

IR for Contemporary Music: What the Musicologist Needs

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Abstract

Active listening is the core of musical activity

Listening does not only concern receiving musical information. On the contrary, it is “active” and based on a set of interactions between listeners and musical documents—including automatic music information research and extraction—so as to discover intentions. This recognition process is based on the observation of regularities and rules, in order to build “forms” from all indications, information and redundancies. The listener interprets all the signs that are meaningful for him as intentions, attributed to the composer.

Features of computer assisted listening

Let us specify further the active listening situation for the musicologist, taking for example the consultation of a document in such a digital library as IRCAM’s. The musicologist is facing a computer screen, while handling scores and books. This terminal allows him, among many other possibilities, to listen to music, to access musical data bases and hypermedia analyses. The musicologist is handling several devices on several media at the same time.

First of all, the listener needs a framework that takes him/her into account. The purpose is to set the conditions of possibility of listening by restricting the heuristics of “forms”. It is therefore necessary to set a listening framework for the musicologist, to assist him in discovering the “intentions” of music. The main feature of this listening environment is thus its capacity to enable its user to vary the music representation. In the same way that working on a musical piece leads us either to read it silently or to sol-fa, or to hum it, or to play it, the musicologist’s environment must enable rapid changes of the representation of abstract objects.

This is very important: a critical part of the analysis work consists in associating varied representations and contexts. Its purpose is the emergence of meaning from numerous and dissimilar elements that views imagined by the musicologist manage to reconcile. Musical databases help weave these links. In such an environment as the IRCAM Digital Library, we can either:

- associate various representations of music: hypermedia analyses offer sonograms as well as scores or formal schemes.
- or associate various contexts: the musicologist can easily know which works are contemporary with the *Marteau sans Maître* by Boulez using roughly the same instruments, or explore the musical production of the year 1954.

Musicology and contemporary music

We use here the expression “contemporary music” for Western art-tradition music written since 1945. However this definition is controversial, and a lot of ambiguity remains in identifying works that belong to it. But it avoids, at least provisionally, the stumbling block of the stylistic definition.

To characterize it, we use the musicologist’s point of view, with his/her tools, either computerized or not. The musicologist is at the same time a listener and a composer, since analyzing a piece a music leads to “rewriting” it.

The first difficulty the musicologist faces in contemporary music is the confusion in listening. Looking for reference marks, the listener is in a way considerably free, but he is deprived from the listening guiding towards intentions we evoked before. Let us examine the consequences of this confusion in terms of automatic research of musical information:

- The first point is the decline of melody, which used to be the fundamental basis in musical composition. Structural objects used by composers are no longer the ones which are part of the horizontal entities perceived (cells, figures). This raises two kinds of problems:
 - * the first one concerns the computation of the musical surface, that is to say the automatic determination of outstanding elements of a polyphonic music, by combination of structural and sound criteria (instrumental features, timbres, masking effects, etc.).
 - * the second one deals with the research of melodic elements which play a structural role, such as mottos.
- The second point concerns the difficulty of extracting and interpreting harmonic data from contemporary music works. There is no longer a reference system. This problems has arisen since Debussy: in his music, he often “forgets” to resolve certain dissonances, which progressively become part of his harmonic vocabulary.
- The relationship to form: in his effort to recognize intentions, the listener eliminates time from movement, to get the trajectory and the form. The latter derives from a spatial conception; in its expression, it is often mistaken for its structure. The classical sonata is often described according to a rhetorical and intemporal scheme exposition/development/reexposition. Contemporary music proposes two major evolutions in that field:
 - * form can be attached to other representations than symbolic structures: spectral music thus often uses paths through sound spectra called interpolations that contribute to the form. To our knowledge, there is no automatic tool able to interpret this kind of data at the scale of a form.
 - * many contemporary composers do not want form to reveal itself simply, as a reducing logical scheme, for instance the ABA scheme for the *aria da capo*. But the possibilities of using “operating filters” as algorithms in automatic search, to be able to handle complex forms, are still limited.
- Last but not least, we have only evoked music using traditional instruments. Electroacoustic and mixed (computer plus instruments) raise the representation problem: which information structures is

it possible to extract from the audio file of such a piece as *Artikulation* by Ligeti? How can we handle inharmonic sounds?

A synthesis of the musicologist's needs

Our first remark is that the choice of the contemporary catalogue does not modify the nature of the musicologist's work nor his/her purposes. However it seems that this task is more difficult and less systematic for contemporary music. The musicologist must set together by himself "formal filters" enabling him to account for the composer's intention, starting from directories of simple form bearing elements and classical structures.

We state that the musicologist's workstation must have the following features:

- It proposes varied representations of music and circulation possibilities among them, breaking away from physical separations between their producers. It must thus propose to the musicologist the computerized tools and files uses by the composer as he/she was elaborating the piece, if possible. The representations that the musicologist will link together during his/her analysis work are:
 - * the graphical representations (paper score, sonogram, formal scheme, etc.),
 - * the sound representations (audio),
 - * the symbolic representations (MIDI, computerized description of the score, etc.),
 - * if necessary, the tool-representations that concern the working steps of the composer using the computer.
- It allows for the active listening of music in a broad meaning, by consulting different musical documents, each of them being associated to one or several representations we have described.
- It must allow for the reconciliation of reading and writing on the same media. In traditional music analysis, these two phases are split, since the musicologist reads a score and moreover writes a document in a literary form, without any possibility of dynamic link between the two. On a terminal, it is important that the musicologist may have possibilities of writing and annotating on musical objects represented on the screen. In the case of mixed musics, associating computer and instruments, the musicologist has to be able to use the sketch computerized environment run by the composer.
- To face the difficulty of analyzing contemporary music, the system proposes to the listener/musicologist to build his own adequate structures to look for forms using specific languages to encode the patterns, either global or local. The form bearing elements may be:
 - * either musical , to be looked for in symbolic representations (as different kinds of intervals of notions such as the longest sequence of joint intervals, or the longest sequence of disjoint intervals, etc.),
 - * or related to sound, to be looked for in signal representations (search for harmonic zones, peaks, etc.)
 - * or operating processes (fractals, mathematic transformations, etc.).

These form bearing elements can be hierarchically set together as trees, to build a form search profile.

- It includes learning mechanisms, such as:
 - * saving of works achieved by each musicologist,
 - * saving of approaches lead for each of the analyzed pieces,
 - * enriching the directories including form bearing elements and elementary structures.

Examples of implementation in IRCAM projects

Two European projects including IRCAM partnership answer part of these expectations:

- the CUIDADO (Content-based Unified Interfaces and Descriptors for Audio/music Databases available Online) project deals with description and search of audio files, in conjunction with the proposed MPEG7 standard. Form bearing elements are here low level data extracted from signal to be statically correlated to high level descriptors such as genre information. Among proposed functionalities, let us notice: the fast search of sound files, of similarities between audio contents, the creation of user profiles, the editing and classification of sounds.
- The WEDELMUSIC (Web Delivery of Music Scores) project proposes a system of online distribution of scores or fragments of scores. The musicologist has possibilities of research of musical structures, of comparison and annotation.

There is still much work remaining to propose a coherent set of software and devices dedicated to contemporary music.

Suggested Readings

[Berio 1981] Berio, Luciano, 1983. *Intervista sulla musica*, a cura di Rossana Dalmonte, Roma, Bari, Laterza.

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[Rousseaux 1990] Rousseaux, Francis, 1990. *Une contribution de l'intelligence artificielle et de l'apprentissage symbolique automatique à l'élaboration d'un modèle d'enseignement de l'écoute musicale*, Thèse de doctorat, Université Paris VI.