
Book reviews

Perry R. Cook (ed.), *Music, Cognition, and Computerized Sound: An Introduction to Psychoacoustics*. Cambridge, MA: MIT Press, 1999. ISBN 0-26203-256-2.

The preface of *Music, Cognition, and Computerized Sound* describes the work as an introduction to psychoacoustics, geared to those interested in music. Designed to function as a textbook for independent study or for courses at the college sophomore level or above, each of the book's chapters provides a succinct treatment of a given topic. These are intended to be readily adaptable to lecture presentation or specific research needs. An appendix containing suggested exercises for labs and another containing questions and thought problems further support classroom instruction. The work is accompanied by a combined audio CD and CD-ROM providing sound examples related to the text and source code for those examples.

The terms used in the title – music, cognition, computerized sound and psychoacoustics – together represent a vast arena of potential inquiry. The scope of the book can be described as the intersection of those four domains plus specific trajectories that computer music inquiry has taken historically, particularly at Stanford University's Center for Computer Research in Music and Acoustics (CCRMA). In fact, the book finds its genesis in a course offered at CCRMA since the 1980s. All of the contributing authors – John Chowning, Perry R. Cook, Brent Gillespie, Daniel J. Levitin, Max Mathews, John Pierce and Roger Shepard – have been faculty, researchers or students at Stanford. How this prominent lineage in computer music research defines the content of the book provides an interesting point of reflection.

Within the common domain of psychoacoustics, the book covers the physiology of the ear, cognitive psychology related to hearing, the definition and metrics of sound, auditory scene analysis, scales and tunings in relationship to perception, and musical memory.

Beyond this, the research interests of Chowning and Cook are represented in a relatively large volume of material on the human voice, primarily on the mechanics of production and to a lesser degree on perceptual issues. This incursion into the physics of sound production is extended with materials on vibrato and nonlinearity in sound production mechanisms. The appearance of these topics reflects a historical computer music research thread in which the physics of sound production is

studied to inform emulation synthesis. The bulk of this material probably would not appear in a psychoacoustics book that did not have a computer music research frame.

The chapters that discuss the role of tactile feedback processes (haptics) in musical sound production and perception are another distinctive aspect of the book. I particularly welcome the inclusion of this topic, with hopes that it will bring the importance of tactile sense in expressive instrumental control further to the foreground in computer music research.

The final chapter in the book is a brief introduction to designing experiments in perception, geared towards the expectation that students taking a course complete a simple experiment in psychoacoustics as a term project. Given that many students likely to be taking such a course would not be trained in this discipline, this chapter seems a valuable and helpful addition. It covers the goals of scientific research, different types of studies, common flaws in research design, ethical issues, and statistical methods. It is clear, particularly in the latter case, that the one chapter cannot truly do the topic justice. But enough material is provided to cultivate critical thinking about experiment design at an introductory level.

Only a few things struck me as out of place or incomplete. The chapter on 'Storage and Reproduction of Music' discusses the encoding and reproduction of music. This is a topic of interest to the computer music researcher, and it is certainly linked to issues of perception. But in the form presented in the chapter – touching with only the briefest of treatments on topics such as LPC, deterministic and stochastic elements in phase vocoder analysis, and loudspeaker reproduction – it does not seem very helpful. The chapter 'Passive Nonlinearities in Acoustics', while potentially quite interesting, provides its concrete examples primarily in terms of circuit design and thereby probably precludes meaningful understanding by people not versed in electrical engineering. There was an opportunity lost here to provide a bridge to understanding of physical modelling in general and the role and modelling of nonlinearities in particular.

I was pleased with the clarity of the language and the presentation of ideas. I only identified a handful of sentences or paragraphs where I found the language overly convoluted or explanations incomplete. As such, the book should function effectively in its intended introductory textbook role at the college level. However, at

times assumptions are made about the level of understanding of the reader that may not prove to be true. In many settings, for example, one cannot assume that students will have a working familiarity with logarithms – or be able to readily extend the idea of logarithms into an understanding of decibel measures. Terms like ‘centroid’ or ‘inverse square law’ (or even the mathematical description of the Fourier series!) appear in the text with little or no explanation. Materials that can address some of these gaps can be found in the Appendix. For example, the suggested exercises for Lab 2 provide some elaboration on the difference between linear and logarithmic scales and relates this to the calculation of decibel measures.

