

A semantic and language-based model of landscape scenes

Jean-Marie Le Yaouanc, Éric Saux, Christophe Claramunt
[name]@ecole-navale.fr

Naval Academy Research Institute,
BP 600, 29240 Brest Naval, France

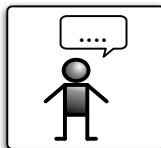


Research context

- Cognition principles have recently changed the way geographical information should be apprehended
- However, landscape descriptions are not satisfactory represented by current geographical models
- In particular, there is still a need for semantic models that provide a bridge between the perception of landscapes and GIS



Perception



Verbal
description



Geolocation

Talk outline

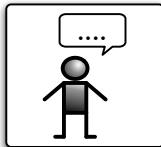
- 1 Research objectives and modelling background
- 2 Landscape perception: experimental setup
- 3 Modelling approach: a spatial and rhythm-based proposal
- 4 Case study
- 5 Conclusion and future work

Research objectives

- The aim of this research is to provide a structural categorisation and representation of the verbal description of a natural landscape (*i.e.*, a scene description)
- The model should illustrate the spatial, relational and semantic constructs that emerge from the verbal descriptions, including the particularities of space and the rhythm that emerges from these descriptions



Perception



**Verbal
description**



Geolocation

Spatial modelling background

- As denoted in previous studies, an observer organises space according to proximities and senses: the *proximate* and *landscape* areas [Grano, 1929]. [Tversky, 1993] organises the perceived space according to scale, observation and the actions achievable in it
- We consider that the perception of an environment is structured at different levels, according to the perception and the behaviour of the observer

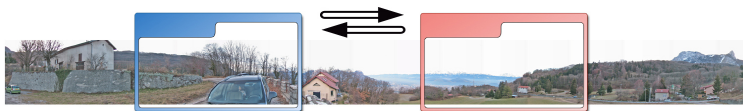
Rhythm-based modelling background

- Space is structured through the use of periodic, recognisable signs that establish the ownership of that place [Deleuze, 1980]. Space is rhythmised by similarities and observable changes
- Landmarks and discontinuities along a path are organised as a melodic line [Lynch, 1960]
- The perception of space and of a musical composition share many similarities [Bar Yossef, 2001]



Experiment principles

- Photographs are used as substitutes for *in situ* landscape observations as they facilitate the acquisition of verbal descriptions
- 360° panoramic images are displayed on a computer screen and individually presented to a panel of 22 participants ¹
- The participants are given the task to produce verbal descriptions precise enough to facilitate recognition of the scene by an external addressee and spatialization of salient features



¹cf. <http://experimentation.yaou.org/>

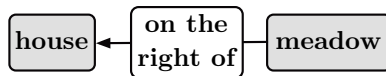
Experiment results

- Most verbal descriptions are implicitly organised by a hierarchy that illustrates the perception and structure of space. The landscape is first perceived and described as a whole, before being detailed.

"I'm in a mountainous region. In front of me, there is an house"

- A scene description is largely based on salient entities associated to others using spatial relations

"On the right of the house, there is a meadow"



- Participants used man-made (50% of the identified entities), relief (30%) and vegetation (15%) entities.

Experiment results

- Participants mixed various perspectives. This reflects the fact that speakers tend to use a greater variety of constructs that expands the richness of the description.

"Far away, behind the meadow, I can see a huge town in a valley. On the horizon, there is a mountain range. Behind me, there is a large road that runs around a hill and a footpath winding around it. "

- The experiment highlights the prominent role played by direction relations (50%), twice as often used as proximity (30%) and topological relations (20%).

Modelling approach (1/2)

- An **environmental scene** is the 360° environment perceived and described by an observer from a static point of view. It is made of entities associated with spatial relations.
- These spatial entities are perceived as forms in the landscape, or salient man-made features.
- An environmental scene is qualitatively divided into **proximity spaces** which are defined according to the **actions** the observer is able to perform in then.

Modelling approach (2/2)

- The *space around the observer* as introduced by Tversky is described by terms such as "*near me*".
- The *experienced space* can be easily experienced through locomotion. It is described by terms such as "*not so far*".
- The *distant space* is the environment, between the experienced space and the space at the horizon. It is described by terms such as "*far away*".
- The *space on the horizon* is the scene in the far distance, and made of silhouettes that constitute landform boundaries. It is described by terms such as "*in the background*" or "*on the horizon*".

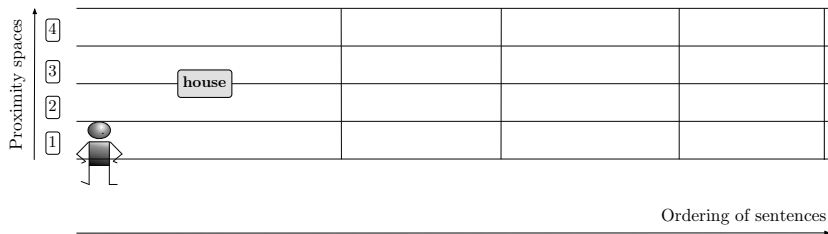
Case study: verbal description example



Figure: Panorama of a semi-natural environment

- *"I'm in a mountainous region. In front of me, there is an house with a little garden. 500 meters behind the house, a footpath crosses a large meadow. Far away, behind the meadow, I can see a huge town in a valley. On the horizon, there is a mountain range. Behind me, there is a large road that runs around a hill and a footpath winding around it. There is a little cottage along the road, and crossroads on the right of the cottage."*

Verbal description schematisation: principles



- A verbal description is ordered by two orthogonal dimensions : the proximity spaces, and the boundaries given by the sentences that rhythm the description
- Concepts, i.e., forms and landmarks are both associated to each others thanks to spatial relations, and to proximity spaces

Ontological view

The ontological view is a semantic schematisation linked to the properties of the forms and landmarks that appear in the verbal description.

