



# The Spatial Knowledge Representation of Players in Mobile Outdoor Gaming

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# Motivation



- Current technology allows people to be connected at any place and any time.
- Location-based services are used for a broad range of applications.

# Getting knowledge from location data



- Know how to get to the nearest pharmacy
- Find the best route for reach the gas station
- Get advice and discover near interesting places



Knowing “where are you” is interesting...



...but knowing “how do you move” is even more!

# Getting knowledge from movement data



- What kind of commuter are you?
- How do you spend your leisure time?
- Do you prefer crowded places?

# [ Mobile outdoor gaming ]

- Most of the approaches in MOG have currently taken advantage of location data without any sense of mobility.
- There is a need for analyzing and understanding movement as unexploited resource to enrich the gaming experience.

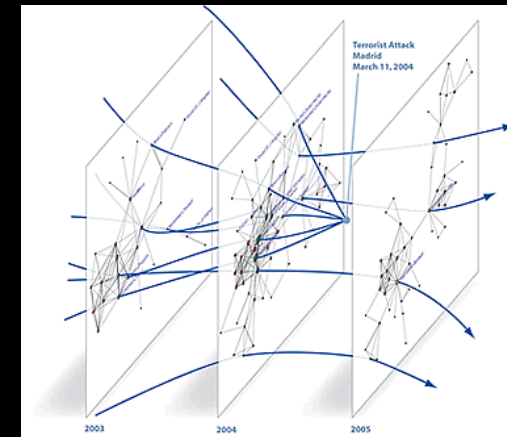
# [ Objective ]

To develop a Spatial Knowledge Representation (SKR) about the movement of players to discover, understand and explain the spatial patterns that characterize the interactions in the game.



# [ Main issues on SKR ]

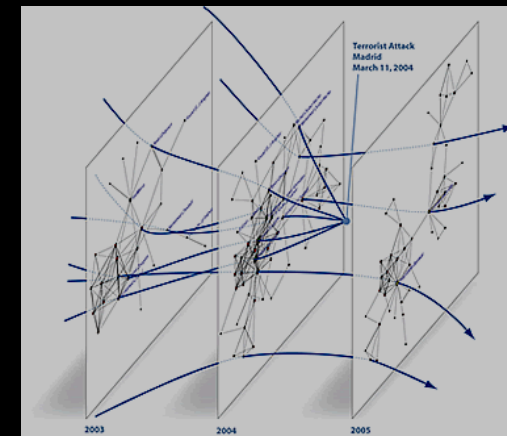
- Spatial representation have been tied up by a static cartographic paradigm. (Peuquet, 2002)



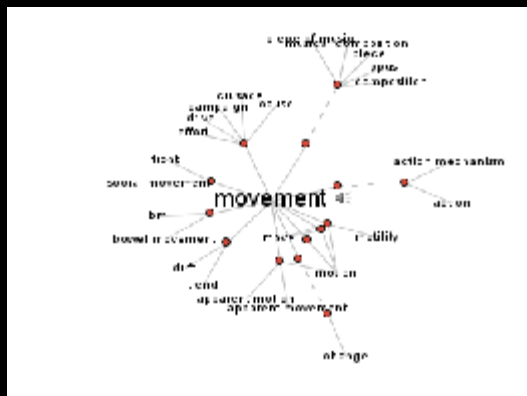
[www.atalab.com](http://www.atalab.com)

# Main issues on SKR

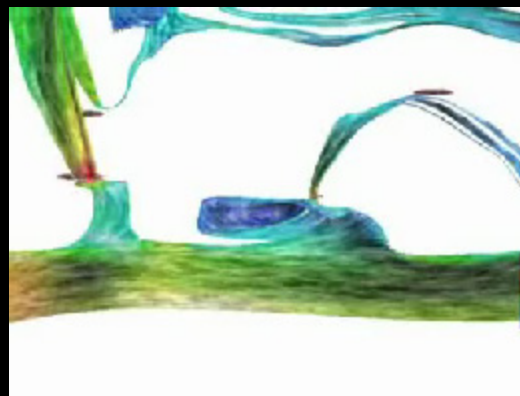
- Spatial representation have been tied up by a static cartographic paradigm. (Peuquet, 2002)
- New representations are needed to conceptualize movement as a dynamic, complex, and non-linear phenomenon.



