reviews

Curtis Roads, ed. *The Computer Music Tutorial.* MIT Press, 1996. 1,234 pp.

Joel Chadabe. *Electric Sound: The Past and Promise of Electronic Music.* Prentice Hall, 1997. 370 pp.

Reviewed by Douglas Geers

To the uninitiated, the field of computer music may seem a bit overwhelming, in that it combines new technologies with music composition and performance practices that often seem quite distant from the Western classical tradition.[1] In fact, the constantly evolving technology makes it difficult even for specialists in the field: imagine being a violin instructor in a situation in which every few months several new violins with different shapes, which require new playing techniques, come to the market, purporting to be vast improvements over previous designs (and which often are)!

This analogy might make some musicians want to give up on computer music, but the fact is that our entire society is undergoing a technological revolution, and it only makes sense for musicians to utilize these innovations too. Just as Wagner employed the improved brass instruments of his day, a wide array of possibilities are newly available to today's composers, theorists, and musicologists—because of computers. For those who are intrigued but unsure where or how to get started, two recently published texts combine to serve as a thorough introduction to both the history and techniques of computer music.

The Computer Music Tutorial

Edited by Curtis Roads, this is a massive and exhaustive introduction to nearly every aspect of current computer music composition and research. Moreover, despite its encyclopedic breadth, the soft-cover edition of the book is listed for $50.00—cheap, by textbook standards. Very soon after its publication, *The Computer Music Tutorial* has already achieved "classic" status in computer music circles.

The greatest value of this book lies in its wide array of topics and in their thorough presentation. Every major subject in the field of computer music is addressed, and many of them are dealt with in sets of multiple

chapters. Moreover, these discussions progress logically from basic concepts to quite advanced ones, and give many references to specific articles or books for readers who want to explore topics even more deeply. In fact, all of the references are compiled into a single list at the back of the book, which is nearly *one hundred* pages long! Obviously, this is a serious work of scholarship and a valuable resource for anyone doing composition or research in the field.

The book's editor and primary author, Curtis Roads, is former editor of *The Computer Music Journal,* the premiere publication in computer music. Roads's experience in writing and organizing texts shows itself here: despite its huge size, the book's structure is immediately clear, making it easy to "zoom in" to a particular topic quickly. Since the chapters are grouped in categories, the general topics are rather obvious. However, if a reader is unsure about exactly what a single chapter covers, s/he need only refer to a concise outline at the beginning of each chapter to learn more about what is contained inside.

Moreover, the discussions are generously accompanied by graphs, diagrams, and illustrations—to such a degree that nearly every randomly chosen page will contain one. In a text that covers many topics involving abstract relationships between mathematics and sound, these illustrations prove extremely useful.

The first two chapters fall under the heading "Fundamental Concepts." They explain essential concepts of digital sound (chapter 1) and methods of programming computers for musical applications (chapter 2). While the decision to begin the text with a discussion of digital sound seems natural in a computer music book, the choice to place programming topics second indicates the scope and point of view of this book. Unlike other texts, *The Computer Music Tutorial* is clearly oriented equally toward both computer music composers and researchers. In fact, it seems to subscribe to the (correct) notion that participants in the field are often engaged in both endeavors. Thus, from the beginning *The Computer Music Tutorial* arms its reader with knowledge of how to represent and manipulate sound as computer data, which opens the door for a composer/researcher to work with sound on the most intimate level.

Section 2 of the book is called "Sound Synthesis," and these chapters (3–8), present detailed explanations of all the commonly used synthesis techniques, as well as more "advanced" methods such as physical modeling, formant synthesis, and stochastic synthesis. Again, each topic is discussed clearly and is accompanied by helpful illustrations. Moreover, the discussions are technical enough that they alone provide enough information for one to write computer code to implement the techniques, if desired. In addition, the clear sectionalization of the text makes it easy to

return to specific sections later to refresh one's memory of particular techniques.

Section 3, "Mixing and Signal Processing," consists of chapters 9–11. These divide the general subject into "Sound Mixing" (chapter 9), "Basic Concepts of Signal Processing" (chapter 10), and "Sound Spatialization and Reverberation" (chapter 11). Once again, one sees the technical orientation of this text in that it begins its discussion of mixing (in chapter 9) with mixing by script—which is the traditional method of algorithmic computer music-mixing—rather than with the graphic interface mixing methods popular in commercial software.

