Novelty, Progress and Research Method in Computer Music Composition

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Computer music composition rests at the interface between science and art. This interfacial position has brought about excitement and interdisciplinary cross talk, but also some persistent problems in artistic output and professional work practices.

1 Introduction

Like other progressive art musics, electroacoustic music suffers a distinct lack of attention from the general public and is sometimes bested by a ghetto or excessively self-referential mentality within its professional community. The reasons for this are complex. First we examine some procedures and attitudes within our community that appear to contribute to this unsatisfactory situation. We consider in turn the following factors: working methods, imitation and synthesis, high and low art, performability, musical universals, tools for musical analysis, progress, and the viability of compositional research.

2 Working Methods

The working methods of composers are many and varied. Traditionally, there are two main paths of musical epigenesis:

• (Path A) Internalized hearing and development of materials;
• (Path B) Development of materials by interaction with an instrument.

Path A demands much of the composer's acuity, but it is the essence of compositional musicianship; path B, though essentially useful, is of less convincing value for complex and basically diverse textures. In short, the imaginative nonphysicality of path A is more versatile than the physicality of path B. Historically, both positions are found. J. S. Bach (when not improvising) and Schönberg used path A, whereas Stravinsky and Ravel often composed or orchestrated at the piano. In either case, the developed materials commonly become realizable when they are communicated to other performers, either by demonstration (oral culture) or by using written notation. The music finally crystallizes into a definitive version (even if this incorporates improvisational variation) in the course of rehearsals. Rehearsal entails not just practice, but invention of interpretation, repair of error, and in some cases revision.

Let us contrast this with the working methods of electroacoustic composers. It is impossible to be comprehensive, but this list may capture the most widely-used procedures:

1. Begin with (designed or found) algorithmic processes and realize them with (designed or found) sounds [B]
2. Begin with (designed or found) sounds and combine and transform them with software and hardware processes [B]
3. Generate and refine material using sequencer-improvise-and edit and MIDI sound engines [A, B]
4. Design a performance interface and use generating system and interact with it in real time [B]
5. Compose using notation (e.g., traditional, frame, etc.) and transfer it to the computer for realization (possibly using imitative timbres). [A, B]

The brackets following each procedure indicate whether it is primarily compatible with path A or B or both. Obviously, some of these procedures may be combined or extended in certain ways. The term sounds here. First, both paths A & B give real-time feedback for compositional ideas; integrated music conceptions can be immediately tested, and I believe this promotes authenticity of conception. Several of the above procedures allow this, but others, such as 1 & 2, even in these days of quick direct synthesis and real-time DSP programs, need not to, and this promotes constructionism framers of mind rather than integrated intuitive ones. Still, there has been tremendous progress since the early days of our field.

Second, and more substantially: these methods differ in how well they accommodate internalized hearing. Effective internal hearing is apparently based on an ability to accurately mentally code and integrate sound objects and sound processes. As we have seen, this is most critical with complex textures. Yet the ability to play back and edit via computer the sounds of a piece in progress, as frequently used in all these procedures (except #4) is not the same as having such internal hearing. The seamless integration of musical objects and processes, and the possibility of emergent formal design, a situation which can favour authenticity, is also not promoted by two paths A & B. Evidently, the ability to internally prehear composed electroacoustic materials or the effects of certain signal processing techniques on a given sound is quite challenging and does not typically approach the specificity of imagination that is found in accomplished orchestral composers who work with traditional sound sources—and this provides a working constraint on electroacoustic musical cognition.

Working methods that do not demand detailed cognitive representations of the composer may be more likely to produce music that lacks general appeal, because we know that one of the reasons that listeners show limited

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liking for contemporary art music is their inability to code it either on the basis of simple pitch or rhythmic structures, and hence assign it meaning (e.g. Smith and Wil 1999). If composers don’t build works from internally-heard cognitive maps, listeners are less likely to build or find one. (The same may apply to relative weightings of importance by the professional community, although this is untested.) This idea is supported by the consideration that where the meaning of electroacoustic sounds is established by other context such as film or drama, it is highly effective for the general listener.

3 Imitation and Syncretism

Imitation or simulation are widespread artistic stances in many 20th century artistic media. This has been driven by ubiquitous new technological capacities: the camera, audio and video recorders, flight simulators, immersive environments. Yet such machine-like (nonlinear imitative) computer visual simulation has created separate successful genres, while sampling remains a vital compositional resource, and while new techniques like physical modeling promise even better auditory simulation that is algorithmically extensible to new ranges of parameters, my impression is that imitation of traditional sounds has proved less and less satisfying to most computer musicians.

first, the ear always hears the difference (except with samples in isolation). If not soon, then eventually. Second, the difference is not normally in favour of the simulation (although there are different cultural values here and Japanese popular culture apparently has different preferences than the West). Third, economically-driven adoption of such MIDI-driven sounds in cartoon and television entertainment and lower budget work was also certain to spell their kiss of death from the perspective of the certifiable avant garde.