[www.atalab.com](http://www.atalab.com)



Orellana 2008



[www.vrvis.at/scivis](http://www.vrvis.at/scivis)



<http://pedestrianlevitation.net>

# [ What should be a SKR? ]

Adapted from Davis, Shrobe and Szolovits, 1993

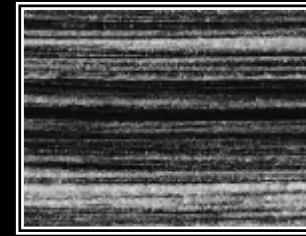
- A surrogate of real world
  - *“The map is not the world”*
- A set of Ontological commitments
  - *About what exists and what are the relations between the concepts?*
- A fragmentary theory of intelligent reasoning
  - *Which inferences can be sanctioned?*
- A medium for efficient computation
  - For organizing, storing, manipulating and recovering information.
- A medium of human expression
  - Telling the others (and machines) about the world.

# [ Our approach ]

- Make an explicit conceptualization of space and movement.
- Make commitments about what movement is.
- State which inferences can be done.
- Compute the spatial patterns and discover new knowledge.
- Produce visualizations to explore and explain the results.

# [ The Frequentie 1550 pilot game ]

Frequency 1550 is a mobile city game that uses GPS and UMTS technology to let pupils of the secondary schools actively learn about history instead of passively absorb knowledge.



[www.waag.org](http://www.waag.org)

# Making a explicit **conceptualization** of space...

## Multi-Tier Framework

### **Cognitive space\***

"What is understood can be represented..."

*\*Formerly social*

### **Sensing space**

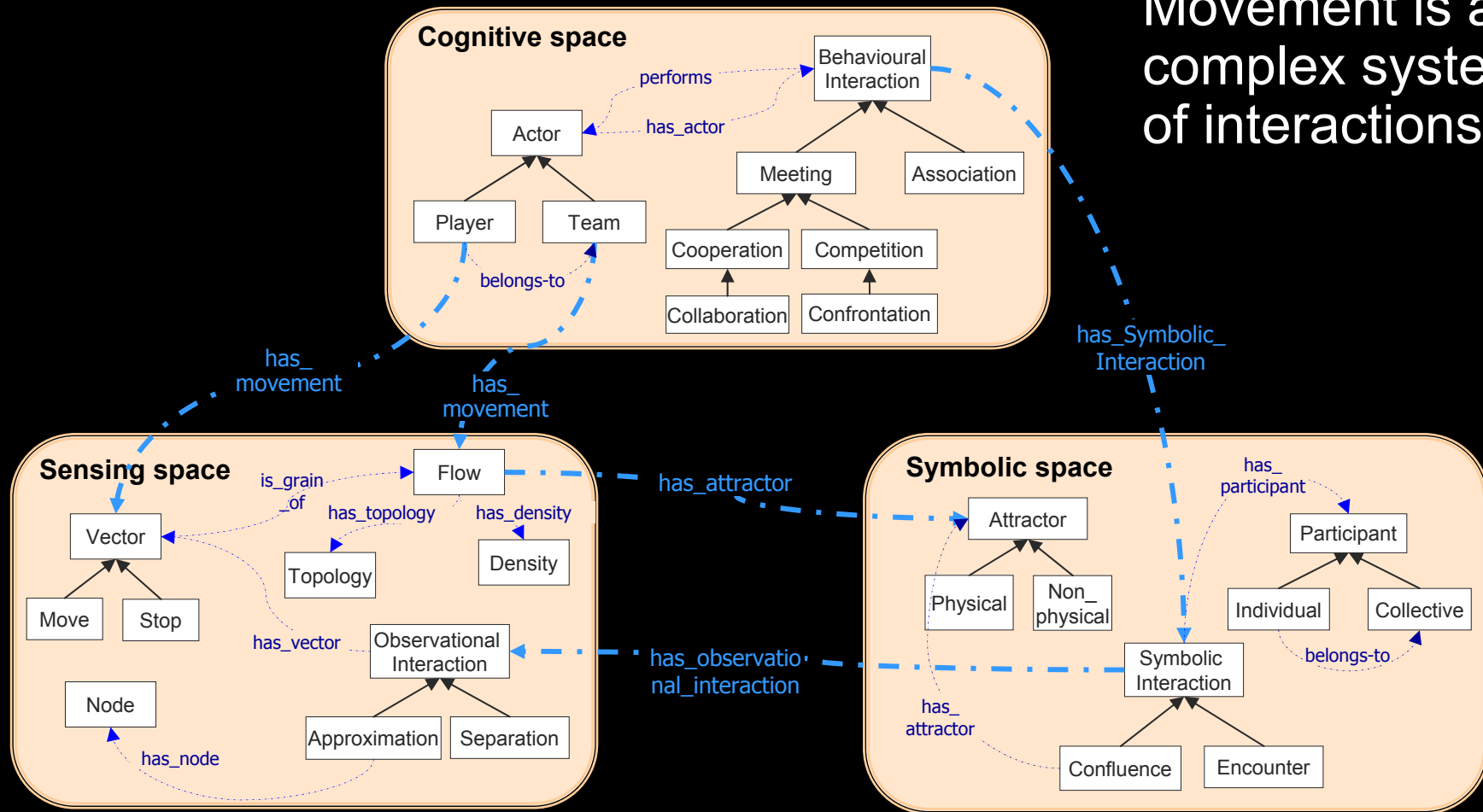
"What is perceived can be represented..."

