

From Dance Notation to Conceptual Models: A Multilayer Approach

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ABSTRACT

In this paper, we discuss the key elements of a semantic dance-move representation model based on rule-based extractions of logical descriptions from existing Labanotation scores. This is part of a larger effort on representing and analyzing dance movement based on choreological approaches and notation systems. The main goal is to develop a Knowledge-Based System that provides functionality (a) to search by movement concepts and characteristics in a meaningful way for dance practitioners, who may not necessarily be specialists in notation or analysis, and (b) to link different manifestations of movement recordings, especially Labanotation scores. We use examples to highlight the primary and abstract representation model and outline the main challenges in interpreting and segmenting a Labanotation score to transform it in a semi-automated way into a sequence of meaningful recognizable movement concepts. We are not aiming to develop an alternative notation system, but to construct a model and methodology to access existing scores (in digital form) and exploit the underlying information about movement for further computational analysis. We take into account some existing choreological approaches, which use an analogy between dance structure analysis and morphological language studies, and identify multiple levels of describing dance and movement. Finally, we discuss limitations of our approach as well as potential uses of the “search by movement” idea and outline some theoretical observations that emerged during this work.

Categories and Subject Descriptors

J.5 [Computer Applications]: Arts and Humanities, *Performing arts, dance*.

General Terms

Documentation, Human Factors, Standardization, Languages, Theory.

Keywords

Dance Notation, Labanotation, Semantics, Language, Conceptual Models, Movement, Segmentation, Documentation, Analysis, Cultural Heritage.

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1. INTRODUCTION

Many significant efforts are providing digital descriptions for dance as a performing art [6][8] and an expression of intangible cultural heritage [15][32] while numerous ongoing projects are exploring movement and new technologies under an interdisciplinary perspective [3][15][22][23][31][33]. Nevertheless, the question of developing the tools and methodologies to study the movement of dance either as part of an art form, a social phenomena or a cultural expression, in a systematic, universal manner is not a question of the digital age exclusively [10][26]. It has been a persistent question for anthropologists, sociologists, and ethno-choreologists for many years. It is of no question that dance is one of the least studied areas of communication forms in comparison to language, music and visual arts, a fact that is due, not only to the lack of research interest of the academic world in the past, but also to the intangible character of dance and the lack of methodologies to document and study it in a systematic manner. For documenting dance while it is performed, there are as many ways of describing, representing and analyzing movement, as there are researchers [26]. It is no question why many current efforts of studying movement, dance and choreography are developed in collaboration with specific choreographers trying to find the emerging patterns of individual creators [3][14][22][29][31]. On the other hand, documenting dance is also a digitization process, where the creation of data is as important as making these data available, accessible, comparable and subject to further analysis and computation [10][16]. The question we are addressing in this paper is how semantics underlying a notational system, knowledge of choreological movement analysis, and existing conceptualization of dance practice, can be related to each other. If a universal (syntactically and semantically) language for dance does not exist, how the different ontologies [4][9][28] could be mapped to construct, useful data models, or standards to capture this knowledge under a digital library perspective. Our aim is to examine the syntactic and semantic gaps that exist between the various digital manifestations of dance descriptions and provide an abstract categorization.

2. MAIN INTERDISCIPLINARY ISSUES

In what follows we present the main issues that make automated interpretation of a dance description (digital or not) a big semantic challenge. For if automation and computing require clear semantics and formal interpretations, standardizing dance and movement descriptions is not a straightforward process.

