The MIT Press

Computer Musicology: Accomplishments and Challenges
Author(s): Eleanor Selfridge-Field
Source: *Computer Music Journal*, Winter, 1996, Vol. 20, No. 4 (Winter, 1996), pp. 29-32
Published by: The MIT Press
Stable URL: https://www.jstor.org/stable/3680415

JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For more information about JSTOR, please contact support@jstor.org.

Your use of the JSTOR archive indicates your acceptance of the Terms & Conditions of Use, available at https://about.jstor.org/terms

The MIT Press is collaborating with JSTOR to digitize, preserve and extend access to *Computer Music Journal*

JSTOR

This content downloaded from
132.174.251.2 on Sun, 21 Feb 2021 04:42:20 UTC
All use subject to https://about.jstor.org/terms

Eleanor Selfridge-Field
Center for Computer-Assisted Research in the Humanities
Braun Music Center
Stanford University
Stanford, California 94305, USA
esf@ccrma.stanford.edu

Computer Musicology: Accomplishments and Challenges

The areas of greatest achievement and most striking potential in computer musicology today do not in particular trace their origins to the mid-1970s. Most critical milestones seem to coincide with major hardware developments. Thus, the encoding systems that underlie a host of printing systems (DARMS and SCORE, predecessors of Lime and Nightingale) can be traced back further, to the 1966–1972 era of mainframe computers and plotters. The graphical user interface (GUI) revolution of the 1980s has been a blessing to typesetting and desktop publishing programs but a detriment to analytical work, which lags behind sound and graphics applications. For this reason these older systems, supplemented by newer ones such as Humdrum, can be expected to survive a good while longer. Optical scanning software efforts were encouraged by the sudden availability of desktop scanners in the late 1980s. Numerous World-Wide Web publications, including the prototype of the *Journal of 17th-Century Music,* with sound examples of vocal ornaments by Sally Sanford (Sanford 1996), and the indefatigable periodical *Music Theory On-Line* (Rothfarb 1996), suggest the rapidity with which music scholars are growing into these new capabilities.

Among hardware changes, the most significant was undoubtedly the advent of the personal computer in the mid-1980s. It engendered dozens of cottage industries devoted to particular kinds of notation, analysis, and graphical display finely tuned for particular platforms and operating systems which, alas, were too frequently "improved" to give those working alone or in small groups much chance to endure. This frenzy of activity still colors our landscape today, but it is increasingly clear that many fine efforts will, by the end of the century, have come to naught.

This begs the question: What survives, and why? If we look at three goals that have survived from the 1960s, we see that differences of organization and purpose may be more influential than technology in determining outcomes.

Example 1: Melodic Information Management

One can find literature on melodic comparison in the fields of mathematics, computer science, music theory and analysis, music pedagogy, artificial intelligence, library science, sound engineering, psychoacoustics, cognitive studies, and, no doubt, a host of other disciplines. This widespread effort testifies to the inherent interest (and difficulty) of the problem. Only in the fields of library science and folk song research do these efforts rest on the availability of a well-maintained corpora of encoded materials.

From my perspective as a musicologist, I would have to credit a library science project, the *Répertoire Internationale des Sources Musicales* (RISM), with the most useful results in this field (RISM 1996). This automated, world-wide inventory of musical manuscripts from the period 1600–1800 (the RISM AII project) has recently become available with search software on a CD-ROM (through the K. G. Verlag in Munich) containing more than 100,000 incipits of musical manuscripts; 20,000 additions per year are anticipated. At the end of 1995, more than 250,000 incipits from over 180,000 works had been encoded. Yet until this year, the RISM AII project was largely invisible, apart from talks on methodology and progress reports given by principal members of the RISM team (e.g., John Howard, Joachim Schlichte, and Klaus Keil).