### **Symbolic Space**

"What is interpreted can be represented..."

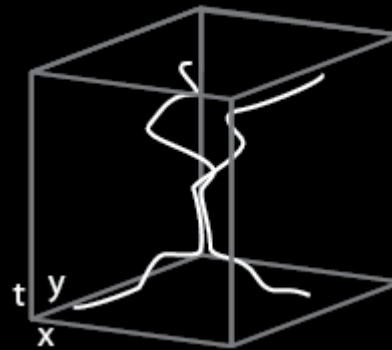
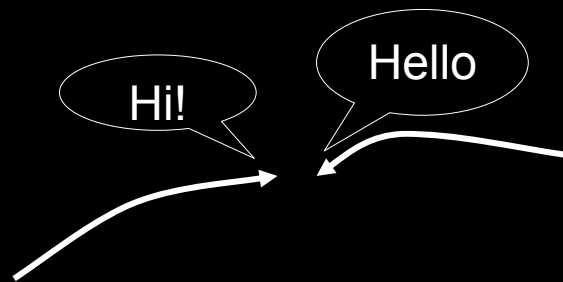
# Making commitments about what movement is...

Movement is a complex system of interactions



# Stating which **inferences** can be done...

What is an “Encounter”?



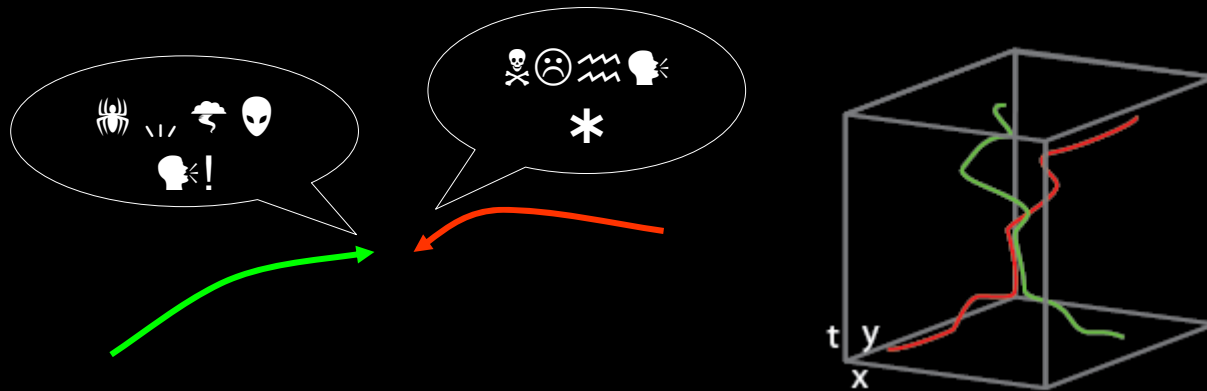
## ≡ Encounter

- ⊃ Symbolic\_interaction
- ⊃ has\_participant some (Individual and (min 2))
- ⊃ has\_observational\_interaction some (Approximation and (has\_vector some move))



# Stating which inferences can be done...

What is an "Confrontation"?