2.1 Segmentation is not (only) a computing issue

Imagine that you hear a language for the very first time. How easy would be for the listener to guess where words begin and end, if he/she finds no meaning in what he/she hears? Dance practitioners of any style have their own concepts, names for steps and moves and while learning or teaching a new choreography, consciously or not, they segment continuously. Sometimes it is easier to learn and remember when they name what they do no matter if those names are simple verbs, terms from specific syllabi, dance specific vocabularies, or even made up words. The segmentation might be measured in beats and reflect the rhythm of the music, or the movement might have its own rhythm. To give another example of a dance and language analogy, studying the structure of dance from motion captured data and physical equations, is similar to study speech (oral language) by signal processing, but completely ignoring the morphological analysis, grammatical and syntactical rules and all the work conducted by linguists for centuries. Likewise, it is like studying music only through the signal but ignoring notation, and other musicological knowledge. Such a method might provide extremely interesting results on emerging patterns, but if the objective is archiving data of dance descriptions for systematic study it is worth to exploit the existing choreological and dance anthropology tools and methodologies. Last but not least, in selecting movement data, whether digital or not, it is important to distinguish between the emic or etic segmentation of movement, as in the first case the practitioners, are the ones who decide how they conceptualize about the movement, while in the second case the observer is the one who segments the movement out-of any cultural context [2][17][18][26]. At this point we need to clarify that the objective of this work is to examine and classify the different descriptions of movement and the languages we use to convey them and not the symbolic meanings that the movement might convey. This differentiates our work from multilayered models that have been presented to annotate gestural and bodily communication [1][25]. Of course expressing emotions and feelings in dance are very important aspects and can imply a specific segmentation on movement but this aspect falls out of the scope of our current work.

2.2 Dance Notation is a universal written language for movement (not dance)

Of course dance has no written language. Although powerful notation systems exist (Labanotation, Benesh, Eshkol-Wachman), there is no comparison with “physical” written language, not even music notation, for two reasons. A) Dance notation systems are very new. What makes a language powerful is its everyday usage and continuous evolution and unfortunately Labanotation (along with other notation systems) is not the language of the majority of dance practitioners and movement creators, but mainly a language of scholars. B) The creator of dance (choreographer, performer, or cultural group) does not necessarily express himself through those notation systems, especially if the movement creators are not traditionally educated in the field of Western dance. With very few exceptions, dance notation has either a prescriptive or descriptive character [2] which means that the Labanotation score is created before the event of dancing to give instructions about the movement, or afterwards, to describe this event. In both cases, a different person than the performer creates the score. Labanotation, as a language [13], might be a powerful tool, but we cannot say that it represents the written language of dance.

Labanotation is the written language for Laban Movement Analysis, thus a symbolic language expressing specific concepts for analysing and thinking about the movement. In some cases, the knowledge of the notation affects the perception of movement in practice. As described in [30] the perception of movement was influenced by the knowledge of Eshkol-Wachman notational system, as reflected an awareness of a body reference system that relates to all movements as enclosed within a sphere. But not all dance practitioners understand or necessarily think within the context of notational languages. So the question that emerges here is how the symbols of Labanotation actually relate to dance segments. Is it an one to one analogy? We are not, in any case, questioning the major contribution of Labanotation system to the structural analysis of dance and the capability it provides for creating detailed descriptions and many other scientific and creative applications. On the other hand many unconventional dance styles (like folk) require so much additional notes (or maybe symbols) that the economy of Labanotation diminishes [26]. Labanotation is able to describe every detail of movement such as a finger movement; however, the combination of symbols becomes too complex to understand by local dance communities [5]. Informal use of Labanotation system for adapting to particular dance styles [20] is another example that proves that the knowledge of the system do not automatically make it usable for any kind of dance tradition, at least not for everyday use from the dance practitioners. Some researchers question if Labanotation is a language or just a script [7]. Actually Labanotation is a language [13], but each score is a script, a recording (prescriptive or descriptive) about movement and it inevitably includes subjectivities and assumptions. As in any language the score is a mean of communication where one needs to decode “who the transmitter is” and “who the receiver of this message”, to decide how much detail is enough to transmit the required message. The emerging question here is that if humans cannot read, or moreover create a Labanotation score without having any knowledge of the particular dance style, how can we create an algorithm to do so? Dancers can read a notation score because they see something recognizable [10][26] We need to decode the process that we follow to read this information, to formally express it in a computer language and eventually reproduce this kind of artificial intelligence.

2.3 Dance is not a universal language

Although it is usually said that dance and movement is a universal language, we agree with the statement of S. Whatley “Dance is not a real language”[27]. For if we are to methodologically study dance and the morphology of its movement, or design and develop tools to archive this knowledge, the above statement becomes as meaningless as saying that Language is a universal language, because all people around the world are able to communicate using their phonetic system. Indeed there are many analogies between dance and language, and one of the most significant is the analogy between the morphology of language and dance structures, as introduced in [17]. “As a system for recording movement, Labanotation can be used in a way comparable to phonetic notation of speech sounds. Just as a linguist working with a living language subjects a phonetic grid to phonemic analysis to obtain an inventory of the basic phonemes in a language, a dance anthropologist can subject an etic movement grid recorded in Labanotation to emic analysis to ascertain which movement have emic relevance and thereby obtain an inventory of basic dance movements comparable to phonemes of a language”[17]. Thus Labanotation alone is not

