BalOnSe: Temporal Aspects of Dance Movement and its Ontological Representation

Katerina El Raheb[1,2], Theofilos Mailis[1,2], Vladislav Ryznikov[3],
Nicolas Papapetrou[2] and Yannis Ioannidis[1,2]
[1]Athena Research Center, [2]University of Athens, [3]Free University of Bozen Bolzano

National and Kapodistrian
University of Athens

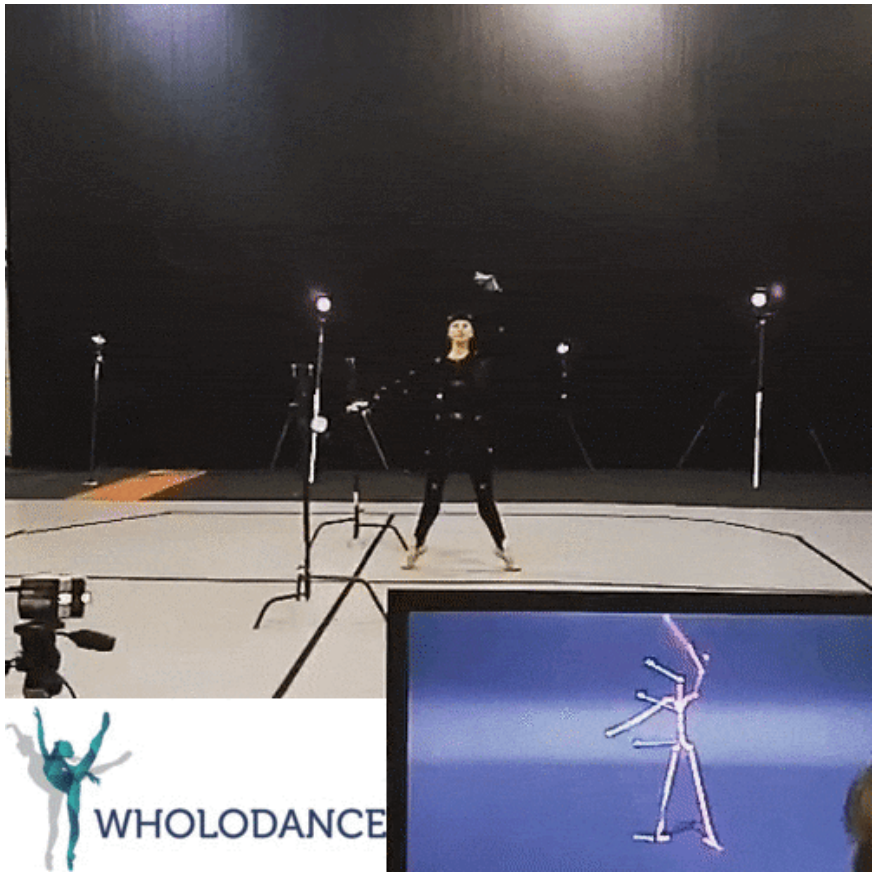
Objectives

- Annotate movement on multimedia content to enhance findability of resources and segments of interest
- Enrich existing content with common and domain knowledge
- Manage large amount of dance recordings in various context (Cultural Heritage Preservation, Dance Education, Humanities Research)

WHOLODANCE

Photo: WhoLoDancE EU Motion Capture Recordings

Ballet Ontology for Annotating and Searching Ballet (not only) ~~Video Performances~~ Recordings



- Multimedia content of dance recordings in different formats is increasing
- No existing standards in managing dance data and representing human movement

Annotation (manual and automated) is highly needed!

Human Movement: a challenging semantic representation problem

- **Segmentation and discretization**: Defining movement entities
- **Complexity of the human body and its movement**: can vary depending on context, even if we focus in one dance genre
- **Temporal aspects**: Movement descriptions imply a temporal description

Example:

Arabesque

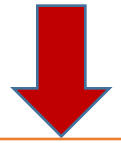
Morphokineme

A. L Kaeppler. Dance structures: Perspectives on the analysis of human movement., 2007.

1st Arabesque level
Balance on one leg
Ballet
Arm Forward
Leg Backwards
Leg Gesture

Semantic Representation of Movement (MoveOnto)

- Includes terminology of movement on different levels of abstraction
- Based on Labanotation System and choreological approaches (Kaeppler) to define concepts
- Extensible approach (non exhaustive vocabulary)