Chapters 12 and 13 are grouped together under the title "Sound Analysis." For researchers and programmers who want to write software that "listens" to music, these two chapters provide crucial information. Chapter 12 discusses pitch and rhythm recognition, giving information not only on how to do it but also when and why it is most successful. In a similar manner, chapter 13 examines methods for dissecting the frequency components of sounds as they change over time, which is known as spectrum analysis. The chapter discusses several techniques for conducting spectrum analysis, including the most widely used types: Fourier analysis, phase vocoding, wavelet synthesis, and filter bank analysis. Since much computer music research and composition depends upon information derived from pitch, time, and spectral analysis, these two chapters are a necessity for those who want to write their own software, or even those who merely want to decide what software and settings will give the best results in a specific situation.

The fifth major section of the text is entitled "The Musician's Interface," and it includes chapters 14–19. These chapters are of special interest to composers, because they unveil a multitude of methods for arranging interaction between the composer and/or performer and the computer, as well as methods for applying complex algorithmic ideas to musical forms and gestures. The sections on musical systems also give examples from the work of well-known computer music composers, such as Barry Truax's work with real-time granular synthesis.

The next group of chapters is called "Internals and Interconnections." These chapters (20–22) deal with more practical concerns, such as how MIDI works, what goes on inside digital signal processors, and how to connect your computer music system. As anyone who has set up a studio will tell you, all of this is important information! However, most readers will probably have less use for these chapters if they are not creating their own studio.

Finally, the last major section is a single chapter introducing topics of psychoacoustics. This chapter is well done, but most computer musicians

will want more details about psychoacoustics than are provided here. My guess is that since psychoacoustics is such a large topic on its own, Roads purposely decided to limit it to a cursory treatment in *The Computer Music Tutorial.* Since a proper treatment of psychoacoustics would require hundreds of pages, this is best left for another book to cover.

Given the massive breadth of *The Computer Music Tutorial,* it is not surprising that, although it is generally successful, the text suffers from a few shortcomings. The first is due to the dynamism of technological development: even when the book was only three years old, parts of it were already outdated. For instance, there is no mention of the MP3 audio file format, DVD audio, or other multichannel sound formats such as Dolby Surround Sound. In addition, Roads's use of text script-based synthesis language syntax (used in the Music-N family of synthesis languages: Csound, Cmix, etc.) as the method of creating musical algorithms misses steps taken toward graphical implementation of these ideas in programs such as Max/MSP and SuperCollider. The omission of these concepts is admittedly a minor problem compared to the wealth of ideas that are covered in *The Computer Music Tutorial,* but it is also a sign that any attempt to codify the state of the art in a rapidly evolving industry like computer music is doomed to relatively quick obsolescence.

Another possible problem with *The Computer Music Tutorial* regards its intended readership: for whom is the book intended? In the book's preface, Roads states that the text is meant for music students as well as "engineers and scientists seeking an orientation to computer music." However, though the text is written clearly, its presentation of ideas is a bit dense and scientific. Most chapters quickly proceed to a level of conceptual complexity that would probably be difficult for music students who aren't familiar with concepts of computer programming or basic psychoacoustics. The book would be useful as a supplement to a well-taught class, but do-it-yourself music students might be overwhelmed by it. On the other hand, computer-savvy musicians, engineers, and scientists will benefit from its brisk pace and high level of discussion.

Another, related, problem concerns the underlying philosophy of computer music, which permeates *The Computer Music Tutorial.* John Chowning states this philosophy in his foreword to the text: "Programming ability enables the composer to understand the overall workings of a system to the extent required for its effective use." Essentially, the authors of this book believe that a composer must know computer programming in order to write sophisticated computer music. Honestly, I think that knowing how a computer system works and how to program it remain valuable for computer music composers; I also think that a talented composer can create rich, sophisticated music today using only preexisting software and

hardware tools. Knowledge of programming does open up additional, exciting possibilities but it is no longer necessary to be a hacker to be a computer music composer.

One last, minor complaint pertains to the topic overviews provided at the beginning of each chapter: these overviews, with their lists of topics addressed in each chapter, are useful, but they would have been even more valuable if the authors had also listed the corresponding page number(s) in the text of the chapter where the topics are discussed. As it is, the reader can find which topics are presented and in what order they appear, but then s/he must flip through the entire chapter, looking for a specific topic's appearance.

In summary, *The Computer Music Tutorial* is an expansive text and a valuable resource for all computer music composers and researchers. Its text is thorough and somewhat scientifically oriented, making it ideal for those who wish to build their own applications. It is probably best used as a reference—something for a computer musician to have on hand just as other musicians keep their *Harvard Dictionary of Music* handy—and is therefore an essential item for the shelves of academic music libraries. It is highly recommended for anyone who wants to deeply investigate the concepts of computer music.

