Digital Notation Representation and Online Retrieval of Musical Information: A Discussion of Current Options and Practices

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Abstract

At the 1989 International Computer Music Conference, position papers for a music representation panel discussed called for the creation of a digital notation "language" which would be portable, inclusive of all music, and capable of not only describing all elements in a score but also of providing the means to present varied performances from the score. Dannenberg, Dyer, Garrett, Roads, (1989). These needs were further articulated by Roger Dannenberg and others in the 1993 Computer Music Journal but few accommodating solutions were offered at the time.

The CD-ROM and HTML-based Web sites currently are the favored choices by musicians for the digital representation of their work, however, the inability of these formats to provide raw (ASCII-like) notation data for use in a variety of software applications remains an insurmountable drawback. For this reason, solutions such as the Standard Music Description Language (SMXL), an extensively developed document-type definition (DTD) of the Standard Generalized Markup Language (SGML), have been proposed and demonstrated (Sloan, 1990; 1993 and Newcomb, 1991). Other possibilities for notation information transmission and retrieval such as the Standard MIDI File and some ASCII-based formats have been the subject of much experimentation. All of these procedures have both their advantages and drawbacks.

This presentation will include visitations to various Web sites which make effective use of the currently available options in online musical information dissemination. In addition, the author has designed a personal Web site utilizing most online choices and will feature this resource during her presentation.

Section 1 - Priorities in Musical Representation

During the 1989 International Computer Music Conference and later in the 1993 volume of the Computer Music Journal, Roger Dannenberg, Curtis Roads, Steven R. Newcomb and others outlined the requirements for an online notation representation language. Some of the issues presented included the need to represent structural relationships in music, the desire to create a system which allowed for the representation of non-traditional notation symbols, and the ability to review and duplicate musical performances (Garrett - 1989 and Dannenberg - 1993). In addition the need for platform, device, and application independence was stressed (Dyer - 1989). These specifications instantly negate the use of such extensively developed technologies like the CD-ROM, but allow for several other options outlined below.

As a community of highly creative and computer literate, individuals, it is not surprising that musicians in general and composers in particular are interested in this issue. Electronic and computer music composers utilize technology daily in their teaching and musical production and even the majority of composers for traditional instruments rely on the computer as a notation "word processor" and orchestral aid. In addition, composers in our century have consistently been the primary researchers and documenters in their field and commonly engage in the private publication and dissemination of their works and the collection of their own private "libraries" of modern musical resources. These libraries, housed in basements, offices, and studios, include limited edition recordings and scores, videotaped performances and interviews and scholarly texts. This level of personal commitment and activity has been almost exclusively motivated by the lack of inclination of public institutions, the entertainment industry and most of the general populace to support classical and experimental music on a significant level. Though it may be initially perceived as a disadvantage, this assumption of an entrepreneurial, independent, and persuasive attitude coupled with a need to articulate clearly its function and importance, prepares the compositional community well to overcome the challenges inherent in digital distribution.

My personal interest in digital storage and dissemination has been closely connected with my work as a technical liaison and advisor for the International Alliance of Women in Music (IAWM) and as a
scholar. In the course of completing my text, Crossing the Line: Women Composers and Music Technology in the United States, I have compiled an extensive collection of primary and secondary resource materials of women's electronic and computer music and research. These materials include rare photos and out-of-print recordings; cassette of interviews, radio shows and unpublished performances; articles and newspaper reviews often from small-press publications; letters, email transmissions; privately compiled biographical data; and many lp and compact disc recordings. In addition I have compiled a large database of bibliographic materials and a discography as well as a comparative survey of the personal musical experiences of over 200 women. The Women's Music Technology Archives, as I have named my project, currently resides physically in my home studio but it is my eventual wish to have all aspects of this collection available via the World Wide Web. As much of the musical material exists in both traditional and non-traditional notations, I also need an easily implemented and effective method of posting items to my site.