Though the book does not address aesthetic issues directly, the materials certainly hold aesthetic implications. Some of these seem likely to raise the eyebrows of composers inclined towards acousmatic theory or those seeking to make spatialisation a primary carrier of musical meaning. In particular I refer to discussions of just noticeable differences in musical attributes and Shepard’s discussion of ‘dispensable versus indispensable attributes’ of musical sound. In a way, I wish that the book had addressed the aesthetic issues head-on in these contexts, though it is arguably out of scope. I find it remarkable the degree to which discussions of music theory are separated from discussions of psychoacoustics. Ultimately, music theory and psychoacoustic research will be tightly linked. We may be a long way away from the time when that can occur in a truly substantive fashion, but the implications of psychoacoustics research for music theory can be discussed now in such a way that connections between the two areas are encouraged. The book could be used to trigger such discussion in a classroom setting. Such a discussion could also touch on experimental design issues: In what fashion might aesthetic and cultural assumptions distort the design of psychoacoustic experiments and interpretation?

Though the disc that comes with the book is labelled as a CD-ROM, it is also an audio CD. Audio CD track numbers appear in Appendix C, listed in relationship to the chapters. Note, however, that the text itself contains no direct references to the disc; the relationships between the sound examples and the text are implicit rather than explicit. There were a few cases where it was not clear to me how a given sound example related to the text. The CD-ROM portion of the disc contains CSound, ANSI-C, MIDI and PV-script sources for generating the sound examples. This was a welcome surprise to me and can serve as a helpful resource to teachers, composers and researchers alike. The code is not commented for the most part, but the examples are probably simple enough to interpret and adapt despite this.

Overall, *Music, Cognition, and Computerized Sound* presents a fascinating range of information in a clear and accessible fashion (with occasional dabs of Perry Cook’s

humour as a welcome flavouring). The book should prove useful to people seeking to couple research in computer music and composition with an awareness of psychoacoustics and the physics of sound. The content is clearly defined by the historical trends of computer music research, and their unfolding at CCRMA in particular. But that is probably good news for people researching and teaching psychoacoustics in the computer music context. Portions of the book may prove less useful to people who do have an interest in music or sound but not in computer music *per se*. The book seems thoughtfully designed as a core text and resource for a college course and will serve well as such coupled with supplementary explanation.

Bret Battey

Patricia Kruth and Henry Stobart (eds.), *Sound*. New York: Cambridge University Press, 2000. 235 pp. ISBN 0-521-57209-6. RRP \$34.95.

God! Well, it starts with him and ends in ‘audiovisiogenics’. It is in fact 235 pages of reworked Cambridge Darwin College lectures from the 1997 series. ‘Some Aspects of Sound’ would have been a more descriptive title. One might add ‘. . . without any sound’, since there are frequent references to sound recordings, but no CD. I imagine that the original lectures would have been ‘illustrated’, or if you want to progress Michel Chion’s path, ‘audificated’.

There are nine essays: ‘Re-Sounding Silences’ (Philip Peek), ‘The Physics of Sound’ (Charles Taylor), ‘Hearing’ (Jonathan Ashmore), ‘Sounds Natural: The Song of Birds’ (Peter Slater), ‘The Sounds of Speech’ (Peter Ladefoged), ‘Ancestral Voices’ (Christopher Page), ‘Shaping Sound’ (Brian Ferneyhough), ‘Sound Worlds’ (Steven Feld) and ‘Audio-Vision and Sound’ (Michel Chion).

There is actually a tenth essay, ‘Introduction’, by the editors who do a very good job in pulling the fairly disparate elements together. Although their ‘linguistics’ (you see, I’m already hooked on Chion’s proposal that we need new words to describe new ideas and perceptions of air-vibrations and their interrelationships with our senses) – linguistic gymnastics – are admirably inspirational, they still point out the fundamental problem of describing and discussing aspects of sound with no sound. To signal that they knew it was the tenth essay, they end with six references for further reading. Cleverly though, Kruth and Stobart introduce the theme of silence as the first essay, neatly balancing this in their conclusion with an evocative description of one of John Cage’s last performances, seventy-five minutes of ‘Empty Words’.