Electric Sound: The Past and Promise of Electronic Music

Although the genre of electronic music is of course much younger than other forms of art music, it already has a remarkable history. From early instruments like the theremin to late 1950s experiments using arcane instructions on mainframe computers to today's desktop PC and Macintosh, the ideas and technology of computer music have constantly pushed each other in new directions. The incredibly rapid evolution of computer technology, especially since 1980, has enabled a multitude of computer music approaches and techniques to be realized; and often yesterday's innovation is yesterday's news. Nevertheless, today's computer musician can definitely learn much from the successes and mistakes of the past. Ideally, every composer and performer of computer music should be familiar with the figures and pieces that have shaped the genre.

Of course, in such a quickly evolving field, most participants have been too busy making music and learning the latest innovations to compile a comprehensive history of it. However, one active composer, Joel Chadabe (professor at the State University of New York at Albany), has recently taken on the challenge. The result is his book *Electric Sound: The Past and Promise of Electronic Music.* This text traces the development of electric musical instruments from Thaddeus Cahill's Telharmonium of 1897 to current interactive computer music systems, and ends with some speculative gazing into the future.

Electric Sound distinguishes itself from earlier electronic/computer music histories I have read in that it avoids getting mired in excessive technical explanation. In other words, whereas other writers have digressed in their texts to explain the details of every new innovative piece of hardware, software, or synthesis technique as it arose historically, Chadabe limits himself to brief explanations of these things. Readers must look to other sources (such as Curtis Roads's *Computer Music Tutorial,* reviewed above) to deeply understand the methods of electronic music. Chadabe's restriction of these materials in *Electric Sound* might not sound earth-shattering at first, but it has helped tremendously to focus his text.

In Chadabe's eyes, the history of electronic music is not the story of the innovations but instead that of the *innovators.* His book is about the people worldwide who have contributed their ideas to computer music, and the contexts in which these musicians and scientists have worked. Meanwhile, the progression of technology forms a kind of Schenkerian "background" to *Electric Sound,* so one might say that technological progress is the true topic throughout. But Chadabe ornaments the surface level of his text with anecdotes of concerts, studio experiments, improvisation groups, and compositions so that the reader always understands that his is the story of an evolving musical community, a community united by its constant fascination with the possibilities of the new.

Throughout the book, Chadabe's story comes wonderfully to life by means of numerous quotations from interviews with his subjects. For instance, when discussing the legendary RCA Mark II digital synthesizer of the Columbia-Princeton Electronic Music Center, Chadabe quotes composer Milton Babbitt eleven times, as well as Harry Olson (RCA executive), Charles Wuorinen (composer), Max Matthews (engineer and "Father of Computer Music"), and Harvey Sollberger (composer, flutist).

In all, Chadabe conducted over 150 interviews with members of the electronic/computer music community for this book, providing readers with interesting, idiosyncratic explanations and opinions about the ideas and music of each place and time. An example is Babbitt's description of Igor Stravinsky's visit to see the RCA synthesizer: "Stravinsky came up one Saturday morning and got so excited he had a heart attack. We had to get him a cab and get him back to the hotel." Thanks to first-hand descriptions like this, *Electric Sound* is not only informative but also enjoyable.

Of course, when covering nearly a century of musical history and careers it is imperative that the text be logically organized. In *Electric Sound* the practitioners of electronic and computer music are sorted according to common goals and/or common methodologies, and this is where the technology itself comes into play. Chadabe has divided his book into twelve chapters, and each focuses on one aspect of electronic music creation or performance, tracing its historical path. Thus, some composers

and instruments appear in more than one location, showing their position in the web of ideas from more than one point of view.

A case in point is chapter 1, "The Early Instruments." This chapter traces the study of music technology back to China in the 27th century BCE and Ling Lun's method for tuning the pentatonic scale. From ancient examples like this, Chadabe quickly moves forward to the nineteenth century, quoting E. T. A. Hoffmann: "But it would be the task of a really advanced system of the 'mechanics of music' to . . . obtain a knowledge of the tones which dwell in substances of every description, and then to take this mysterious music and enclose it in some sort of instrument." After this, Chadabe begins to give details of early electronic instruments, including the theremin, the electronic sakbut, the Hammond organ, and the RCA Mark II.