enough to decide what the words of a language are. Under this perspective, the notions of kineme and morphokine [17], as dance segments are analogous to *phoneme* and *morpheme* in language. Kinemes are actions or positions, which have no meaning as units themselves, but consist the basic building blocks in a dance tradition. A morphokine is defined as the smallest kinetic unit that has meaning, where meaning here does not reflect any pictorial or narrative meaning, but it is used to indicate movements that are recognized as units from the people practicing a specific dance tradition. The third level of dance structure is the motif level. A motif is frequently occurring combination of morphokines that forms a short entity in itself. This approach has been applied to many dance languages mainly folk dance (Tongan, Polynesian, Hungarian, Greek, Bulgarian, USA clogging etc.)[18]. The power of this approach is, simultaneously, its limitation: it is a method that needs onsite documentation, to decide which are the *morphemes* and *kinemes* of a particular dance language. One cannot automatically extract those movement units, unless he is equipped with large, digital datasets that are expressed in a comparable language. Note that in this case the approach is etic (vs. emic) which means that an algorithm actually plays the role of an outside observer who decides what the significant or recognizable units are. The emerging question here is who decides about what's in a movement and what are the concepts to describe it. The one who dances or creates the movement (dancer, choreographer, local person in the case of folk) or the observer?

is an important movement segment for a specific dance culture, could be completely meaningless, or inexistent in another. What it is a Kineme in one dance language it could be a morphokine a *motif*, or unacceptable non-sense in another. To decide about which movement segments convey meaning, the study and essential knowledge of the particular dance tradition is inevitable. The supplementary relation of the morphological analysis tool to the notation system is also reflected in the glossaries that accompany most studies and serve for the following:

- 1) Provide a map between a cultural-specific movement segment and the detailed description in terms of movement in a universal language.
- 2) Provide a useful guide on how to segment a Labanotation score and thus be read easier by applying some simple rules.
- 3) Connect particular Labanotation description with a cultural context allowing the interpretation of the score in a more consistent manner to the style of this particular dance tradition.

3. A MULTILAYERED CONCEPTUAL APPROACH

3.1 Notational vs. Conceptual Levels

In the following paragraph we are organizing these different expressions of dance descriptions from a semantic perspective.