It is hard to dispute the aural sense in this position, but there are practical problems in composition which can be solved in no other way. Those who have indulged in serious orchestral composition know that the economic constraints on rehearsal time for professional orchestras precludes new music of any substantial virtuosity (some would say complexity) in nearly all countries of the world. Yet with excellent simulation timbres, which the dedicated composer can collect and refine—for certain no existing procurable collection is adequate—a highly credible and listenable result can be achieved. Listenable, that is, unless one happens to have access to adequate rehearsal time with real orchestras. Here in Australia we do not.

The same is true with virtuosic or structurally complex mixes of different “ethnic” traditions of music. The communication problems between different cultures, and differing musical habit traditions, notation systems, tunings, conventions of orality, etc. mean that only the electroacoustic studio environment may allow possible realization. Again the trade-off is inauthenticity of sound experience.

The central mission problem is not approximating the sound elements but the manner of their connection—more properly, determining that “elements” of speech or trilling or other kinds of motor behavior like music performance become complexly context-dependent with practice: what in psychological research in language or motor performance is called coarticulation. In other words, as one element is being executed another is being simultaneously prepared, and this looking ahead changes the current element. The coarticulation problem has been recognized as a major stumbling block for modeling speech production for many years; it emerges partially as articulation in music. If we ignore it then we are making computer music "unphysical" in failing to lay basic cognitive motor design in human communication. Unless this is modeled, and perhaps physical modeling is the best hope here, it will be another subliminal battle lost for electroacoustic composers.

There is also another divide between the complexity of sounds that the computer generates in production and those that do not. Mainstream computer music continues to harbour a reenactment towards things dance-like or motoric, as in mainstream contemporary art music, the rhythmically minimalist traditions still have an iconoclastic, diary, populist stance. In my view there are intermediary positions, but I cannot recall any ICMC concert where the audience was encouraged to dance. This reenactment seems to stem from intellectual positions that de-emphasize the importance of the body. I wonder if we can retreat from these polemics.

4 High and low art

It is obvious that the divide between high and low art occurs in our discipline and the position of most of the major bodies is unequivocally on the side of high art. As I have said in print before, this contributes to making the body of work in our field too aesthetically monolithic. Quite apart from style, simplicity and transparent carry risks for the high art composer, as methods will be understood, and perhaps deprecated on the basis of this understanding. My personal predilection is for complexity, yet in some sense complexity is a safe option: appropriate simplicity is very challenging to achieve.

5 Performability

The power and reliability of the studio environment have led to the humbling of the live performer, who is not as used to risk as (s)he once was. The economics of competition also act against risk, for failure may carry financial penalties. The projection of electroacoustic performance virtuosity lacks both an appropriate general

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interface and a widely compelling and visible set of control gestures and there absences visuate the focus and engagement of the audience. These limitations can also reduce the performer's vitality of involvement.

6 Musical universals and perception

There are substantive musical universals, and although their precise enumeration remains controversial and they cannot be discussed here for reasons of space, some have argued that music (such as most computer music) that contradicts universal tendencies (for such things as scale and rhythmic regularity and perceived fundamental pitches) faces an uphill battle perceptually, functionally, and commercially. Basing his argument on the perception of the success in clarifying some of the world's musical habits are readily apparent, since many of the universal properties of music must have some evolutionary genesis and this implies that the design of new circumscriptions will presage markedly different musics from substantive cultural impact over the time scale of cultural change, which is mimics in comparison to the time scale of physical evolution.

Using such arguments to argue for "reactory" artistic positions seems circular; however, the idea that increasing education will enable the generic listener to enjoy or understand abstract art music has little empirical support and runs counter to evolutionary biology. Indeed, as recent psychological research has suggested, there may be little increase in liking with increase in familiarity. The hope that electroacoustic music's restricted impact is due to some kind of tyranny of the airwaves or cumulative effect of poor aural education practices in society that are corrottable by wider training in perception appears likely to be a chimera. Likewise, we will not overlook visual perception by training. The varying bandwidths and semantics of the different sensory modalities seem to suggest that music in media will remain a handmaiden to visual phenomena indefinitely.

7 Tools for musical analysis

The lack of a viable system of music analysis for electroacoustic composition is a considerable problem. We rave so far no general solution to the problem of notation, no genre-specific traditions of aural training (as for example in timbre), no substantial body of agreed-upon masterpieces that interested students will cut their analytical teeth on, and no analytical procedures specific to what core repertoire we do have that goes beyond the level of identifying sound sources and isolated techniques. There is very little discussion about medium-term structure and the techniques of electroacoustic variation. In short, there is very little analytical work that treats electronic musical statements—as opposed to electronic musical tools—in depth.