Computer Music Journal, 20:4, pp. 29–32, Winter 1996
© 1997 Massachusetts Institute of Technology

This content downloaded from
132.174.251.2 on Sun, 21 Feb 2021 04:42:20 UTC
All use subject to https://about.jstor.org/terms

The predominantly human and social factors that have contributed to this success include: the longevity of the project (it was conceptualized in the 1960s and patiently developed in the 1970s and 1980s); the sustained commitment to one set of goals (melodic sorting) despite internal personnel changes and external platform changes; the selection of an encoding system that suits the repertory by accounting for all the attributes of music necessary for its comparison; rigorous proofreading of the data; flexibility in design of output and presentation methods (currently including SCORE for printing and Windows software for search and display); creation of a huge database for testing and debugging of software as well as eventual searching; and access to extensive contextual information about the data (provenance, source, data—112 fields in all), which greatly enhances the value of the sorting routines. This unwavering commitment to one goal may be related to the fact that RISM has been conceptualized, organized, and maintained by scholars with only recent commercial interventions, for example in licensed distribution of the material on a CD-ROM.

Example 2: Optical Recognition Software

Research and development efforts in the optical recognition of music (OCR) stand in sharp organizational contrast to the RISM model. In 1993, the Center for Computer-Assisted Research in the Humanities (CCARH) canvassed some 37 announced research projects. We received seven detailed replies, and these formed the backbone of our extensive coverage of this topic in *Computing in Musicology* (Hewlett and Selfridge-Field 1993, pp. 107–166).

In our view, optical recognition of sufficient competence to warrant replacing manual methods of data entry would have to approach greater than 99.5 percent accuracy on repertory that is similar to that with which we work, and provide output to a code that is either used by our existing software or identifies the same attributes as our code, thereby facilitating complete translation to an intelligent representation. (Please regard "we" and "our" as variable names here.)

Optical scanning is hampered on four fronts. First, there are no coordinated efforts; OCR software follows the example of notation software in attracting the interest of dozens of developers. If 37 efforts were consolidated into three or five, better results might be achieved faster. Second, the data formats supported are highly diverse (DARMS, SCORE, MIDI and various MIDI extensions, and MOD were those most prevalently supported in our survey of 1993). In printing applications, data loss is effectively limited by the fact that the same programmer controls input and output formats. Scanning software aims to interface with third-party products employing a range of output formats.

Third, the goals of individual developers vary from one to the next. One may want to replicate all the features of an existing paper page in an electronic image. Another may want to convert simple spatial coordinates to create a crude sort of MIDI data (representing pitch and duration only). A third may want to create a modern score from parts in an early printed part-book. A fourth may want to "scan" a modern score to create parts for performance.

What is not common among these efforts is a standard view of what constitutes a complete set of data. Scanning programs seem to have the most difficulty with objects that are large (e.g., clef signs and brackets) and/or "white" (e.g., whole notes). Lapses in these areas are inordinately harmful to the logic and integrity of data sets that are supposed to make musical sense.

Finally, recognition programs suffer from a more general problem shared by notational software developers; although perceived as a complete and self-consistent method of expression, common music notation only remains commonly understood because of the rigor of oral tradition in music pedagogy over the past 250 years. It "represents" far less than is generally assumed to be the case.

The overall effort to create competent optical recognition software has been characterized by multiple goals, the use of diverse representation schemes, a variable degree of flexibility in design, and a lack of extensive testing.

This content downloaded from 132.174.251.2 on Sun, 21 Feb 2021 04:42:20 UTC
All use subject to https://about.jstor.org/terms

Example 3: Data Representation

The issue of a common representation for sound and graphics is still a daunting one. As music technology evolves, there are more and more things one can do with sound for which there is no common graphical notation apart from what may be provided by a popular software developer's menu, icon, or dialog box. So sound files, when one attempts to use them in a notation program, contain a lot of surplus baggage. Correspondingly, notation programs produce files that are glutted with spacial placement information that has only to do with the graphical image of the page and nothing whatsoever to do with sound. From the perspective of analysis, the desired representation may favor the "basic" sound information or the "basic" notation information, or may require the representation of attributes (such as accentual patterns) that do not constitute either.