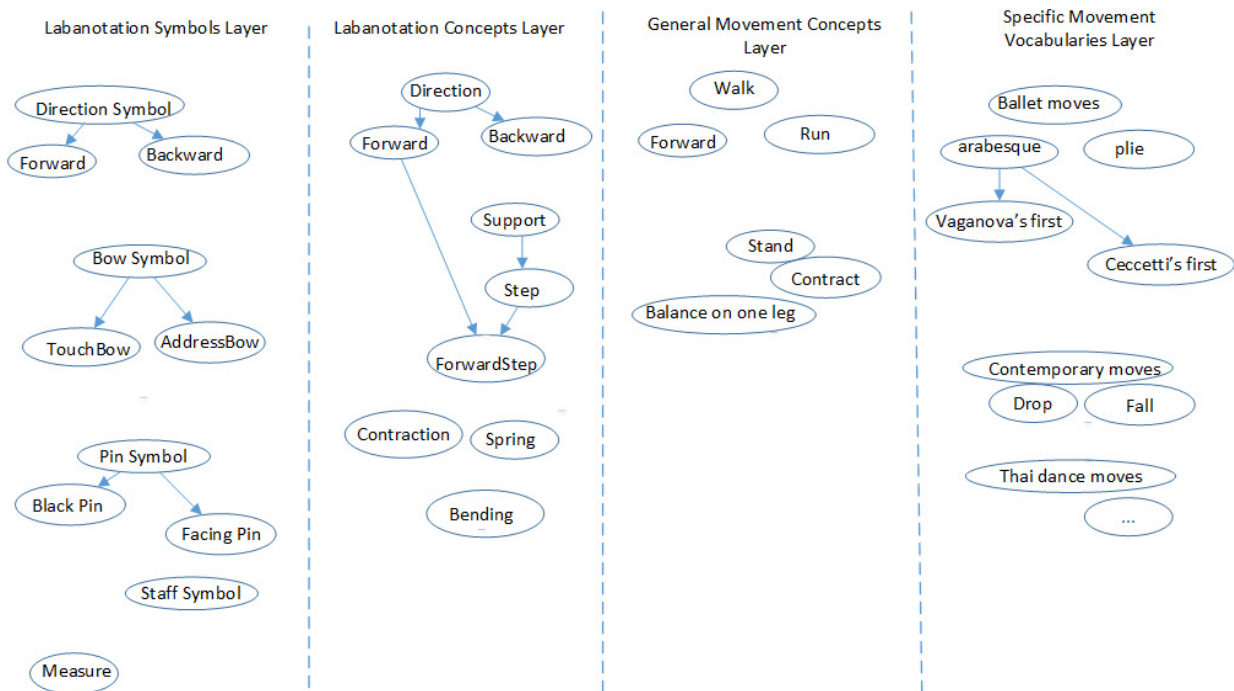


Figure 1. The different layers of describing movement including some examples

In addition, those movements are treated as “entities”, units of a dance tradition, with their own “meaning” within a particular dance context. In the following paragraph we are attempting to organize these layers of knowledge from a semantic point of view [2][10]. Most important, what these studies [18] show is that what

We propose a four-layer model including the notational or Labanotation symbols (LN) layer and three conceptual levels, which are distinguished according to their relation to formal movement analysis, to common language movement description or to specific movement or dance practice vocabularies. This layering could serve as a useful guide to categorize semantic models for movement. The layers of this model are the following:

Labanotation Symbols (LNS) Layer: This layer includes the various classes of symbols, as they are categorized by Labanotation system for analyzing movement and are implemented in software applications e.g., LabanWriter [19]. Examples of such concepts are *DirectionSymbol*, *Staff*, *Measure*, *BowSymbol*, *PinSymbol*, *TurnSymbol*, *Body Parts Symbol*, *Joint Symbol* etc.

Labanotation Concepts (LNC) Layer: This layer includes the concepts that correspond to the lowest level of interpreting a symbol based on its location in the score and how it is related to other symbols. E.g., in Labanotation (LN symbol layer) there are Turn symbols, and by interpreting Turn symbols based on their location, the corresponding concepts might be e.g., *Rotation*, *Leg Rotation*, *Turn*, *Arm Rotation*, and *Twist*.

Generic Movement Concepts (GMC) Layer: This layer includes movement concepts that are not directly related to Labanotation concepts or Laban Movement Analysis, but are common sense expressions of movement, e.g., *Running*, *Walking*, *Turning*, *Jumping*, *Skimming*.

Specific Movement Vocabularies (SMV) Layer: This layer includes specific terms, and notions, movement concepts that come from particular dance languages and constitute the vocabularies and grammar of those dance genres. It could include any of ballet terms (e.g., plié, arabesque, pirouette, en dehors, tendu), contemporary dance terms (contraction, suspension, fall, drop), or even idiosyncratic vocabularies. They could be *kinemes*, *morphokinemes*, *motifs* or any recognizable units, named or not, of less known dance languages.

At this point we discuss some of the existing semantic models, presented in related works and examine in which of the layers they belong. LabanXML [24] is a semantic model to represent Labanotation symbol concepts, thus it would be a model of Labanotation Concepts layer. On the other hand MovementXML [12] is a model to represent simple concepts of movement as they are expressed in Labanotation, thus it would be a model of Labanotation concepts layer. Similar to the above, is the Labanotation based ontology we presented in a previous paper [9], which actually is a model in between the layer of Labanotation concept and General Movement Concepts layer. Note that in none of the above conceptual models, formal rules were implemented to directly, map the Labanotation symbols from original scores into instances of the ontology in an automated way, and this is our contribution at this stage of our work, writing down the definitions to move from one layer to the other

Within each of those layers, taxonomies and hierarchies of concepts occur as it is shown in Figure 1. For example in the notational level (LNS) there are clusters or families of symbols that share some common characteristics e.g., Direction, Bow, Turn (Turn Left, Turn Right, Turn Any side), Pin (Black Pin, Black Pin1-4) and the same stands for each one of those levels.

