From Landmarks in a Map to Multi-Scale Anchors

PhD in Geographic Information Science

Context

[LostInZoom](#) is a research project funded through a Europe Research Council Consolidator grant. The aim of the project is to optimise the way we zoom into maps by using landmarks as 'anchors' as we travel from one level of detail to another. This idea is illustrated in Figure 1.

It is usual for all of us, in our daily use of multi-scale maps, to feel momentarily lost in the moments when we switch and zoom from one level to another. The project seeks to minimise these moments of disorientation through the use of anchor-point theory. Anchor-point theory (Couclelis, 1987), argues that people's mental representation of space is composed of fragments at different scales and that these fragments can be connected via landmarks (so called anchor-points). Thus the project is based on an interdisciplinary approach between geovisualisation, spatial cognition, and human computer interaction.

Figure 1: An example of the role of anchor points in connecting different conceptualisations of space

Multi-scale visualisation is a long-time research topic at the LASTIG lab. In particular, LASTIG researchers have investigated the automation of map generalisation, i.e. the process of generating small scale legible maps from more detailed maps at larger scales. LostInZoom and this PhD will build upon this past research to design this novel way of zooming in and out of maps.

Research Challenges

The aim of this PhD is to propose a multi-scale model in order to generate anchor-based multi-scale maps where anchors are made more prominent and visible across scales. Multiple representation databases (MRDB) have been proposed as a way of supporting instantaneous delivery of multi-scale maps. The idea needs to be revisited in the context of anchor based modelling, and with a view to using more heterogeneous data sources such as OpenStreetMap.

Without prejudging the findings of other members of the project, the anchors are likely to be complex groupings of map features that form a landmark or familiar place, rather than a simple salient symbol. The saliency of a landmark lies in its meaning, and meaning arises from the context; the context comes from the co-locations among a constellation of objects in the map – and thus Gestalt principles of perceptual grouping (Wertheimer, 1938) lie at the heart of the interpretation process. This is why the design of this multi-scale model of anchors must better integrate perceptual grouping and partonomic principles (Chaudhry & Mackaness, 2007).

It follows that another important aspect will be in defining the range of scales over which a symbolised object remains, and to explore the relationship between the form of symbolisation and that scale range. This is the idea that geographic phenomena can have multiple representations according to the scale of the map.

Ideally smaller scale maps are derived from the larger scale (Dumont et al 2020). It is the ambition of this research, that anchors will be similarly derived automatically using map generalisation techniques.

This PhD will create models and guidelines for building the multiple representation databases necessary for anchor-based zooming. The project comprises a set of interrelated challenges shared across the project team; this will require close collaboration among other PhD students and post-docs who will be recruited into the project. The team dynamic will be an important aspect to the success of this project.

Methodology

The LostInZoom project is based on an experimental approach. For example user surveys inspired from cognitive psychology will be conducted in order to understand how map users perceive and utilise multi-scale anchors as they zoom. Such surveys will be useful at the beginning of the PhD project to better understand the perception of groups and patterns in current maps, and then later in the project to validate the new propositions to model anchors at multiple scales.

The practical implementation of the propositions will build upon open source libraries and software since LostInZoom will follow open science principles. The advantages are numerous; for instance, the map generalisation propositions could be included in the open source platform CartAGen developed at IGN.

The PhD student will start the project focusing on a few examples of complex multi-scale anchors, focusing on the urban and nested urban structures, or a ring road, which have different representations across scales and are undoubtedly salient in a topographic map.

Student profile

We are looking for students with a Master degree in geographical information science or related discipline, with a passion for cartography and geovisualisation. Having expertise in programming, in data modelling and database technologies would be a distinct advantage.

Wage conditions

The PhD grant at IGN is a full-time 3 years grant, with a 1680€/month gross salary. The grant can be extended to 2000€/month with teaching activities, given at ENSG, the school of IGN.

Work place

The PhD candidate will work at the LASTIG lab, in the GEOVIS team, in the buildings of IGN, the French National Mapping Agency (73 avenue de Paris 94160 Saint-Mandé France). Visits to Edinburgh will be possible during the three years.

PhD Supervision

- Guillaume Touya, directeur de recherche, LASTIG, IGN, ENSG, Univ Gustave Eiffel. guillaume.touya@ign.fr
- William Mackaness, senior lecturer, School of Geosciences, University of Edinburgh. Dr.W.Mackaness@ed.ac.uk

To apply, please send to both supervisors the following documents before 30th April 2021 : CV, cover letter, academic transcripts, and the addresses of two referees who we may write to, to ask for a letter of reference. The cover letter should address the following questions: 1) why this project interests you, 2) the specific interests, skills and experiences you would bring to the project, 3) why you want to pursue a PhD, 4) what aspirations you have for the future.

Bibliography

Chaudhry, Omair Z., et William A. Mackaness. « Utilising Partonomic Information in the Creation of Hierarchical Geographies ». In ICA Workshop on Generalisation and Multiple Representation. Moscow, Russia, 2007.
Coucclelis, H., R. G. Golledge, N. Gale, and W. Tobler. 'Exploring the Anchor-Point Hypothesis of Spatial Cognition'. Journal of Environmental Psychology 7, no. 2 (June 1987): 99–122. https://doi.org/10.1016/s0272-4944(87)80020-8.
Dumont, Marion, Guillaume Touya, and Cécile Duchêne. 'Designing Multi-Scale Maps: Lessons Learned from Existing Practices'. International Journal of Cartography 6, no. 1 (28 January 2020): 121–51. https://doi.org/10.1080/23729333.2020.1717832.
Touya, Guillaume. 'Finding the Oasis in the Desert Fog? Understanding Multi-Scale Map Reading'. Tokyo, Japan, 2019. https://generalisation.icaci.org/downloads/abs2019/Abs2019_paper_5.pdf.
Wertheimer, Max. « Laws of organization in perceptual forms ». In *A Source Book of Gestalt Psychology*, édité par W. D. Ellis, 71-88. London, 1938. http://www.psych.yorku.ca/classics/Wertheimer/Forms/forms.htm.