‘Re-Sounding Silences’ gets you into the swing by asking more questions than it answers – for instance, ‘Why is it that divine kings throughout Africa seldom

speak publicly?’ The first three-quarters of this essay tackles the phenomena of positive silences used in ancient, non-European cultures. In his enthusiasm to back up his case, Peek may be overstepping the mark by stating that ‘“normally” silent creatures are chosen for a range of significant communicative cultural functions in the arts as well as religion’. What is not examined here is the possibility that the many creatures that do make noise tend also to be unmanageable and very capable of damaging artist and cleric. The final quarter skims over the converse notion that ‘it is abundantly clear that Europeans worry about silence’. The clear non-abundance of examples unbalances this essay. Nevertheless, I am drawn into the discussion and propose that, whether positive silence or positive sound, behind all this lies the perpetual scheming of the human animal, surviving through sound.

Out of the forest, into the laboratory. ‘The Physics of Sound’ is a heavily abridged textbook. Although the subject is better done by way of an ‘audiflicated’ lecture, or full textbook, Taylor attracts us by describing the profound impression that Dr Alexander Wood’s Cambridge sound lectures left on him. Those of us who know of Taylor’s animated and fascinating public lectures can ‘hear’ the examples as we read, but this easy dash through the tubes of sound may not work so well for others. The subject of noise is rather side-stepped in favour of an examination of tones and acoustics. Through tones, the path of additive synthesis is followed, but the equal and opposite subtractive is not. Much of the world’s sound is made by nature’s modulation and filtering of noise, a model that has been continued and developed as an essential ingredient in electronic sound synthesis. My point here is that there is no tone without noise, so the two extremes must be shown as equal and opposite. Taken at face value, this essay may fall between an over-long introduction to sound for secondary school physics and a refreshing evocation for the initiated, minus the juice.

‘Hearing’ starts neatly with the inferred message that there is much to do – the way is uphill: ‘Unlike the eye, about which Charles Darwin has much to say, the Origin of Species is silent about the ear.’ But this essay is actually about the workings of the inner ear, and even that becomes an introduction to the wondrous intricacies of the cochlea. Here presented is much memorable material. Did you know that a hair cell doesn’t sport a hair at all? Each cell offers around one hundred hair-like sensors, stereocilia, whose physical movements are converted into electrical signals. It must be said that the title is a little misleading. This book is called ‘Sound’. Sound, whether wanted or not, has to be interpreted, consciously and unconsciously. Therefore, in ‘hearing’, there has to be an element of ‘listening’, the individual’s making sense of the sound. Maybe the fundamental idea of ‘the whole picture’ is missing from this, and the previous essay. Taylor says, ‘Most people have their highest

sensitivity in the region of 1,000–2,000 Hz.’ Ashmore says, ‘we are most sensitive to sounds with a frequency of about 2000 Hz’. What neither says is that this is because the frequencies projected by the human mouth, apart from the fundamentals, that enable us to distinguish between the fricatives – the sounds that clearly define the voice-projected word – are in this frequency region. From this, the question arises: Did speech develop to fill the ear, or did the ear develop to best detect speech? So, this essay should really be called something like ‘Receptors in the Hearing Process’, but fascinating nonetheless.

‘Sounds Natural: The Song of Birds’ covers exactly what it says. Slater moves mellifluously through the subject: ‘Why sound’, ‘How birds produce their sounds’, ‘Sounds simple and complex: calls and songs’, ‘Why do birds sing?’, ‘Repertoire of songs’, ‘Song learning’ and ‘Why learn?’. The essay, although brief, is peppered with sonograms, graphs and tables. It encourages us into the fascinating world of birdsong. Birds have two throats within their syrinx, alternating between each or singing two completely unrelated lines simultaneously, making them the ultimate double-trackers. Indeed, most of what they produce audibly is enriching, even if you are surrounded by trees and sleep with an open window in May! Again though, the book’s Introduction mentions a Sound Event following the original live lecture.

