# An XML-based Web Interface to Present and Analyze the Music Aspect of Dance

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**Abstract.** The present work describes a Web interface aiming at the advanced fruition of music content. This browser application, already available on the Internet, adopts the international standard known as IEEE 1599 to encode music information in XML format. The paper explores a specific goal of the framework, namely the representation of music and dance simultaneously. The key issues are two: offering the user an experience of dance performances based on a great variety of materials, and providing the dance student with an educational tool. The paper will provide a basic overview of the IEEE 1599 standard and will present a clarifying example from a ballet.

**Keywords:** XML, Dance Notation, IEEE 1599, Labanotation

## 1 Introduction

Cultural Heritage (CH) can widely benefit from Information and Communication Technologies (ICT) in archiving, presenting, analyzing CH content and enhancing user experience. Such benefits, as well as obstacles and proposed solutions, are discussed in many EU funded projects and ongoing support actions, e.g., eCultValue.[3] Intangible heritage,however, e.g., performing arts and some forms of music, and other crafts, can only be preserved and experienced digitally through the different manifestations of their descriptions and prescriptions.

The goal of enjoying, and furthermore describing music in a comprehensive way, namely taking into account the multifarious aspects it consists of, is a challenging one. Many research has been done and is currently in progress to achieve such results in the digital field, by using computer-based techniques and formalisms.

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[3] `http://ecultvalue.wordpress.com/`

In this paradigm we explain how an already existing platform for the advanced visualization of music scores can integrate other forms of media, and we indicate the correlation between a music and the corresponding performed dance piece. The interface can integrate different forms of material about the dance, e.g., metadata description about the play, info about choreographer, composer, dancers, music scores, dance notation scores and videos from different productions, demonstrating differences in style and traditions within the production and performance of the same play. In this manner, the tool can designate the music pieces that were written to accompany or are directly connected to dance plays such as suits, ballets, and some traditional dances.

Taking into account the fact that human understanding and learning is connected to receiving and processing different signals e.g., audio, video, haptics putting together different media can help the user deepen the experience of enjoying music in its various representations. In this case, the user can hear the audio and watch the music score, thus is given the chance to correlate the *symbolic* and *logical* aspect with the audio rendering (an activity known as *score following*); but the novelty introduced in this paper is the fact that the user can experience music through watching dance, which in many cases can be viewed as a visual interpretation or metaphor of the music.

*Music visualization*, long before referring to abstract digital visualizations on screen, is a locution used to describe dance where the movement has equivalents to the timbres, dynamics, and structural shapes of music in addition to its rhythmic base. In the beginning of the 20th century, the contemporary dance pioneering artistic duet Ted Shawn and Ruth St. Denis, introduced the concept of *Music visualization* as follows: "In its purest form is the scientific translation into bodily action of the rhythmic, melodic, and harmonic structure of a musical composition, without intention to interpret or reveal any hidden meaning apprehended by the dancer" [11].

Although music and dance are highly related in many people's mind, in Performative Dance this relation is not to be taken for granted, as it can vary from high correspondence to simple coexistence or complete independence. Lopukhov makes the distinction between the principles of "dance to accompany music", "dance set to music", and "the integration of dance and music" in choreographing a classic ballet, by discussing the leading, following or equal role one can play to the other respectively [10].

By combining music, dance scores and video of the performances in various representations, in a unique environment, the platform we will introduce in the following sections can be a useful tool to demonstrate examples of dance-music relationships. In addition, it could take advantage of dance notation scores.

In particular, Labanotation [9] is a notation system for recording and analyzing human movement, originating from the work of Rudolf Laban and having been developed and extended by many practitioners, notably Ann Hutchinson Guest. This formalism uses abstract symbols to define the direction and level of the movement, the part of the body moving, the duration of the movement, and the dynamic quality of the movement. An example is provided in Figure 1.

Labanotation is currently supported by the American Dance Notation Bureau (DNB), a non-profit organization whose mission is to advance the art of dance through the use of that system of notation.