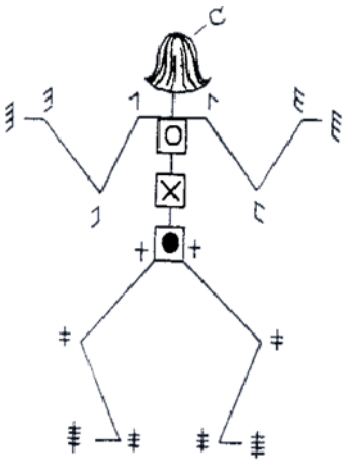


Combine Facts (Annotations)

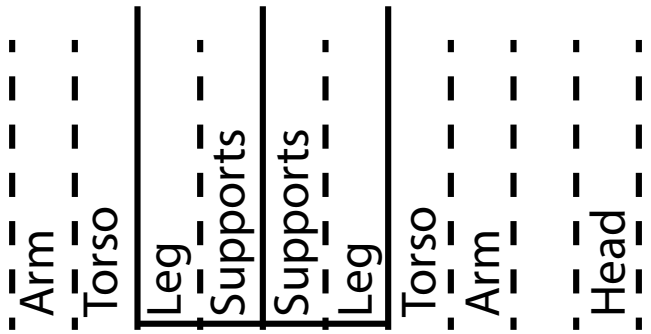
+

Rules (Domain Knowledge expressed in DataMTL)

Labanotation: a complex timeline



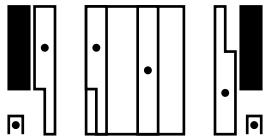
- A script-symbolic language to notate human movement –similar to music notation
- Uses symbols to describe basic movement information (directions, levels, body parts)
- Used by choreologists, dance archivists and anthropologists

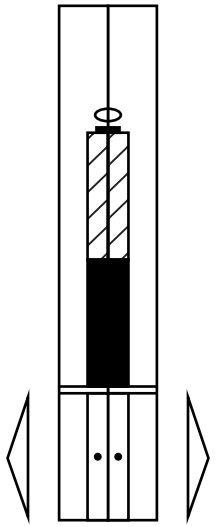


Rudolf von Laban, (1879-1958)

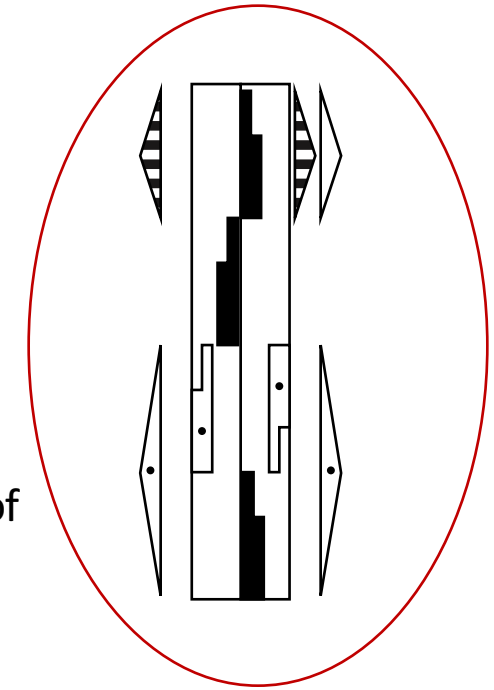
Labanotation Examples

Examole 1. The composed movement consists of movement occure simultaneously, within the same interval





Examole 3. The composed movement consists of parts that are synchronized in various time intervals



Examole 2. The composed movement consists of sequential parts where which one of them consists of parts which occure simultaneously, within the same interval

Time representation and DatalogMTL

- **DatalogMTL** is a language for representing temporal ontologies. It provides:
  - a natural way to represent time in dance movements;
  - a temporal component with complex rules;
  - expressive query component.
- Based on DatalogMTL we can encode complicated dance combinations via simple predicates and rules.