Early in ‘The Sounds of Speech’, Ladefoged gives his game away by stating, ‘Now undoubtedly the most important sounds for humans are those of language.’ Predictably, what follows is rather long and dry. Will the fact that the syllable *ma* has four different meanings in Standard Chinese when pitched differently and the syllable *si* up to six different meanings in Cantonese ever be remembered by anyone who either doesn’t know it already or is studying these specific intricacies? Will the statement even be believed that, ‘In English, and in most European languages, the meaning of a word remains the same irrespective of whether it is said on a rising pitch or a falling pitch.’ Will you now try the following in the course of your daily diversions: say, ‘Yes!’ sharply in a low pitch – it means, ‘Yes!’; say ‘Yes,’ starting at mid pitch, elongating the ‘e’ and dropping the pitch slowly – it means, ‘I don’t really believe you!’; say ‘Yes?’ quickly, starting at mid pitch and rapidly raising it – it means, ‘That’s preposterous – you’re kidding – prove it!’. There are several others. But Ladefoged works in California, and we all know that American is a different and difficult dialect of English.

Not even Kruth and Stobart can fancy-foot their stride into Page’s ‘Ancestral Voices’. He uses seventeen pages to discuss the fairly obvious fact that we can’t really know and consequently can’t provide an accurate representation of the sound of music before the advent of mechanical recording. Somewhere hidden in the text is the idea that the social and philosophical views of the time are part of any performed work and therefore we

would have to be there, to travel back in time, into the smells, lifestyles and acoustics in order to hear, or better, experience it in its original form and 'frame'. But this idea is not brought forward to balance his examination of the changes of voice tone and vibrato through the centuries, for instance. However, the material that is produced provides stimulation for our continued delving into the world of consonance and dissonance.

Ferneyhough follows on to develop this in his 'Shaping Sound' which, teasing his passion for alliteration, could be 'Sonic Simulation Style by Shaping Sentences'. The editors even admit that the text is 'quite appropriately, almost beyond words'. Style-warning aside, he illustrates this study of twentieth-century music-making techniques in his sections, 'Percussion, the urban sound', 'Sonorism and sound mass', 'Sonic innovation, critical theory and social Utopia', and 'Parameter to spectrum: a material history of sonic legitimation' with descriptions of appropriate composers' works supported by score examples. Early on, he proposes that a sudden increase in percussion awareness, led by jazz and other ethnic vibrations, radically changed the sound world of Western concert music in the twentieth century. I propose that percussion was the battering ram that broke the door down, but it was mechanical recording that excited the crowd to grab the ram. The moment it was possible to record something unique, including the preposterous, private and impossible, it was done – the Okeh Laughing Record, various historical events, Beatrice Harrison (cello) with nightingales or church bells, birdsong, tap-dancing. Add the like of these ingredients to various styles of music all into a 'Gramophone Parlour' at an Exposition in the early twentieth century and you have an acoustically mixed model of much music composition for the rest of the century.

Feld exercises his anthropology in 'Sound Worlds'. He demonstrates his straddling of the seesaw of worlds of sound and sounds of the world with one example of each. The first part is a concise examination of the term, and social implications of, 'World Music', from its birth as an academic convenience to its middle-age as a commercial success label. In direct contrast to this, he presents the Kaluli tribe of Papua New Guinea, not quite their world of sound but more their body of song, their sound of word. While he is engagingly successful in pointing out in some detail the individual's belonging to the song, and the reverse, he does not really study the 'sound world' of individuals in the tribe, although he repeats that phrase many times in the text.

Concluding this cranial crunch of sonic s(t)imulation, 'Audio-Vision and Sound' is an extra chapter. I imagine this means that it wasn't in the lecture series but Chion sold it to the editors later. This man is certainly a salesman: two-thirds of his Further Reading is by him. Anyway, the essay grinds away in building support for my long-held theory that one receives a 'sound film' as a homogenised body of audiovisual experience, but all too often the compositional methods and subsequent

analyses are performed on the various isolated ingredients, fragmenting and weakening that body.

Chion makes up several new words in his analysis. These will be either amusing or thought-provoking, and represent the exhilarating problem which, you will no doubt have gathered, runs through the book – and a fair amount of our lifetime: how to represent or replace sounds with words. Equally obvious by now are the wide variation of methods suggested and the degrees of success. Each chapter is followed by short helpful lists of Further Reading, five of which are extended with even more helpful 'and Listening'.