8 Progress

In science, progress is fundamental and inevitably builds on specific previous work of others. Successful novelty is normally highly valued. In art, the valuation of novelty is cultural and societal subgroup-dependent, and progress is a problematic notion. While within certain periods increasing complexity and sophistication demonstrably evolve (e.g., 19th century Western art music), at other periods intentional simplification (mid-18th century rococo, late 20th century minimalism) or even regression (e.g., pastiche, 1980s back-to-bop jazz and movement) is operative. Hence the simple identification of progress with increased sophistication and complexity is problematic. Structural progress in one musical parameter often means a de-emphasis of the complexity of another, since the mean cognitive and attentional potentials of humans are unvarying on the time scale of cultural change. However, more sophisticated culturally-disseminated schemas can evolve, that allow improved "chunking" of information in working memory.

9 The credibility and viability of compositional research

Compositionally, neither novelty nor progress presumes the other; there is a more reliable sense of progress in the tools used by composers than in their statements. Yet even in this area of compositional research there are methodological problems. Primarily, there is a lack of systematic evaluation of results. The wheel keeps being re-discovered (and republished); to a degree not found in most fields. In my experience articles about compositional procedures often fail to cite previous work, or do so in such a perfunctory way that it seems apparent that the author has not absorbed the full results of the previous article. Far too often there is no attempt to integrate the current work with previous work. I illustrate this with two case studies.

Case study I: Nonlinear dynamics in music

The allure of nonlinear dynamics is palpable for many electroacoustic researchers and there are a number of papers that apply this to generation of music (see for example Hermann 199 and citations therein). However, there are not many that build on previous work. For example, an early article in this area (Praxing 1988) pointed out, as had been done before in other fields of application, that nonlinear systems exhibit certain consistent types of behavior that don't depend too critically on the particular mathematical equations used, and that this was handy. Furthermore, the intermittency regime (a particular class of mathematical behavior for nonlinear systems) was found to be by far the most useful as a source of musical variation. Yet later papers have mostly promoted one set of mathematical functions over another, and most often simply again described
the basics of nonlinear dynamics, giving little or no detail, little or no rigor, and little or no reference to specific types of behavior such as intermittency.

As a single example, a work by Little (1993) in one of computer music's frontline journals, *Interface*, describes yet again the ideals of chaos, and develops "new" compositional techniques based on chaos which have been well-documented before. The reference section to this paper has no references to music at all. It is possible to assume that the author has little or no idea that he is not the first to do this. Are we not entitled to expect more guidance of authors from the editors of our journals?

Case Study #2: 1/f noise

The idea of the overturning of truths which were formerly gospel can occur in any field, let us consider what one illustrative example may say about computer music: the use of 1/f noise distributions in electroacoustic composition. This type of spectral energy distribution occurs widely in physical systems, yet its theoretical foundations are still problematic (e.g., Voss & Clarke 1978). It continues to attract the attention of physical scientists, and because of its relation to fractals and self-similarity, some of the lay public.

Fundamental changes of perspective in physical laws inevitably percolate into the social sciences and to the creative arts, particularly music. The transfer of this particular "law" to the musical domain was initiated by the publications of Voss and Clarke 1978, Gardner 1978, and later Voss 1988. The claim was made that "frequency fluctuations of music...have a 1/f spectral density at frequencies down to the inverse of the length of the piece of music" (Voss and Clarke 1978). This distribution has now become a standard algorithmic composition method, and appears with significant discussion in standard texts such as those by Charles Dodge and Thomas Jerse (Computer Music), Richard Moore (Elements of Computer Music), and others (see Nettheim 1992 for further examples).

Yet the original paper and its extension are apparently seriously flawed in methodology and conceptualization, as examined systematically and compassionately by Nigel Nettheim in *Interface* 1992 (On the Spectral Analysis of Melody), who has written:

"The claim of Voss and Clarke that 1/f processes well represent pitch in music has been found in these preliminary studies of classical music to have only slender support, and the claim for duration must evidently be rejected." Nettheim's discussion I find convincing. He shows that the original work contained assumptions of statistical stationarity and independence of distributions in different musical parameters for which justification was not provided and indeed which are either unlikely or demonstrably contrary to empirical evidence, and concludes that "the appropriateness of spectral analysis as a tool for musical analysis (of note-to-note progressions) seems so far undemonstrated." The point here is not primarily to criticize the work of well-regarded researcher Voss, but to exemplify my belief that review processes in our discipline are inadequate.

Will Nettheim's work change the status of 1/f noise in computer music? Unfortunately, probably not. Composers will use available tools, and if traditional music and speech aren't 1/f, then we can build new perceptual skills, some will say: we are not slaves to history. My view is that we fight unnecessary battles in using nonperceptual guiding principles; 1/f noise is a seriously flawed music generation system.

Yet composition is an idiosyncratic matter: the composer's search is for particular solutions to particular problems that have arisen because of creative music and with contextually unique properties. General context-free theoretical principles are rare in art, but not in science. There is a tension between the needs to generalize and induce which are essential features of scientific method, and the impulses to particularize and make unique which are essentials of the creative arts.

References


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