DatalogMTL Syntax

- A **DatalogMTL program**, , is a set of rules about our domain:
- A **data instance**, D, is a finite set of facts:

Body

Head

$\boxplus[0,3]Plie\ Releve(x)$

$\boxplus[0,1]Right\ Support\ Middle\ Place(x)$
$\boxplus[0,1]Left\ Support\ Middle\ Place(x)$
$\boxplus[1,2]\ Right\ Support\ Low\ Place(x)$
$\boxplus[1,2]Left\ Support\ Low\ Place(x)$
$\boxplus[2,3]\ Right\ Support\ High\ Place(x)$
$\boxplus[2,3]Left\ Support\ High\ Place(x)$

Conjunct

$$Right_Support_Middle_Place(:Video_1)@[12sec, 13sec]$$

DatalogMTL & Ontology Based Data Access

In the Ontology Based Data Access case, data instances can be derived from relational assertions and the corresponding mappings

Annotations					
VideoId	Movement	StartTime	StopTime	PostTime	Comment
123	Right_Support_Midde_Place	25 sec	26 sec	12/09/2016 @ 10:54am	-
123	Left_Leg_Gesture_Back	25 sec	26 sec	12/09/2016 @ 10:54am	-

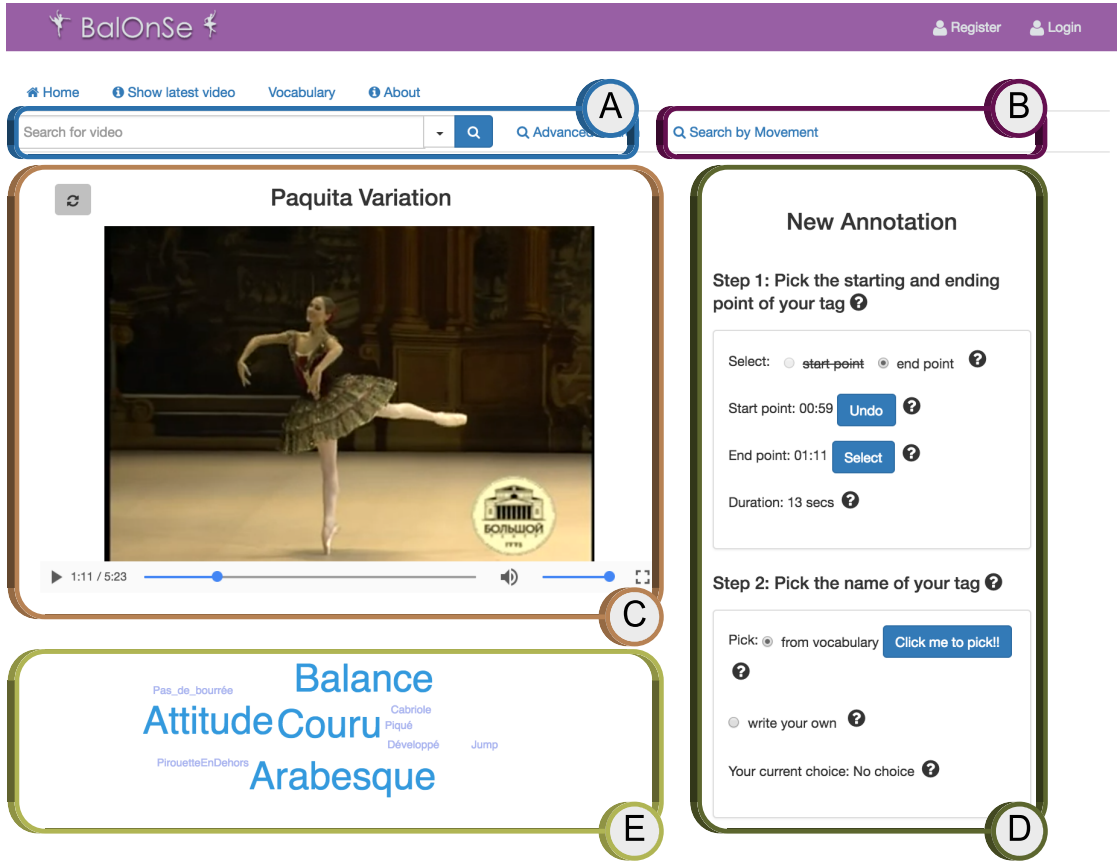
$$Right_Support_Middle_Place(\text{“}:Video''||x)@[tb,te] \leftarrow$$

```
SELECT VideoId AS x, StartTime AS tb, StopTime AS te
FROM Annotations
```