The words are on a good if slightly thin glossy/chalky paper of 170 × 246 mm, with an ample 35 mm border all round for you to compose your new words and generally annotate the whole volume. It's certainly not an easy read, but offers stimulating rewards for perseverance, whether you're a composer striving ever higher for enharmonic clusters, a theoretician trading new words for newer, or a sound buff attempting to understand and unravel the string of sensorial vibrations that binds the universe.

Ron Geesin

David Cope, *The Algorithmic Composer*. Madison, WI: A-R Editions Inc., 2000. 302 pp. with CD-ROM (Mac format). ISBN 0-89579-454-3. RRP \$49.95.

The Algorithmic Composer forms the last of a trilogy of books following the development of David Cope's work in algorithmic composition. The first was *Computers and Musical Style*, which appeared in 1991, followed in 1996 by *Experiments in Musical Intelligence*. All three books appear in A-R Editions' Computer Music and Digital Audio Series.

Chapter One of the present volume is titled 'Background' and first discusses some historical precedents for algorithmic composition in the mainstream of musical history, going back to Philippe de Vitry's combination of *color* and *talea* in the isorhythmic motet of the fourteenth century. In a relatively brief following section the author describes some contemporary algorithmically based computer music programs, focusing on Common Music, Patchwork and Symbolic Composer, all of which, as it happens, employ LISP, as does Cope's own work. He then summarises his own earlier work as contained in the programs, Experiments in Musical Intelligence (EMI) and Simple Analytic Recombinancy Algorithm (SARA), and presents the case for a new program. This should be interactive, able 'to keep a running tabulation of the melodic, harmonic, motivic and structural content of a current work as well as maintaining a sense of a composer's overall ongoing style' (p. 35). Cope's attempt to provide such a program resulted in the new program Alice (Algorithmically Integrated Composing Environment), with which the rest of the book is largely concerned.

The next chapter, 'Fundamentals', describes some smaller 'tryout' programs – those that Cope has developed to explore ideas or certain aspects of programming technique – which are presented on the CD-ROM and from Alice benefits to some degree. First is 'Fun', a simple random drawing program, which possesses no claim to intelligence. The next program, 'déjà vu', performs a certain amount of analysis of what the user has drawn, and can consequently associate images and classify them by name on the basis of the recognised features. The third is a natural language program called 'Backtalk' that analyses typed responses from the user and develops a primitive dialogue.

The proclivity to the principles of analysis displayed in these programs prepares us for the next chapter, titled 'Inference'. By this term Cope indicates the synergy of analysis and association, a prerequisite to any application of musical intelligence. There are interesting sections on how Alice deals with voice leading (e.g. in tonal music), and with the analysis, processing and generation of related pitch-class sets. Some may think that these techniques would be of little interest to many contemporary composers, but they do indicate a praiseworthy tendency on the part of the author to comprehensiveness. While the earliest versions of Alice used combinatorial principles and augmented transition networks to develop musical continuity, Cope felt the need for the application of analysis on prior material (either in the form of an external database or within the current work-at-hand) to extend and deepen the musical connectivity. This is done by allowing Alice to extrapolate rules according to an ingenious technique fully described in the book, employing the list-processing possibilities of his chosen language. This avoids the need for some explicit rule definition by the user.

Chapter Four, 'Creativity', expands the concepts of Alice's compositional principles by applying rules-about-rules and going beyond the pitch paradigm to the organisation of rhythm, dynamics and texture. Chapter Five considers formal matters: structure and coherence within an Alice composition. This is probably one of the most illuminating chapters for the reader who is interested in how Alice operates. The subject of musical *signatures* is discussed: an important concept, which Cope introduced in the first book of the trilogy, and defined as 'contiguous note patterns that recur in two or more works of a given composer, therefore indicating aspects of musical style'. Signatures may develop over time and 'can provide valuable insights into how a given style matures' (p. 148). Examples of signatures from a number of classical sources are given. The process of signature recognition through pattern matching is indicated, and extensions of this idea through hierarchical applications are shown, arriving at what Cope calls 'meta-patterns', which Alice can use to match signatures to their evolving musical contexts.

