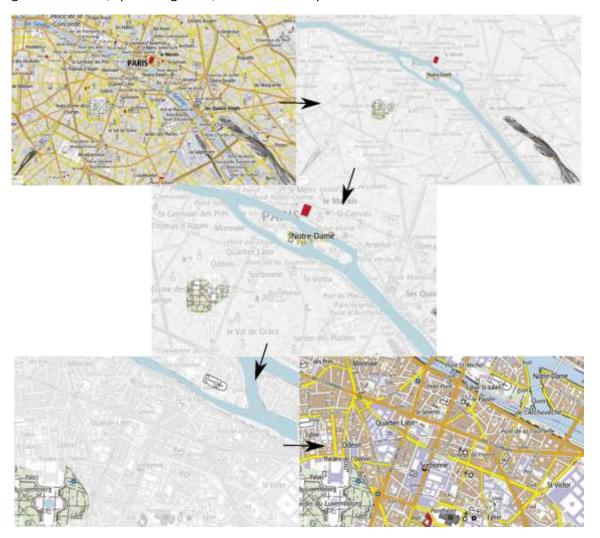# Exploration of the Anchor Theory in Multi-Scale Maps

PhD in Geographic Information Science

Context

LostInZoom is starting a research project funded by a Europe Research Council Consolidator grant. It is usual for all of us, in our daily use of multi-scale maps, to feel lost for a few seconds because the map has changed after we zoom in or out. The aim of the project is to change the way we zoom in on maps by using landmarks salient at different scales to anchor the multi-scale representations (see figure below).

This idea is based on the anchor-point theory of spatial cognition (Couclelis, 1987), which states that a person's mental representation of space is composed of fragments at different scales that are tied by landmarks called anchor-points. The project is based on an interdisciplinary approach between geovisualisation, spatial cognition, and human computer interaction.

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 to generate small scale legible maps from more detailed maps at larger scales. LostInZoom and this PhD researcher will build upon LASTIG's past research to design this novel way of zooming on maps.

Research Challenges

This PhD seeks to explore the anchor theory in multi-scale maps, i.e. exploring what types of map features can anchor our multi-scale mental representation of space, and help us know where we are during and after a zoom. This use of anchors during a zoom raises different research questions that the PhD candidate will investigate:

- Do people use multi-scale anchors in current multi-scale maps although these are not enhanced in the zooming process? Where do we look in an interactive map during a zoom, to recognise where we are?
- What are the salient features visible at multiple scales that can be used as anchors in anchor-based zooming mechanisms?
- Do Gestalt principles of perceptual grouping play a key role in the recognition of anchors in maps?
- Do different people use different anchors in the same maps? Is there some common ground based on visual saliency?
- Are artificial anchors (e.g. grids, specific symbols) more effective than geographic anchors?

This PhD is central in the project as a better understanding of the role anchors could play in multi-scale cognition will help designing better maps along with anchor-based zooming animations. Other PhD students and post-docs will be recruited in the project to deal with these other challenges, and the project members will often work with each other.

Methodology

This PhD research will be mainly based on an experimental approach. User surveys inspired from cognitive psychology will be conducted, with a wide range of users and maps, to investigate the research challenges described above. As long as the pandemics limits social interactions, these user surveys will be conducted online, but as soon as possible, on site experiments will be conducted to combine them with eye-tracking techniques, in order to know where people look in the map during and after a zoom.

This experimental approach will be combined with more quantitative analyses of the maps. First, we plan to apply content analysis, a classical technique in social sciences (Muehlenhaus, 2011), to analyse the legend of the maps used in the surveys. As multi-scale anchors should be visually salient in the maps to be properly used during a zoom, we also plan to use techniques from computer vision to analyse the visual saliency and the clutter from our maps (Rosenholtz et al., 2007).

Student profile

We are looking for students with a Master degree in geographical information science, or in cognitive sciences, with a taste for cartography and geovisualisation.

Wage conditions

The PhD grant at IGN is a full-time 3 year 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). Foreign travel to visit collaborators of the LostInZoom project will be possible.

PhD Supervision

- Guillaume Touya, directeur de recherche, LASTIG, IGN, ENSG, Univ Gustave Eiffel. guillaume.touya@ign.fr
- Ian Muehlenhaus, Director of Program Development, University of Wisconsin – Madison

To apply, please send to both supervisors the following documents before 30th April 2021 : CV, cover letter, academic transcripts, and some references. 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

Couclelis, 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.

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Muehlenhaus, I. (2011). Another Goode Method: How to Use Quantitative Content Analysis to Study Variation in Thematic Map Design. *Cartographic Perspectives*, (69), 7-30. https://doi.org/10.14714/CP69.28

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