The advantages of this separation are the following:

1. Distinct between movements that are different or belong to different sub-domain ontologies but share the same name e.g., contraction in Labanotation Concepts layer is the specific movement of joints indicated by space measure symbols, in Generic Movement Concepts layer it might mean something more generic and in the Specific Movement Vocabularies Layer it might refer to Graham technique contraction. Also what is referred with a single

word in a system it might mean something else in another e.g., *Jump* (an action or a quality of movement? [11]), *Arabesque* (a ballet or an oriental dance term?), *Drop* (generic term or a Limon technique's term?)

2. Find movements that are close as movement description in any of the three lower levels, but have different names.
3. Once the links between different layers are developed we can "guess" missing information by linking one layer to the other, as described in Example 1.
4. Incrementally build the relations of the nodes from one level to the other and add information, and also relate to other forms of description and information, such as pictures, videos, motion caption.
5. The model can be extended, to reflect additional ontologies and notational systems and the relationship between their entities. For example what is described in the paper of Saad et.al [27] is a transition between a notational layer (Benesh) and a conceptual level based on the systems' description of movement properties. Also the Specific Movement Vocabularies Layer can include endless numbers of vocabularies from more academic syllabi, to particular style and individuals' idiosyncratic vocabularies, or even other movement practices (e.g., martial arts).

Example 1. What is shown in Figure 2, in a glossary of expressing ballet syllabi using Labanotation, it is interpreted as "degage devant en l'air" [21], whereas there is no indication on outer rotation of legs, straight legs, or stretched foot (coup-de-pied), because the reader is supposed to know the ballet technique. On the other hand the same motif in Figure 2, can be found in many Balkan round dances to describe a simple raise of the leg where the leg is slightly bent, and relaxed. In both cases the minimum amount of symbols is used to describe the *kineme*, and the reader is expected to guess the rest of the details by the context, by knowing the ballet and the folk dance's style and technique respectively.

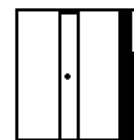


Figure 2-folk or ballet kineme?

Using logical expression [9], this description literally says:

SupportOnLeft (hasDirection OnPlace AND hasLevel Middle)AND RightLegGesture (hasDirection Forward AND hasLevel Low.

So in this case, knowing the score's particular dance style is essential to correctly interpret the motif in a higher layer of description, and decide if it is a folk or a ballet *kineme*.

It is difficult to say that the aforementioned *kineme* in the folk dance is identical with a ballet *kineme*, just because they share the same notational description as they come from different dance traditions, with a completely different technique, style and cultural context. Nevertheless, finding this kind of similarities in some of the layers (notational or conceptual) it might give interesting links

and connections for various researches, educational or artistic applications. In the Dance Digital Archive [6] for example, there is the functionality of searching for similar pictures or parts of dance pictures through image processing, and while the results might not always be absolutely correct from an ontological point of view, they might provide inspirational new insight on what “similarity” in dance is about. Last but not least, if the descriptions in each layer have the required metadata (i.e., where does this description come from, who is the descriptor, etc.), more studies can be applied on how we document and communicate movement in dance. For in what we described above, we focused on a specific example, however, one can find others with more detailed descriptions. Therefore if the mappings in different layers exist, one could compare those descriptions, and understand “why, or where or who describes a movement in one way or another” and how much info should one provide for a satisfying documentation. A related question is that when a description is more detailed than another does it mean that in the first case additional details were required for the specific dance style, or it was simply the notator’s decision?

3.2 Example- Moving from one layer to the other

To what follows we explain through an example, the relation and transition from one layer to another. Imagine that you have a large number of digital Labanotation scores and you need to search for particular scores that include specific symbols that symbolize a required movement with specific characteristics, e.g., “give the scores that include a particular hook indicating the point of the foot touching the floor”. Moreover decode the symbols into something that gives an insight of what this symbol is about, and ask questions such as “bring me all the Labanotation scores in a database that include something which is similar to an arabesque (ballet)”. We propose a methodology to apply rules directly on the Labanotation scores and extract basic knowledge from a LabanWriter file.