In this context, the rhythmic patterns underlying the movement description (beats, meters, phrases) are used to achieve a preliminary synchronization with the video of the same performance, by synchronizing the music meters and phrases. We will discuss this case later on, including the challenges and ideas for future enhancement. But before describing the integrated framework for experiencing music (Section 3) and the case study (see Section 4), it is worth introducing the underlying XML format that keeps music information organized and synchronized, namely the IEEE 1599 standard.

## 2 A Short Overview of the IEEE 1599 Format

IEEE 1599 is a standard recognized internationally by the IEEE, sponsored by the Computer Society Standards Activity Board and designed by the Technical Committee on Computer Generated Music (IEEE CS TC on CGM). IEEE 1599 adopts XML (eXtensible Markup Language) in order to describe a music piece in all its aspects [1].

The innovative contribution of the format is providing a comprehensive description of music and music-related material within a unique framework. The symbolic score - intended here as a sequence of music symbols - is only one of the many descriptions that can be provided for a piece. For instance, all the graphical and audio instances (scores and performances) available for a given music composition are further descriptions, as well as text elements (e.g., catalogue metadata, lyrics, etc.), still images (e.g., photos, playbills, etc.), and moving images (e.g., video clips, movies with a soundtrack, etc.).

Comprehensiveness in music description is realized in IEEE 1599 through a multi-layered environment. The XML format provides a set of rules to create strongly structured documents. IEEE 1599 implements this characteristic by arranging music and music-related contents within six layers:

– *General* - music-related metadata, i.e. catalogue information about the piece;
– *Logic* - the logical description of score in terms of symbols;
– *Structural* - identification of music objects and their mutual relationships;
– *Notational* - graphical representations of the score;
– *Performance* - computer-based descriptions and executions of music according to performance languages, such as MIDI or MPEG4;
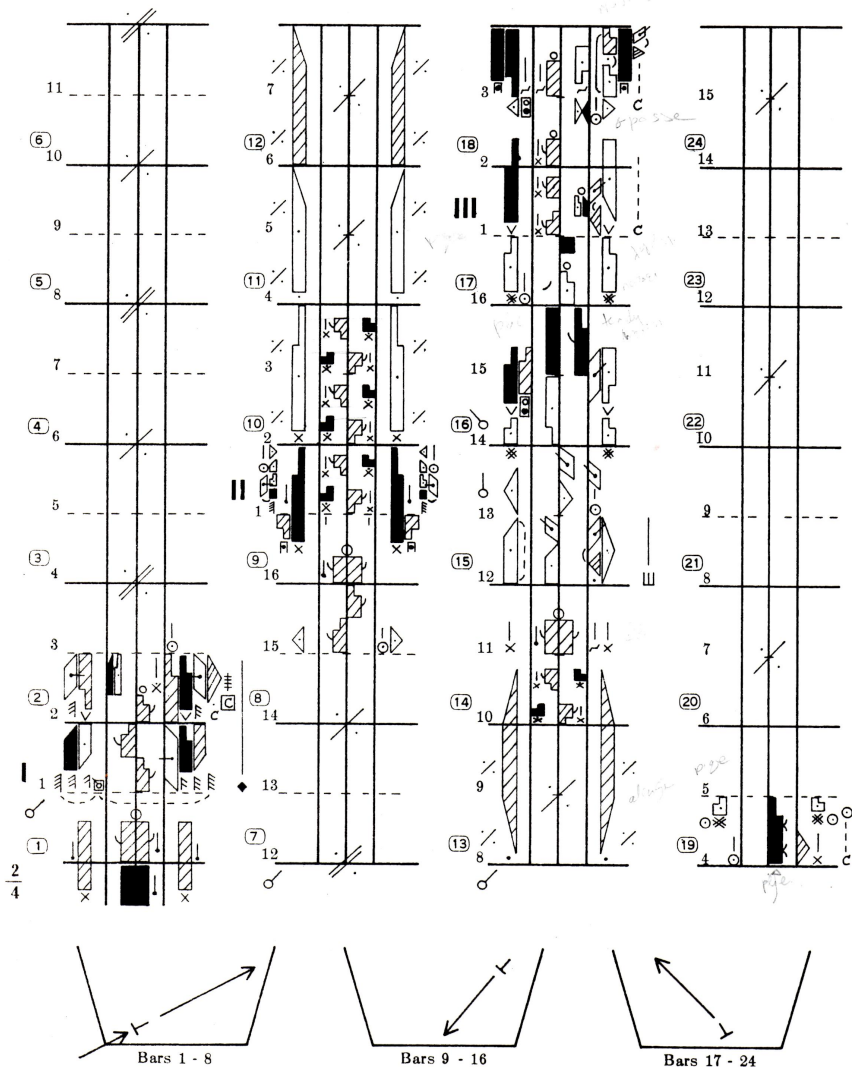– *Audio* - digital or digitized recordings of the piece.

