Anchor-Based Multi-Scale Map Zooming

PhD in Human-Computer Interaction

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 disoriented 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

The LASTIG lab already worked in the MapMuxing project to combine multi-scale visualisation and human-computer interaction techniques, in order to make the exploration of maps more fluid.

LostInZoom and this PhD will build upon this past research to design this novel way of zooming in and out of maps, which combine a focus on anchors and progressive transformations.

Research Challenges

When looking at the current multi-scale maps, such as Google Maps, OpenStreetMap, or the "Geoportail" from IGN (Dumont et al., 2020), we note that only basic zooming interactions are implemented for multi-scale maps (Bederson & Hollan, 1994). These techniques associated with maps that change over scale minimize the cues recalling the previous maps during the exploration.

As illustrated in Figure 1, an anchor-based zooming would use landmarks highlighted at multiple scales as anchors to guide the user into their journey through space and scale. The main challenge of this PhD is to design such an anchor-based zooming technique. Animations are often used to support zooming interactions and are also used with maps (Harrower, 2007). The PhD candidate will study in particular the role that can be played by animations, and staged animations in the anchor-based zooming.

Another key challenge will be the evaluation of such a zooming technique with realistic maps. Maps are very complex visualisations that might also contain cognitive biases (I am more comfortable exploring a map from a place I know very well for instance), and designing controlled evaluation survey with maps is not an easy task (Lobo et al., 2015).

Finally, zooming is the only way to interact with multi-scale maps, and the PhD candidate might also study the design of anchor-based overview+detail and/or focus+context techniques, to complement the anchor-based zooming in specific use cases (e.g. large tabletop displays, or small screens).

Student profile

We are looking for students with a Master degree in computer science with a specific focus on human-computer interaction and/or information visualisation. Students with a Master degree in geographic information science and expertise in programming can also be valid candidates.

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, with all the members of the LostInZoom project team, in the buildings of ENSG-Géomatique (6-8 Avenue Blaise Pascal, Cité Descartes, Champs-sur-Marne, France). Visits at the University of Twente, in Enschede, should be possible during the PhD.

PhD Supervision

- Guillaume Touya, senior researcher, LASTIG, IGN, ENSG, Univ Gustave Eiffel, Principal Investigator of LostInZoom. guillaume.touya{at}ign.fr
- Paulo Raposo, assistant professor, University of Twente, the Netherlands, p.raposo{at}utwente.nl

To apply, please send to both supervisors the following documents before 20th May 2022 : 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

Bederson, Benjamin B., et James D. Hollan. « Pad++: A Zooming Graphical Interface for Exploring Alternate Interface Physics ». In Proceedings of the 7th Annual ACM Symposium on User Interface Software and Technology, 17-26. UIST '94. New York, NY, USA: ACM, 1994. https://doi.org/10.1145/192426.192435.

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.

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.

Harrower, Mark. « The Cognitive Limits of Animated Maps ». Cartographica: The International Journal for Geographic Information and Geovisualization 42, n° 4 (2007): 349-57. https://doi.org/10.3138/carto.42.4.349.

Lobo, María-Jesús, Emmanuel Pietriga, et Caroline Appert. « An Evaluation of Interactive Map Comparison Techniques ». In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 3573-82. CHI '15. Seoul, South Korea: ACM, 2015. https://doi.org/10.1145/2702123.2702130.

Touya, Guillaume, Maria-Jesus Lobo, William A. Mackaness, et Ian Muehlenhaus. « Please, Help Me! I Am Lost in Zoom ». In *Proceedings of the ICA*, 4:107. Firenze, Italy: Copernicus Publications, 2021. https://doi.org/10.5194/ica-proc-4-107-2021.