Since the publication of the 1993 articles, discussion of the issue of music representation has virtually ceased in the ICMC. However, much activity has continued to concentrate on the problem at several sites and by many individuals in the field. This demonstration attempts to re-invigorate our association's interest in the issue by showing some of the considerable advances which have occurred during the past three years that could be of much use in the musical community. All examples used in this demonstration are permanently posted at the following URL:

http://www.music.uiowa.edu/ehturner/musicrep.html

which I hope will continually be accessed by individuals interested in musical representation issues after the conference.

Section 2 - Non-Notated Musical Resources

The representation and transmission of non-notational musical resources on the WWW is already well-developed and continuously updated with each improvement of the Hyper Text Markup Language specification (HTML). The display and demonstration of illustrations, photographs, video clips, and texts is limited only by the abilities of a researcher's particular Web browser. In recent months, the capabilities of these browsers (especially Netscape Navigator and Microsoft Internet Explorer) have allowed for real-time transmission of audio (i.e. online "radio broadcasts" of interviews and music) and fairly sophisticated animated sequences.

HTML was created utilizing concepts and constructs of the Standard Generalized Markup Language (SGML). HTML only has a specific set of markup tags available but the nature and Dailability of these tags is more than adequate for the needs of most interested developers of WWW documents. Perhaps the most useful addition to the HTML tag set is DTD (document type definition) has been the Common Gateway Interface (CGI) which allows client service requests on the Web to be received and processed by a server with results being returned quickly to the external application. This powerful database access capability coupled with the easily-implemented hyperlinks to other Web documents has become common for the HTML. DTD and adds the interactivity that was initially only possible in the CD-ROM format. Other interactive elements are also specifically available to Windows 95/Internet Explorer users through the ActiveX plug-in which allows a Web developer to create real-time animations and transactions through Visual C or Visual BASIC programming. Another potentially promising development is the JAVA object-oriented language which enables platform and application independent presentations (Tittel, Gautier, Hassinger, and Erwin - 1995).

However, it is the actual meta-language SGML itself which allows for the most thorough and sophisticated exchange of information including musical resources. DTDs for a wide variety of information formats have been developed and utilized by both the government and the publishing industry. As an open-ended "language of languages" and an ISO standard, SGML can be used to describe virtually any document so as to be useful on any platform, in any application, and with any hardware device.

An example of the flexibility of SGML is illustrated in the DTD developed by the Association for Computers in the Humanities in the Guidelines for Text Encoding and Interchange. The TEI P2 [Sherberg-McQueen and Burnard, 1994]. The TEI P2 provides standard DTDs for describing a variety of text formats, and more importantly from a musical standpoint, interviews and performances. Two drawbacks which have prevented extensive use of SGML in the private sector, however, include the enormous time
commitment and programming detail inherent in the language and the lack of publicly available parsers for the reading of marked up documents.

Section 1 - Options for the Online Representation of Musical Notation

The creation of a truly platform, device, and application independent digital representation of musical notation has continued to present a problem since the initial series of papers and articles published in 1989. Composers have traditionally made their work available on the internet through the ftp and gopher functions which allow a user to retrieve and download software, images, and soundfiles. Basic HTML programming now allows musicians to make their work available from a notebook.

However, problems with this method include the inability to see or hear the information before making a decision to transfer data and the unfriendly user-interface which requires one to memorize lengthy pathnames and document titles. Additionally, the HTML DTD does not contain the same representational tools for flexible notation markup as it does for text presentation. Currently one can only represent a musical score as a .gif image and as a sound file; the inability to mark up discreet musical elements makes it impossible to utilize these documents in any significant way. For example, musical materials posted using HTML cannot be downloaded to notation applications for editing purposes or to MIDI (Music Instrument Digital Interface) applications for playback through a digital sequencer. This format also does not allow for the easy insertion of notational examples into published texts and does not account for time-based elements in a musical performance.