Music events are univocally identified in the encoding, so that they can be described in different layers (e.g., the graphical aspect of a chord and its audio performance), and multiple times within a single layer (e.g., many different music performances of the same event). Consequently, in the multi-layer environment provided by IEEE 1599, one recognizes two categories:

**Fig. 1.** An example of a choreography encoded according to Labanotation. Title of dance: "Variation Falling Crumbs" from *The Sleeping Beauty*, choreographer: Marius Petipa, notator: Ann Hutchinson Guest. Courtesy of the Dance Notation Bureau.

1. *Inter-layer synchronization*, which takes place among contents described in different layers. Different layers store - by definition - heterogeneous information, to allow the enjoyment of heterogeneous music contents simultaneously, in a synchronized way. Applications involving multi-media and multi-modal fruition, such as score following, karaoke, didactic products, and multimedia presentations, can be realized thanks to this kind of synchronization;

2. *Intra-layer synchronization*, which takes place among the contents of a single layer. Each layer contains - by definition - homogeneous information. Thanks to this feature, one can jump from an instance to another instance of the same type in real time, without losing synchronization.

Coupling the aforementioned kinds of synchronization, it is possible to design and implement advanced frameworks for music. For further details about the format, please refer either to the official IEEE documentation [12] or to a recent book covering many specific aspects [2].

## 3 The *EMIPIU* Web Portal

*EMIPIU* is an acronym standing for *Enhanced Music Interactive Platform for Internet User*. This project aims at applying computer-based technologies to music cultural heritage, in order to provide innovative and advanced ways to enjoy music contents.[4]

The technological core is the IEEE 1599 format (see Section 2), which is described and documented in one of the parts the portal is composed of. However, the most relevant area of the portal is the *Music Box*, where many examples of music pieces are provided. The purpose is to illustrate the multifarious ways to use the format. As a consequence, music is very heterogeneous regarding the genre, style, ensemble, historical period, language, etc. Examples range from Gregorian chant to jazz, from Italian opera to South American tango, and so on.

Moreover, the presence and type of multimedia materials is intentionally unequal. In the *Audio* layer some pieces present only audio contents, other pieces are associated to videos referable to live performances, mainstream movies, cartoons, etc. Similarly, the *Notational* layer supports not only traditional scores, but also unconventional graphical representations. This is particularly interesting for a number of cases: contemporary notation [6], Braille scores for visually impaired people [13], etc. Section 4 will discuss another relevant case study, namely the encoding of dance movements, which is made possible by the features of the *Notational* layer.

Finally, the Web portal presents a multilingual interface which accompanies all the stages of the project: design, development, dissemination. This framework has been designed by following the logic of Web 2.0 tools, thus exploiting social software and social networks. Besides, the portal aims at establishing a community to share information and to encourage the discussion on the many issues of the project.

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[4] The address of the *EMIPIU* portal is `http://emipiu.di.unimi.it`.

## 4   A Case Study from *The Sleeping Beauty*

The purpose of this section is illustrating the advantages offered by IEEE 1599 to the encoding of music for ballets and dance performance. Considering a dance piece from classical repertoire is like adding a "visual" representation of this music, especially if the dance piece is one that its movement rhythm is very close or even identical with the musical. By this manner, the tool of EMIPIU can designate the music pieces that were written to accompany or are directly connected to dance plays (suits, ballets, some traditional dances).