Example 2. Let’s say that we have Labanotation scores that include any of the motifs in Figures 3, 4, or 5 which actually describe different forms of an arabesque [21]. We mentioned previously the fact that the human reader subconsciously “searches” for familiar patterns to read what’s in the score [10]. What Figures 3, 4 and 5 have in common is the motif shown in Figure 6. In the first three figures, motifs are all different forms of “an arabesque”, while Figure 6, presents what a reader would simply describe as a “generic arabesque” without going into further detail. If we describe the motif in Figure 6, using a logical description (Labanotation Concepts level) we will have the following:

SupportOnRight (hasDirection OnPlace AND hasLevel Middle) AND LeftLegGesture (hasDirection Backwards AND hasLevel Middle)

In a more Generic Movement Concepts (GMC) Layer we would describe this with terms such as *Standing on one foot, Standing on one leg, Balance on one leg, Leg is behind body*, while in the Specific Movement Vocabulary (SMV) Layer we simply call this an arabesque (ballet). Wikipedia gives the following definition for an arabesque: “In dance (particularly ballet), arabesque is a body position in which a dancer stands on one leg while the other (the working leg) is extended behind the body, with both legs held straight. The active leg may touch the floor in tendu back (called arabesque par terre) or can be elevated. Common elevation angles are 45° (also called à demi hauteur) and 90° (à la hauteur).

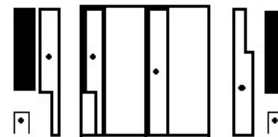


Figure 3. Arabesque allongé

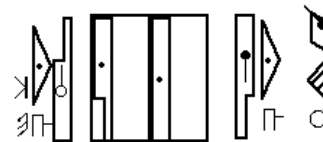


Figure 4. Arabesque 2nd Ceccetti

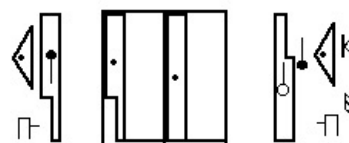


Figure 5. Arabesque 2nd Ceccetti

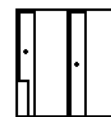


Figure 6. Generic Arabesque

So if we need to locate “an arabesque”, we need to take the following steps:

- 1) Define how it is described in common language: “body position in which a dancer stands on one leg while the other (the working leg) is extended behind the body”
- 2) Express the above notational description in a formal language, in a similar way to the aforementioned in the Labanotation Concepts layer.
- 3) Map the concepts of the formal language with the symbols of the score through rules, i.e., map the symbols with each of the conceptual levels.

By this process we are aiming at artificially reproducing the process of the reader who knows what “an arabesque is” through an abstract definition which gives him the ability to locate the pattern in Figure 6, in all of those Figures 3, 4 and 5. In addition to the above, we can enrich the Labanotation Concept description in order to include the symmetric definition (an arabesque is still an arabesque whether it is on right or leg foot), different levels (arabesque in relevé or in plié) to indicate variations of the same *kineme*, and also relate the formal definition of “what could be an arabesque” with generic and ballet specific concepts, e.g., “working leg”.

4. CONCLUSIONS & FUTURE WORK

In this paper, we present a preliminary semantic model to distinguish between the different layers of describing movement,

starting from a formal, universal, notational layer and moving incrementally towards a dance specific language layer. Our ongoing work is focused on expressing and implementing the rules to map the hierarchies of concepts between the notational and Labanotation concept layers, and incrementally build those rules to include links to the higher layers, taking into account the existing work and formalization.