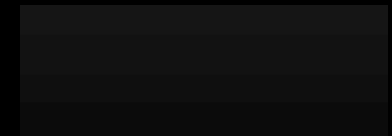


## ≡ Confrontation

- ⊔ Behavioural\_interaction
- ⊔ has\_actor some (Player min 2 and (Player belongs\_to some Team (a,x)) and (Player belongs\_to some Team (b,y)) and (different\_from (a,b)) and (different\_from (x,y)))
- ⊔ has\_symbolic\_inetraction some Encounter

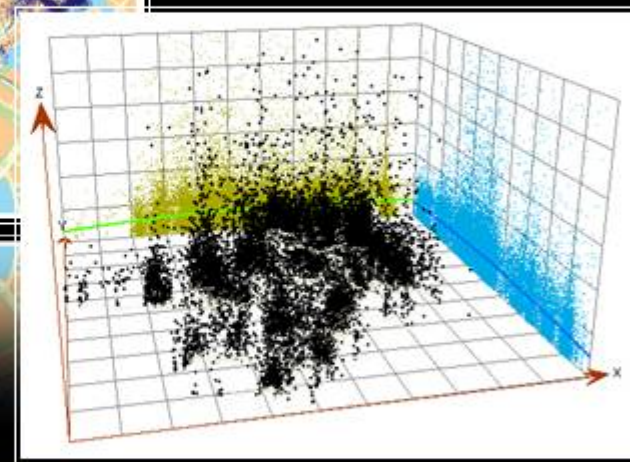
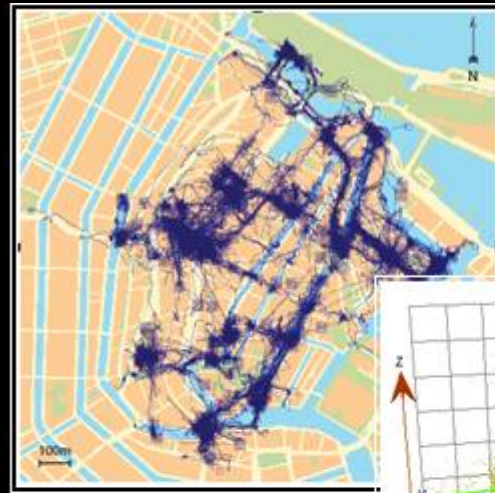
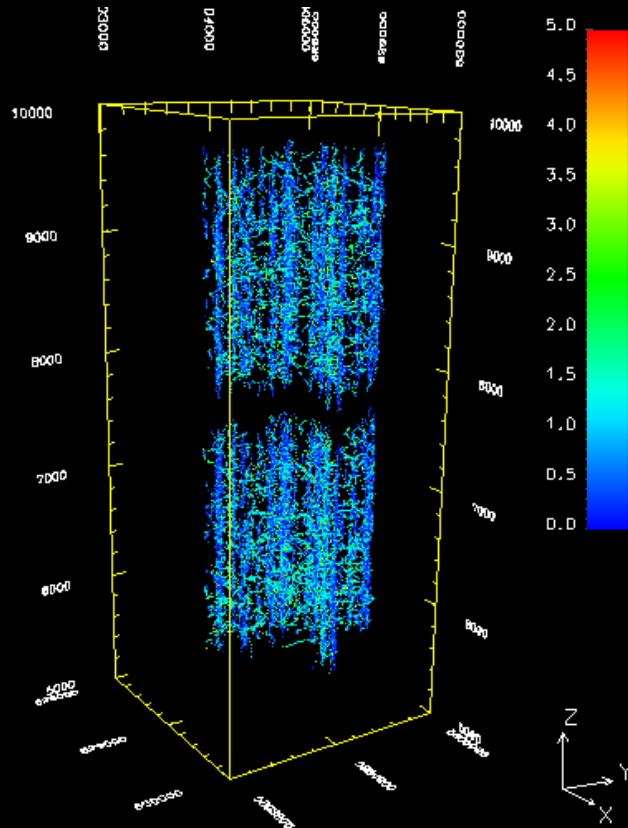
# Computing the **spatial patterns** and discovering new knowledge...