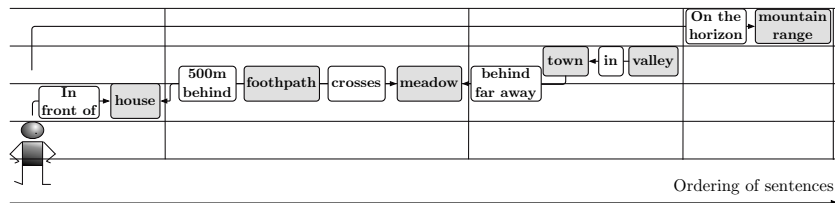
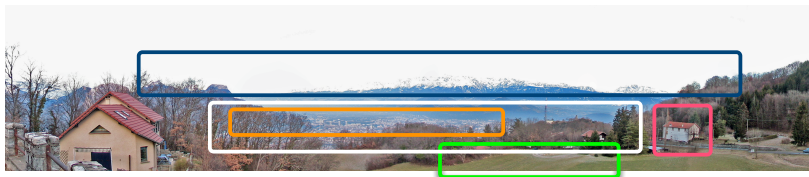
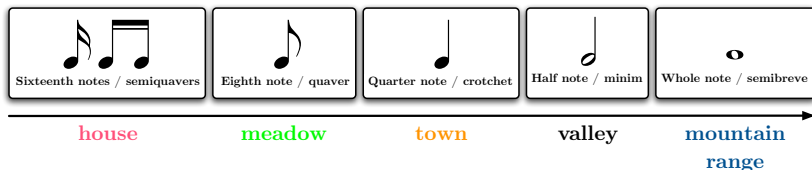


Figure: Ontological view

Music score-based view

- Spatial entities are represented by their spatial extent, by similarity to the way notes are time stamped on a music score.
- Sentences are characterised by staves.



Music score-based view: case study

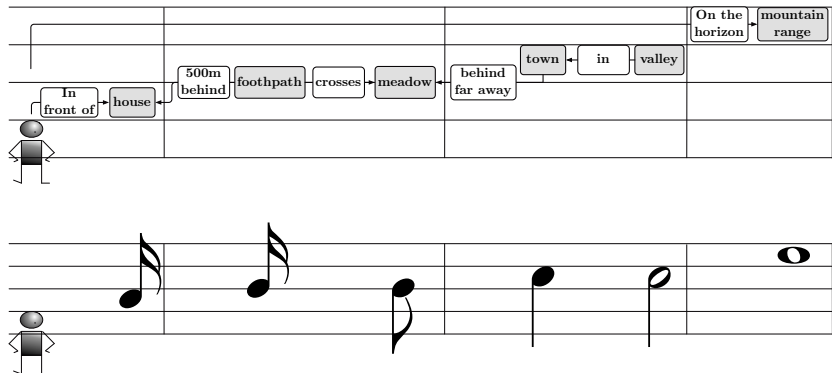


Figure: Music score-based view

Music score-based view: cross-comparisons

A mean for the analysis of differences and similarities in the linguistic descriptions of different landscape scenes

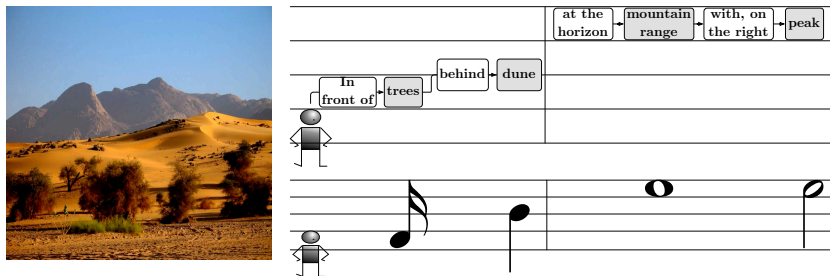
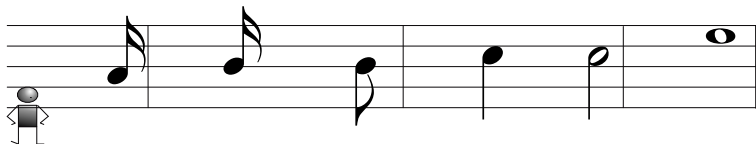
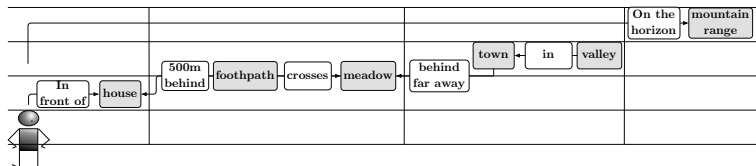


Figure: Music score-based view of the desert scene

Music score-based view: cross-comparisons



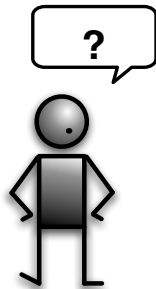
Conclusion

- We introduce a language-based and cognitive approach that models a verbal description of a landscape scene. The model is based on a structural and proximity-based schematisation
- Ontological and music score-based schematisations provide a semantic view of a verbal description of an environmental scene
- These schematisations allows cross-comparison of verbal scene descriptions
- Overall, the modelling approach complements current spatial semantic models

Perspectives

- Current work concerns the development of a mapping between our modelling approach and a GIS-based representation
- This schematisation should also provide a support for the development of a manipulation language (*i.e.*, spatial and rhythm-based operators)
- This modelling approach might also provide a support for cross-cultural comparisons of landscape descriptions

Questions



This concludes my presentation. Thank you for your attention. If there are any questions I'll be happy to answer them now.