5. REFERENCES

- [1] Allwood, J., Cerrato, L., Dybkjaer, L., Jokinen, K., Navarretta, C., & Paggio, P. (2005). The MUMIN multimodal coding scheme. *NorFA yearbook, 2005*, 129-157.
- [2] Bartenieff, I., Hackney, P.; Jones, B.T, Van Zile, J; Wolz, C. (1984). The Potential of Movement Analysis as a Research Tool: A Preliminary Analysis, *Dance Research Journal*, Vol. 16, No. 1. (Spring, 1984), pp. 3-26.
- [3] Bud Blumenthal: Dancers! Project, <http://www.dancersproject.com>
- [4] Ceusters, W., & Smith, B. (2011). Switching Partners: Dancing with the Ontological Engineers. *Switching Codes. Thinking through Digital Technology in the Humanities and the Arts*, 103-124.
- [5] Choensawat, W., Sookhanaphibarn, K., Kijkhun, C., & Hachimura, K. (2013). Desirability of a teaching and learning tool for Thai dance body motion. In *Design, User Experience, and Usability. Health, Learning, Playing, Cultural, and Cross-Cultural User Experience* (pp. 171-179). Springer Berlin Heidelberg.
- [6] Dance Digital Archive, <http://www.dance-archives.ac.uk/>
- [7] Durr, D. (1981). Labanotation: Language or Script. *Journal for the Anthropological Study of Human Movement*, 1(3), 132-138.
- [8] eclap project: European Collected Library for Artistic Performance, <http://www.eclap.eu>
- [9] El Raheb, K., & Ioannidis, Y. (2012). A labanotation based ontology for representing dance movement. In *Gesture and Sign Language in Human-Computer Interaction and Embodied Communication* (pp. 106-117). Springer Berlin Heidelberg.
- [10] El Raheb, K., & Ioannidis, Y. (2013). Dance in the World of Data and Objects. In *Information Technologies for Performing Arts, Media Access, and Entertainment* (pp. 192-204). Springer Berlin Heidelberg.
- [11] Fdili Alaoui, S., Caramiaux, B., & Serrano, M. (2011). From dance to touch: movement qualities for interaction design. In *CHI'11 Extended Abstracts on Human Factors in Computing Systems* (pp. 1465-1470). ACM.
- [12] Hatol, J. (2006). MOVEMENTXML: A representation of semantics of human movement based on Labanotation (Doctoral dissertation, School of Interactive Arts and Technology-Simon Fraser University).
- [13] Guest, A. H. (2005). *Labanotation: the system of analyzing and recording movement*. Psychology Press.
- [14] Inside Movement Knowledge, <http://insidemovementknowledge.net>
- [15] Intangible Treasures - Capturing the Intangible Cultural Heritage and Learning the Rare Know-How of Living Human Treasures FP7-ICT-2011-9-600676-i-Treasures <http://i-treasures.eu>
- [16] International Conference Exploring Research and Programming Potential for Labanotation Proceedings (2004)
- [17] Kaepler, A. L. (1972). Method and theory in analyzing dance structure with an analysis of Tongan dance. *Ethnomusicology*, 173-217.
- [18] Kaepler, A. L., Dunin, Elsie Ivancich, ed. (2007). *Dance structures: Perspectives on the analysis of human movement*. Budapest: Akademiai Kiado. ISBN 978-963-05-8542-2.
- [19] LabanWriter, <http://dance.osu.edu/labanner>.
- [20] Laura Le Pere (1995). *Dance Literacy Through Labanotation Part II: The Informal Use of Labanotation* <http://thebestofhabibi.com/vol-14-no-2-spring-1995/labnotation-part-ii>
- [21] Miles, A. (1976). The Gail Grant dictionary of classical ballet in Labanotation. Dance Notation Bureau.
- [22] Motion Bank, <http://motionbank.org>
- [23] Moving Stories, <http://movingstories.ca/movingstories>
- [24] Nakamura, M., & Hachimura, K. (2006). An xml representation of Labanotation, labanxml, and its implementation on the notation editor labaneditor2. *Review of the National Center for Digitization (Online Journal)*, 9, 47-51.
- [25] Poggi, C. Pelachaud, E. Magno Caldognetto. (2004). Gestural Mind Markers in ECAs, In A. Camurri, G. Volpe (Eds.): *Gesture-Based Communication in Human-Computer Interaction (LNAI 2915)*, Berlin: Springer-Verlag.
- [26] Royce, A. P. (1977). *The anthropology of dance* (pp. 7-8). Bloomington, IN: Indiana University Press.
- [27] Sarah Whatley *Beneath the surface the movement vocabulary in Siobhan Davis' choreography since 1988*.
- [28] Saad, S., De Beul, D., Mahmoudi, S., & Manneback, P. (2012). An ontology for video human movement representation based on benesh notation. In *Multimedia Computing and Systems (ICMCS), 2012 International Conference on* (pp. 77-82). IEEE.
- [29] Siobhan Davies Replay, <http://www.siobhandaviesreplay.com>
- [30] Spitzer, N. (2011) *Dancing and talking: exploring the value of talk within dance improvisation practice*. Unpublished MResThesis. Coventry: Coventry University.
- [31] Synchronous Objects, <http://synchronousobjects.osu.edu/>
- [32] The Greek Dance Pandect, <http://www.dance-pandect.gr/>
- [33] The Transmedia Knowledge Base for Performing Arts, <http://tkb.fcsh.unl.pt/>