In 1990 the American National Standards Institute authorized the working group, X3V1.8M, to develop a standard for the digital representation of musical information using SGML-based procedures as a model. By 1991, the group, consisting of Steven R. Newcomb, Neill Kipp, and Victoria T. Newcomb had developed the Hypermedia/Time-based Structuring Language (HyTime) and the Standard Music Description Language (SMIDL - http://www.aii.org/simg/gen-apps.html). HyTime, an application of SGML, allows for the description of the time schedule and element structure of any medium while the SMIDL DTD in HyTime addresses aspects specific to music. HyTime has been approved as an ISO standard (ISO/IEC IS 10744:1992) while SMIDL is still in the approval stage (ISO/IEC DIS 10743:1995). SMIDL currently represents the most flexible digital musical representation medium available easily satisfying the requirements of platform, application, and hardware independence articulated at the 1989 ICMC conference and in subsequent journal articles [Sloan - 1993].

The HyTime DTD consists of several sections each of which addresses a specific problem of time- and structure-based representation. The measurement and scheduling portions of the DTD are necessary for the description of the position and duration of events in the document while the location address portion includes the internal document linking mechanisms of SGML and adds addressing capabilities for external documents. Addressing can include names, semantic location (e.g. the third vocal line) or by coordinate location ("the quarter rest in the third measure of the second violin line"). With HyTime specifications of both traditional and non-traditional (graphic) music notation can be made in terms of where and when events occur. Most importantly, the final rendering portion of HyTime can be included for the purpose of using the scheduling markup to actually create either a performance or a score representation. SMIDL offers specific details of music notation within HyTime such as pitch, rests, and chords and handles both visual issues and gestural (performance) sound objects. Using pitch representation (either by frequency spectrum or by the use of a table or "gamut" of pitches) typical SMIDL markup of a low D of half-note duration might look like this:

```xml
<notem
<repeat>
<note>
<nonpitch>...</nonpitch>
</note>
</repeat>
</notem>
```

where the `<notem>` tag denotes a "cantous event", `<musicdur>` and `<ct> call up a duration value at a certain point in time, and all `<pitch>` tags describe note values from a table (pitch gamut) created in the document's header [Sloan - 1993 and Newcomb, Kipp, and Newcomb - 1993].
Section 4 - Conclusion

Some individuals and institutions have developed their own interesting and complex experiments in online digital music representation. In Nottingham, England, Eric Foxley and others continue work on an enormous musical database utilizing ASCII to describe musical events. The possibilities of ASCII-based work has been demonstrated in the medieval literature community with the Chorrette Project, a Princeton-sponsored SGML initiative for the marking up of early manuscripts. Editors for the project have specified several pages of ASCII-equivalents for ancient lettering practices. The same ASCII mapping could be applied to music notation.

One group that is making the time commitment and providing a potential model for future SMDL development are the members of the VARIATIONS project of the School of Music Library at Indiana University. The VARIATIONS project has a three-fold purpose which is being implemented in the following order: 1) the provision of a vast workable computer network for the retrieval of music information in the library itself and on the main university campus and its partner schools via student modem access, 2) the sending of cd-quality (44kHz 16 bit) audio on demand over this network to registered students and eligible faculty and staff, and 3) the eventual provision of marked up musical scores and texts for research and study purposes. The VARIATIONS project has been in existence since 1993 and has been scheduled to launch the full implementation of its library network and audio transmissions since January 1996.

My study and experience in the digital information storage and retrieval methods described above has led to my decision to utilize a combination of HTML and SGML/SMDL-based markup in my distribution of the Women and Technology Archives for scholarly use. My primary consideration is for making the existence of my resources known to interested persons. The use of HTML and the creation of a Web site of "biographical information pages" for each composer will be the most efficient way to do this and the majority of my energies will initially be focused on putting photos, soundfiles, and documents online in this format for encyclopedic browsing. After this stage is completed, I can begin the analysis of text and notation files for their feasibility as SGML/SMDL documents. As this detailed markup is completed, the ability of scholars to work with my collected texts and to draw comparisons and complete new research utilizing connective patterns inherent in the surveys, vistes, discographies, and bibliographies created will be virtually unlimited and unprecedented. Such an effort will take time and many enthusiastic collaborators. As demonstrated throughout this text, the need is present and the knowledge is available in the musical community for the universal access and dissemination of its resources and discussion and experimentation in this area needs to continue to be supported.