$$Right_Support_Middle_Place(:Video123)@[25\ \text{sec}, 26\ \text{sec}]$$

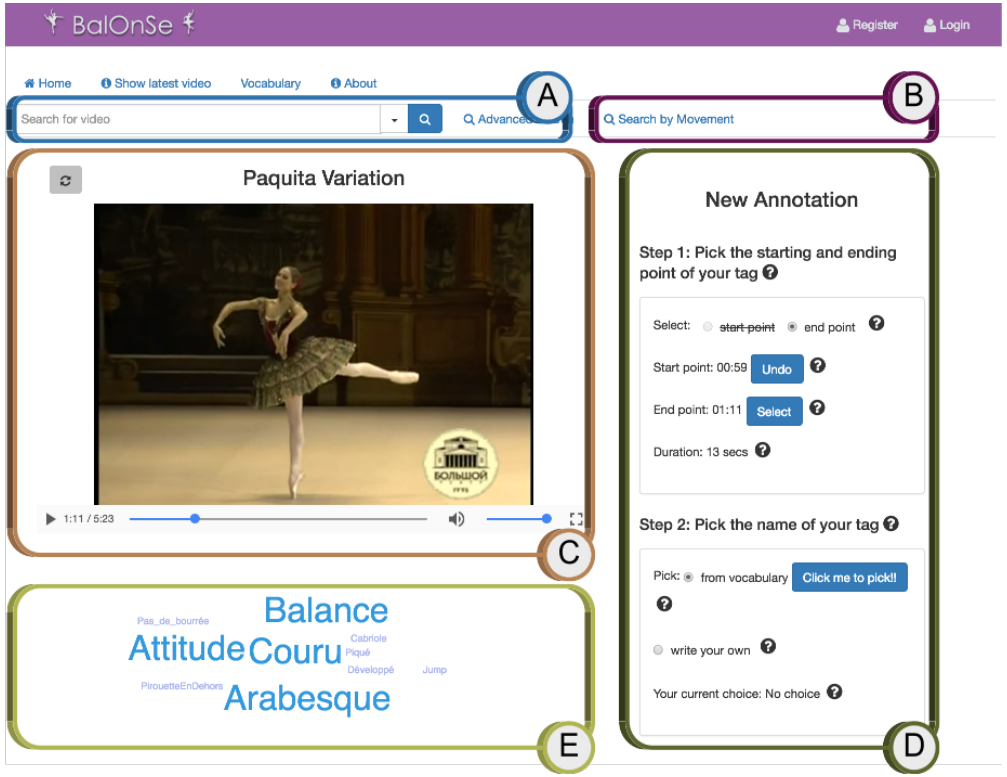
BalOnSe platform

- Annotation with archival functionalities and user moderation;
- Semantic-domain specific
- Rich predefined vocabularies for key-word search;
- Usable user interface including video streaming, and preview of statistics of annotations;
- Temporal Reasoning
- Modularity and extensibility.



BalOnSe Components -Annotating

- Multimedia content annotation:
- an archival system for the videos
- user interfaces to annotate video content
- store annotations in a relational database system.



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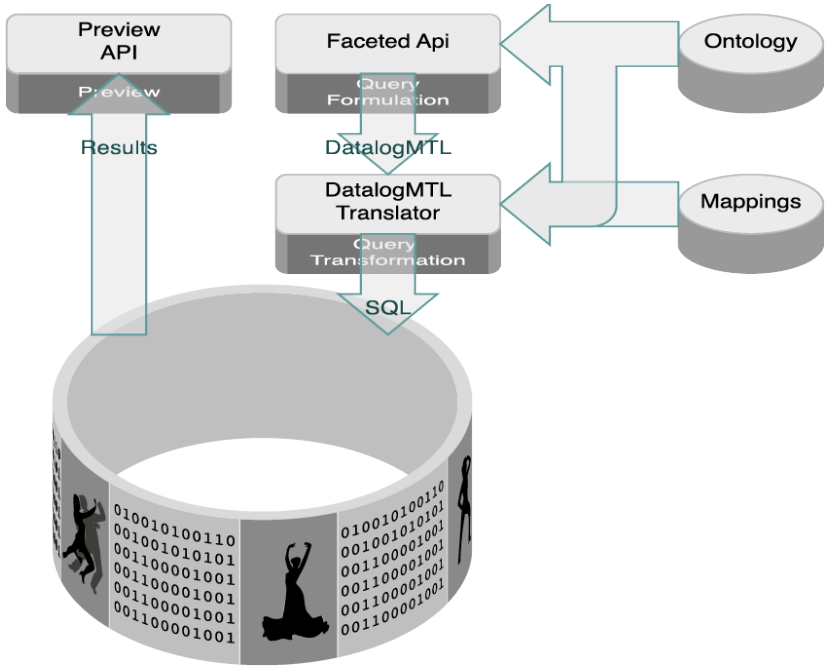
BalOnSe Components -Query Answering

- **Query Formulation**: Allows the user to navigate through the ontology and the corresponding temporal component to formulate simple DatalogMTL queries;
- **Query Transformation**: DatalogMTL queries are rewritten against the ontology and further unfolding into relational SQL queries based on the corresponding mappings;
- **Query Execution**: SQL queries are executed by a relational database management system;
- **Preview**: The results of query execution are video fragments corresponding to the complex movements that were queried.