The music piece expressly inserted into the *EMIPIU* digital archive is "Pas de six: Variation III" (also known as "Falling crumbs") from *The Sleeping Beauty* by Pyotr Ilyich Tchaikovsky. The complete example is available in the Music Box section of the *EMIPIU* portal.

Tchaikovsky was the first composer to write music specially for ballet (*The Sleeping Beauty*), where, with choreographer Marius Petipa, he created an example of "dance set to music" principle, although not in a very successful manner, according to Lopukhov, as the symphonic music is more complex, and deep that the choreography itself. Despite this fact, in *The Sleeping Beauty*, Tchaikovsky invariably gave a distinctive musical feature, a musical physiognomy to each of the characters through his musical leitmotifs [10]. The *Fairy Variations* is a characteristic example, as each fairy dances, she bestows a gift on the Princess, and these gifts are physical assets or qualities expressed by the character of each dance [8]. A tool collecting different representations of the material allows the user to see or even question such claims, as he/she can compare the symphonic with the piano score, the choreography, observe the qualities of the performance and so on, all synchronized in a unique environment.

Fig. 2 shows a screenshot of the Web page containing the variation. It is worth to note that multiple score versions are available, as well as multiple audio/video performances. In accordance with the concepts introduced in Section 2, these different representations can be enjoyed in a fully synchronized environment. Besides, it is possible to switch homogeneous materials in real time, without making the user perceive a gap.

From a technical point of view, the key issue is broadcasting multiple digital media streams together, so that the browser can minimize the loading time when another material is selected. The problem is not trivial, since the number of media can be high, as well as their quality. However, a strategy to manage them is described in [3], and this technique is the one employed in the *EMIPIU* portal.

In the present context, it is particularly relevant to show heterogeneous kinds of score notation, including not only the "traditional" ones - i.e. those conforming to Common Western Notation - but also standard notation for movement. In this case the interface shows three alternative documents: the orchestra full score, a piano reduction and the related Labanotation extracted from [8].

As regards audio/video material forms, once more multiple digital objects could be encoded and synchronized. The user could refer to the same performance, showing dance movements from different angles - a useful didactic tool

not only for students but also for directors, choreographers, etc.; or he/she could compare different performance events as well as different productions. For the sake of simplicity, the latter case is the one shown in the current example: the user can select either the Bolshoi production or the Royal Ballet one. The Labanotation score shown in the interface is based on the Royal Swedish Ballet version, which is closer choreographically to the Royal Ballet one, but again not identical. As mentioned above, the synchronization with Labanotation was based on the analysis of the musical aspect of the dance score (meters, beats and phrases), thus the synchronization with the movement is not always perfect.

## 5    Conclusions and Future Work

This paper has coupled the comprehensive description of music and music-related aspects offered by the IEEE 1599 format with an example of standard formalism to encode dance movements, namely Labanotation scores. Many aspects strictly connected to music representation, ranging from interfaces for an advanced enjoyment to educational frameworks, have been explored in other papers and scientific publications (for example, see [4] and [5] respectively). Here the authors have addressed the specific field of dance.

From the dance point of view, the resulting tool can represent *rhythmical aspects* (meters, beats, phrases), *audio* (music which the dance is performed on), *performance* (video recordings of the performed dance), and *notation* (Labanotation score). General metadata (i.e. information about composer, choreographer, etc.) can be easily added, too.

Now the challenging aspect is the structural and logical description of dance. The IEEE 1599 format already supports these elements for music compositions. As regards the dance field, an ontology-based approach to the problem has been proposed in [7]. The future work will be the integration of music and dance descriptions - both structural and logic - within a unique XML document. The current achievements are shown in Table 1.

|  | Music | Dance |
|---|---|---|
| **General** | Available | Easy to add |
| **Logic** | Available | Challenging |
| **Structural** | Available | Challenging |
| **Notational** | Available | Available |
| **Performance** | Available | Available |
| **Audio** | Available | Available |
| **Visual** | Available (related to audio) | Preliminary |

**Table 1.** A comparison between available music and dance descriptions, organized in layers.

**Fig. 2.** A screenshot from the *EMIPIU* portal, illustrating the graphical interface to select and enjoy different materials related to the same music piece.

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