## Spatial patterns for “Encounters”



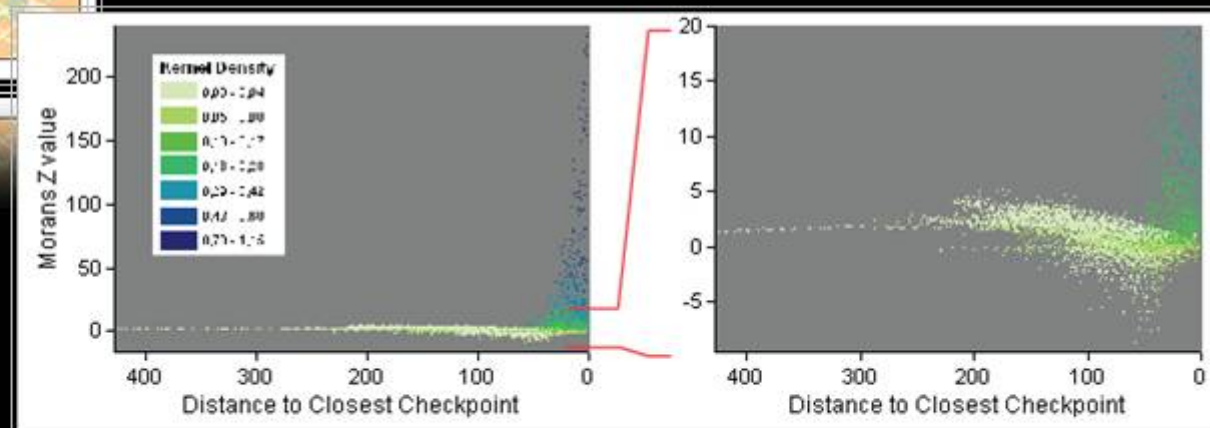
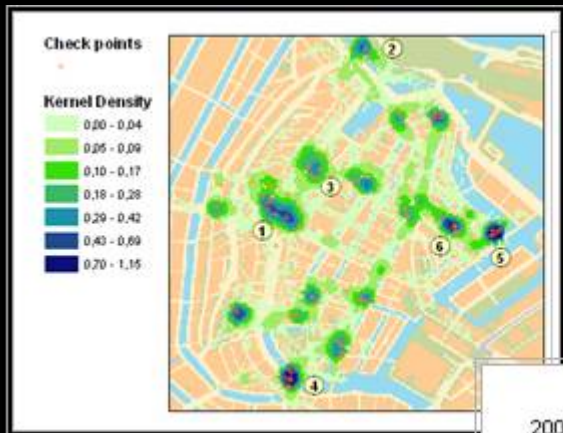
# Computing the **spatial patterns** and discovering new knowledge...

## Visual Patterns for “Stops”



# Computing the **spatial patterns** and discovering new knowledge...

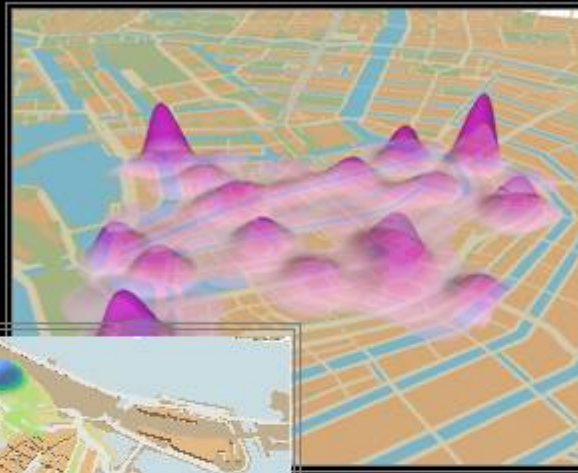
## Multidimensional Patterns of “Attractors”





# Producing new visualizations...

Attractors



Attractors



Flows



Confrontations



# [ Conclusions ]

- Mobile devices link real and virtual worlds by providing location information, and could change the perception of the environment, creating new cultural, social, and virtual landscapes.
- New spatial knowledge representations are needed to provide models for different notions of space and movement.
- Our approach demonstrated to support multiple representations and therefore could be extrapolated to other application domains.

# [ Future research work ]

- Continue the development of the concept of interactions as a metaphor of movement.
- Implement the symbolic and cognitive space tiers.
- Apply our approach in different application domains.
  - Movement of visitors in the Dwingelderveld National Park (Netherlands)

# [ Thanks to... ]

- GeoPKDD Project (FP6 STREP)
- Mercator Research Group (UPM)
- You!

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