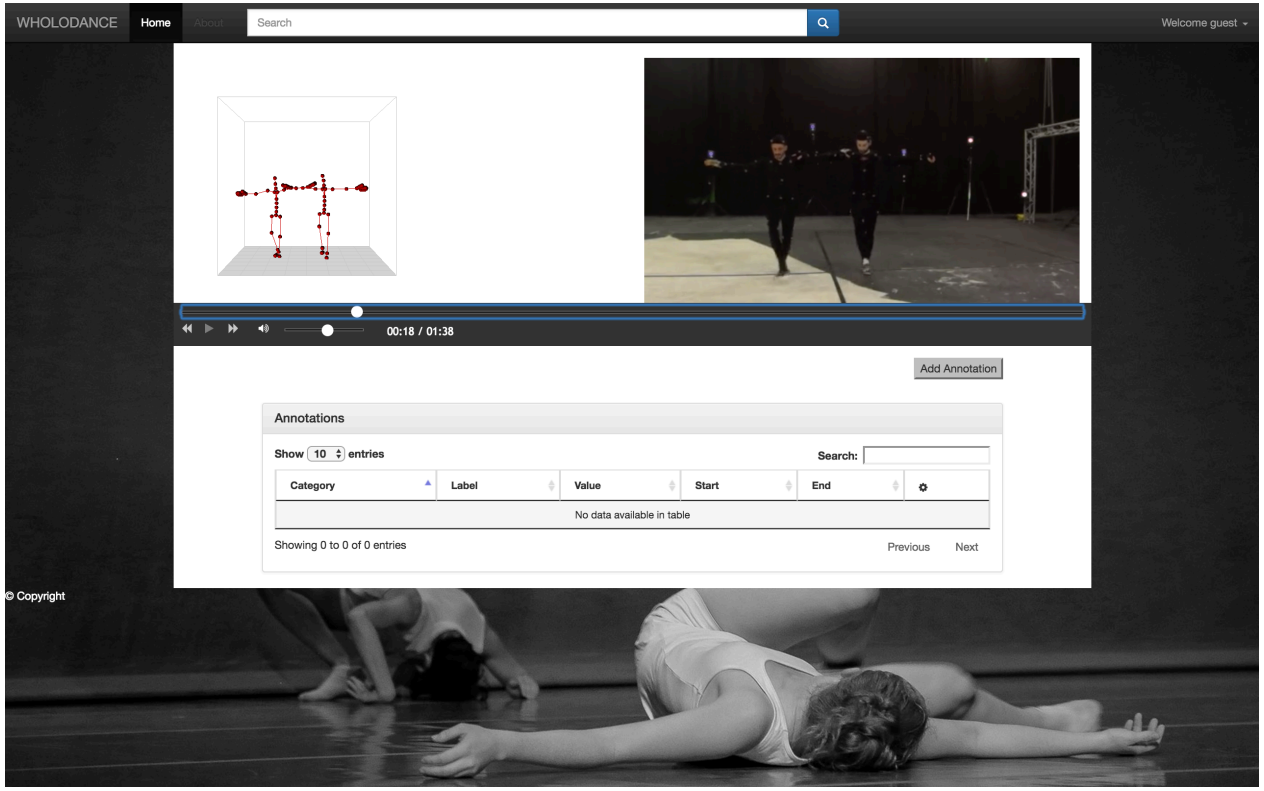


Conclusions

- An approach to describe the temporal aspects of ontological representation of dance movement.
- MoveOnto ontology expressed in DatalogMTL language to represent movement in time.
- Expressing Rules based on notation and analysis of movement from a cultural perspective

Future Work

- Faceted browsing
- Examine Datalog MTL extenstions to infer conclustions when there is no perfect synchronization.
- Extend with fuzzy values to express the degree of similarity between movements.
- More experiments with users
- Interface enhancements



Thank you!

Katerina El Raheb,
kelraheb@di.uoa.gr

Theofilos Mailis
Vladislav Ryznikov,
Nicolas Papapetrou
Yannis Ioannidis

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http://www.wholodance.eu