The other chapters proceed in similar fashion, following the threads of their topics, including "The Great Opening Up of Music to All Sounds," which traces the origins of *musique concrète* and its progeny; "Computer Music," which begins with Max Matthews's experiments at Bell Labs during the 1950s and progresses to today's complex systems utilizing techniques such as physical modeling and artificial life; "Synthesizers," which includes both the classic analog studios of the 50s–70s as well as uses of digital synths such as the DX7; "Inputs and Controls," which reveals many creative ways that have been attempted in order to give "musical" interfaces to electronic instruments; and "Interaction," which follows the history of musicians' attempts to create situations where an electronic instrument could perform by using its own musical intelligence. Finally, Chadabe looks into his crystal ball with "Where Are We Going?"

Another intriguing aspect of *Electric Sound* is Chadabe's recurring descriptions of "alternative" performances with electronics. These descriptions not only document part of the evolution of electronic music, but also trace a significant portion of the attempts during the second half of the 20th century to create musical performances different from traditional concerts. Chadabe begins, appropriately, with John Cage's *Cartridge Music* (1960), in which phonograph pickups and contact microphones are attached to household objects and used to amplify very quiet sounds. Other alternative performances mentioned include ones that featured improvisation, amplified brain waves, dance-controlled music, and installation pieces, among others. These sections are quite valuable because they remind the reader that truly innovative music contains innovative ideas, and that these ideas are much more important than whether or not one possesses the latest piece of technology.

On the other hand, one problem with *Electric Sound* is that it focuses on the use of electronics and computers in "art" music, ignoring the vast in-

fluence they have had on popular music, especially from 1980 to the present. Chadabe does mention the use of synthesizers by rock bands in one chapter, but this is mainly done to explain the economic situation of the company that created the equipment. New technology has been integral to recent trends in pop music such as hip-hop, techno, and other genres. For instance, hip-hop utilizes sampling, which is directly descended from *musique concrète.* Moreover, the steady beats of modern dance music are a direct result of synthesizers' precise timing abilities. In reality, if one examines the fringes of the pop music world, some of this music is indistinguishable from what is classified as "serious" composition in the electronic music scene. Therefore, it would have been appropriate for Chadabe to devote at least one chapter of *Electric Sound* to the use of electronics in pop music, and his failure to do so is perplexing.

Another slightly aggravating aspect of the book is what I perceive to be an underlying notion that the history of this music is the history of an evolution toward real-time interactive electronic music making. This point of view pervades the book and is sometimes detrimental, as it seems to relegate other forms of electronic/computer music, such as the installation pieces and tape pieces, to the evolutionary dustbin. Although interactive music can be intriguing, surely all the media of computer music continue to be valid. In fact, since interactive music's goal is to make the electronics into instruments and/or performers in the model of human musicians, it can be quite conservative conceptually. To realize the truly innovative possibilities from technology, it would instead be best to find the ways that it can do what a traditional performer/performance cannot.

In addition, at times in *Electric Sound,* despite Chadabe's best efforts to make the text enjoyable, it becomes a veritable deluge of artists' and researchers' names. While I sincerely appreciate his desire to be thorough and to give credit to all of the innovators who have contributed to the development of electronic music, the multitude of names sometimes begins to seem like the pops and surface noises on an old LP recording—a distracting presence that draws the mind away from the more significant content. Could it be that because he personally interviewed so many people, Chadabe mentions them in the text as a kind of "thank you" for their assistance? Or is he just a nice guy who doesn't want to overlook anyone's efforts? Whatever the reason, the body of the text would flow much more smoothly if the lists of names were trimmed a bit. One possibility would be to name a research group and/or its leader while listing the remaining participants in a footnote. This way everyone would be acknowledged without so much disruption of the narrative.

However, even with these shortcomings, *Electric Sound* is the best history of electronic music to appear for several years. Moreover, as I stated

above, its use of first-person narratives and quotations colorfully brings the topics to life, creating an enjoyable reading experience. While not every musician—or even every computer musician—needs to own a copy of this book, it is a worthy historical document and deserves to be available in every public and academic music library.

Note

1. Today several terms are used to describe sub-genres of the field I am calling "computer music." These include *electro-acoustic music* (which implies the participation of live instrumentalists), *tape music* (any piece in which the final form of the piece consists entirely of prerecorded audio on tape, CD, or other media), *acousmatic music* (which usually is tape music that involves highly processed samples of non-instrumental sounds), *computer music* (which to some aficionados indicates tape music without live performers, but which can be understood more generally —as I do in this review—as any music in which the computer takes on a primary role in the composition or performance), and *computer-assisted music* (music for acoustic instruments in which the computer is used to a large degree in the process of composition—usually involving some algorithmic processes). Technically, all of these computer music genres are sub-genres of electronic music (which also includes pieces that employ non-computerized electronic devices for music making). Another well-known sub-genre of electronic music is *electronica* (which usually refers to popular music created primarily by using computers and synthesizers).