legacies for kind future souls. You'd have to ask though, which future composer will relish rendering the bequeathed ideas of her forebears, when it's so much easier to knock out challenges to her own posterity? Any later interpreter, doing the hard work, may feel aggrieved not to receive first billing on the credits.

One day, my text music 'Clash two stars together (exclamation mark)' may receive its premiere. It will inevitably be disappointing as a sound phenomena, perhaps due to the culturally ignorant vacuum of space, the vagaries of plasma shock waves or our preference for the visual side of things. One can only hope some soundscape enthusiasts will be available to float blindfolded in space suits at the point of fusion.

## Cognition, Audition

It is possible to write music that remains outside the human auditory systems capabilities. The psychoacoustic limits on cognition and audition are a fertile ground for composers. We are very used these days to concept pieces whose write-up is interesting but whose output is out of range of our observation. A work whose event stream is too fast to adequately cognate can still be realised. In fact, our failures to cognate may become the effect, as in the timbral resultant of Ligeti's micro polyphony.

Remapping of events into the domain of our hearing, or sonification, was already mentioned and can be seen as an attempt to bring phenomena within our auditory scope for analysis by our great pattern spotting minds (which are hopefully not too biased to Beethoven or the Beatles to appreciate a good star cluster canon).

## Comprehension, Performance

There are practicalities of time and space to confront in the auditioning of sound art. For a half hour concert piece, a human has no difficulty listening to the whole work. For a thousand year long piece (if you don't believe

such pieces exist, go to [longplayer.org](http://longplayer.org) to hear one such work by Jem Finer), their lifetime (and dedication!) excludes an exhaustive auditioning. This does not mean that a human listener cannot understand the design of the piece, though alien artists or AIs might seek to design concept pieces that human minds cannot unlock. Further, whilst works may thwart random access auditioning, listeners might be able to sample enough pertinent regions in a short space of time to get a good image of that piece's sensation space (Collins 2002b covers this in detail).

For impossibilities of space, simply consider a work you can never hear: playing inside an impenetrable sound proofed box, or on a unique record on a distant space probe, or functioning in a venue no performer would enter, as with a lava proof DJ mixer.

## Logic

A work may include deliberate flaws designed to make it unrealisable in the form of contradictions built into the instruction set. Most pieces are well-formed, but the artist seeking impossibilities may delight in oxymoron. Paradoxical word games and thought experiments are easy to construct: 'the sound of this piece not being performed'. Paradoxes are traced to confusions between language and meta language, and are often speciously clever. Fuzzy logic revises the status of paradoxes by relaxing them to halfway between true and false.

As an example, here's a self defeating piece which is impossible to complete, a text music for pianist and hitman:

*Pianist: Select any one Beethoven Piano Sonata to play.*

*Hitman on balcony: If pianist moves to play a note, kill her.*

*The piece ends when the pianist has played any one Beethoven Piano Sonata.*

As for Gödel, in alliance with Barrow, I am encouraged and perplexed that whilst Gödel

proved that some mathematical systems were incomplete, whether this does or does not carry across to the physical universe is a matter of philosophical contention. Therefore, gather an indeterminate number of philosophers in a room and get them to discuss the question, ad infinitum. Call it Music for Philosophers.

## Conclusions?

If composition is all about establishing and breaking rules, what better set of rules than those of the universe; an engagement with the limits of science proves promising. Impossibility is intimately tied to limits, since what is impossible only makes sense in terms of what is possible. Limits are revised constantly: just because something is impossible at the present time does not mean it is outside our eventual technological capability (and conversely, what is easy now could become intractable again).

It is debatable whether the best impossible music is unrealisable, and different composers may seek different aspects of impossibility as their project. Ultimate unrealisable music cannot be created by a human, nor by a computer, nor by practical economics and the bounds of the physical laws of the universe, or better yet, any sensible universe. Which gives me an idea for a comic opera. One great thing about opera; there's no penalty in that medium for an inconceivable plot.

I look forward to the day of Stockhausen's Helikopter Quartet performed in Space Shuttles sent at 1/10 light speed in different directions. More kindly, imagine a performance of the spatial string quartet in a terrestrial environment using future conveyances that make no noise. Thus future technology solves the work's problems of spatialisation, though perhaps ruining its charm for diehard fans.

Science teaches us not to make absolute conclusions. In writing an article like this I must allow; no sooner do I lay down a challenge of impossible music, than some clever so and so will provide the living refutation of my claims. Whichever team of geniuses cracks 21<sup>st</sup> century science will no

doubt overturn a whole lot of cherished tables in doing so. This may mean artworks that seem very clever and impossible now turn out to have a more reasonable explanation. New limits will take the place of the old; but it's impossible that humanity's fascination with ultimate questions will ever wane.

## References

- Barrow, John.D. 1998. *Impossibility: The Limits of Science and the Science of Limits*. Vintage: Random House Group.
- Collins, Nick M. 2002a. Relating Superhuman Virtuosity to Human Performance. *Proceedings of MAXIS*, Sheffield, April, 2002.
- Collins, Nick M. 2002b. Infinite Length Pieces: A User's Guide. *Proceedings of MAXIS*, Sheffield, April, 2002.
- (both available as PDFs from <http://www.axp.mdx.ac.uk/~nicholas15/publications.htm>)
- Delatour, Thierry. 2000. Molecular Music: The Acoustic Conversion of Molecular Vibrational Spectra. *Computer Music Journal*, 24:3, pp 48-68, Fall 2000.
- Finer, Jem. 2000-2999. Longplayer. [longplayer.org](http://longplayer.org).
- Sturm, Bob, L. 2001. Composing for an Ensemble of Atoms: The Metamorphosis of Scientific Experiment into Music. *Organised Sound*, Vol 6, Issue 2, August 2001.