Cope has also defined two further concepts, which

Alice can use to extend unity in a work. These are *unifications* and *earmarks*. Unifications are patterns found in a single work in a database that contribute to the unity of the work. Alice quantifies and types them, and employs them to extend music-in-progress in natural ways. Earmarks are patterns raised to the status of gesture, occurring in definite locations within a work, such as cadenza passages.

As well as the pattern-matching and other analytical tools employed by Alice, Cope has incorporated SPEAC analysis. Derived from the theorist Heinrich Schenker's work, SPEAC stands for Statement, Preparation, Extension, Antecedent and Consequent. Notes or phrases may be classified according to their function within the musical continuity, and Alice can employ these classifications to assist larger-scale formal coherence.

Chapter Six, 'The Alice Program', describes in practical terms how a composer might use the program. This is appropriate, because a robust version of Alice is included on the CD-ROM, with source code for those users familiar with LISP who may wish to extend its functionality in ways suited to their own way of working. However, two points should be noted here. First, Alice as presented on this CD-ROM is a Macintosh program, and there is a suggestion it may only be suitable for a certain range of Macintosh computers, at that. Secondly, as Cope warns, the user should not imagine that composing with Alice is necessarily easier than composing without its aid. The choice of the musical material for the database (typically, one or more earlier works by the composer, or selected sections of such) is critical for matching to the analytical and compositional choices the user extends to the program. A poorly matched database can only give poor results.

In use, Alice is likely to be highly interactive, with the user choosing databases, setting control thresholds for the pattern matching processes, choosing the best output from those offered by Alice, and so on. Input is via standard MIDI file, which may be supplied from the user's choice of notation program. Extended output can also be converted from a standard MIDI file to conventional notation, or can be heard directly via an appropriate MIDI synthesizer. While working with the program, the user may choose from a number of displays of analysis results: statistical graphs of pitch distributions, texture maps, etc.

Chapter Seven, 'The Future', discusses some shortcomings of Alice, imagined or real, and some ways in which the program might be extended. Among the shortcomings are those associated with MIDI, e.g. the difficulty of varying the dynamics of a note during performance, or of varying the articulation of instrumental performance. Ways to personalise the program to conform to certain composers' methods of working are suggested, and the implications of using very large databases, for example incorporating the works of several composers, are explored. The main limitation at present for this is not just the amount of memory required, but

also the processing time for the multiple pattern-matching processing and analysis that must take place.

Cope's final statement of belief is optimistic: 'I believe that collaborative composition between humans and machine programs during the next millennium will become more personal and more personally meaningful. Ultimately, the differences between human and machine that so many feel so acutely will disappear, and the two will seem as one.'

David Cope is to be commended in producing a book of great interest and importance in the application of computers to musical composition. He has been generous in providing a major program, *Alice*, for algorithmic composition on the CD-ROM, together with many smaller programs of related interest, and performances of the book's musical examples. He appears to be inviting collaboration from interested fellow-composers in developing *Alice* further and perhaps in personal directions. Of special interest in *Alice* is the large number of alternative forms of analysis that may be used – the program can provide many ways of viewing what the composer is doing, to the point, undoubtedly, that may reveal unexpected if not unsuspected tendencies.

As fascinating and worthwhile as the techniques Cope has introduced undoubtedly are, I question whether this is the approach the informed composer-programmer

should be taking for algorithmic composition. The reliance on a database of prior work which is then analysed for tendencies for recombination, however sophisticated, is a bit like, as McLuhan put it, driving into the future with one's eyes firmly on the rear-view mirror. Cope appears to be aware of this: 'I have been cautious in my estimation of the innovative worth of my ideas, preferring to believe that newness is often merely the embellishment of older, possibly less understood ideas. In all my work, there is a strong thread of reliance on extant music rather than the development of new formulas.' (p. 265) If a composing program relies on a database of previously composed music, then however good the analytical processes are, the resulting music can never be better than the model(s) in the database. I feel, therefore, that Cope's work should be viewed with great respect in the application of analytical principles to music, but should be eschewed as a model for composition, which must be allowed to give greater rein to new and possibly experimental modes of compositional strategy. An algorithmic system that permits such experimental thought is likely to give more exciting results, while no doubt presenting greater challenges to our current musical preconceptions.

Richard Orton