This problem, ultimately, is one of several that complicates efforts to develop a universal standard for the interchange of musical data sets. The optical scanning community, led by Cindy Grande, has played a major role in promoting the standards effort with the Notation Interchange File Format (NIFF) proposal now being beta-tested (see "The Development of the Notation Interchange File Format" in this issue). Although NIFF is oriented very much toward the page (the default being 8.5 × 11 in, read from the upper left-hand corner, etc.), and thus toward notation programs, but since sequencer programs find many more users than notation programs, willing sponsors have been much more oriented toward an acquisition system that will generate MIDI data. While not platform-specific, NIFF is aligned with the Resource Interchange File Format (RIFF).

We can appreciate how tangled the motives of underlying representation become when we compare NIFF with another proposed method of interchange, the so-called Standard Music Description Language (SMDL) created by a committee formed in 1985 and, at this writing, still pending ISO approval. From the SMDL perspective, music exists as a document but one that is less exclusively confined to the page than in NIFF. An SMDL document can exist in real time and, through a companion standard called HyTime, with hyperlinks. It is machine- and operating-system independent. Through its "parent" SGML (Standard Generalized Markup Language), it is a sibling to the World-Wide Web's HTML (HyperText Markup Language). What SMDL lacks is that kind of beta-testing that made RISM work; if it took 100,000 incipits to debug a system for monophonic representation, it may take at least 100,000 polyphonic works to debug this far more complex system.

It is difficult to compare the organization of this effort with those of the previous two cases. There is necessarily a many-in-one goal; one method of interchange is desired, but it should accommodate all kinds of applications on all platforms. This "plural-within-the-singular" goal is complicated by the diversity in type and number of essential attributes required for different kinds of applications in music. Since an interchange method must provide so much to so many users, it may not be able to afford much flexibility in its implementation.

The most problematic part of interchange development may be in testing and debugging. The attribute sets of the A (input) and C (output) applications and the interchange code (B) must all be more or less comparable for bugs in the method itself to be isolated. It is likely that in the development stage, B will account for fewer features than A, but if this is true, the loss of features may prevent C from operating at all. (That is, if program C requires pitch-inflection information, and A or B provides only a MIDI note number, it will be incumbent upon C to provide some intelligence that, given data in its own format, it has not previously required.) The interchange B cannot be expected to compensate for what A's native code, in relation to C's, may lack. If A and/or B have more features than C, C should be able to function, provided that attribute organization and identification are handled in a common way in all three situations. Most programs still lack reversibility of external and internal representations (one cannot, for example, push a button to return from a page-specific code to an input code in printing programs).

These problems that affect the standards discussion have been prominent in our minds at CCARH

This content downloaded from 132.174.251.2 on Sun, 21 Feb 2021 04:42:20 UTC
All use subject to https://about.jstor.org/terms

for many years, as we have attempted to create large databases of polyphonic music for printing, sound, and analysis (CCARH 1996). We remain confident that this can be done, but we are increasingly sensitive to the varying needs of individual repertories. Like the work of RISM through 1994, our work still remains largely invisible, but also like RISM, we have remained faithful to one goal, have employed a single encoding system (Walter B. Hewlett's *MuseData*), have tested the system on diverse chores and with varied repertories, and have proofread the data ad infinitum. Relative to other efforts of which we are aware, the quantity is significant. We expect to be able to make significant amounts of our data available soon, and if it enjoys the same success as the RISM incipits, we shall feel that we have achieved our goal.

References

CCARH. 1996. CCARH World-Wide Web home page at URL http://ccrma-www.stanford.edu/CCARH/welcome.html.

Hewlett, W. B., and E. Selfridge-Field. 1993. *Computing in Musicology,* vol. 9. Menlo Park, California: Center for Computer-Assisted Research in the Humanities.

RISM. 1996. RISM World-Wide Web home page at URL http://www.rism.harvard.edu/rism/Welcome.html.

Rothfarb, L. 1996. *Music Theory On-Line.* World-Wide Web pages at URL http://boethius.music.ucsb.edu/mto/mtohome.html.

Sanford, S. 1996. *Journal of 17th-Century Music.* World-Wide Web pages at URL http://www.sscm.harvard.edu/sscm/journal/Welcome.html.

This content downloaded from 132.174.251.2 on Sun, 21 Feb 2021 04:42:20 UTC
All use subject to https://about.jstor.org/terms