

# Fully Automated Multi-Scale Progressive Generalisation

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 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

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, which combine a focus on anchors and progressive generalisation.

## Research Challenges

To enable smooth zooming during the exploration of multi-scale maps, the anchors are not totally sufficient, and it is necessary to have maps progressively generalised and this amount of generalisation (21 zoom levels, possible maps even between the zoom levels) is only possible if the process is fully automated. The current multi-scale maps available, from Google, or OpenStreetMap, and even the “Plan IGN” from IGN France are produced with minimal map generalisation, and we believe that the use of more map generalisation to create these maps would reduce the gaps of abstraction that we can observe in these maps (e.g. all the buildings disappear at once, instead of being progressively generalised until their disappearance).

The aim of this PhD is to develop fully automated multi-scale generalisations. Automated map generalisation models already exist, but the main challenge is the consistency and the progressiveness of the map across scales (Dumont et al., 2020), as these models were designed for the generalisation of a paper map at a single scale. Is it better to use a star (all the scales are generated from the same detailed dataset), a ladder (we use the previous scale to generate the following smaller scale), or a mixed approach?

Another challenge will be to automatically handle large datasets, with partitioning techniques and distributed processes. Indeed, it is not possible to generalise the whole France, at ten or more scales on a single computer.

## 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 in the PhD project to validate that the generalised multi-scale map is more fluid for the user than the ones without generalisation.

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](#) and its Python port CartAGen4Py developed at IGN.

The PhD student will start the project focusing on a small region, before addressing issues related to larger datasets.

## 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, 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 labs of foreign collaborators of the LostInZoom project will be possible.

## PhD Supervision

- Guillaume Touya, senior researcher, LASTIG, IGN, ENSG, Univ Gustave Eiffel, Principal Investigator of LostInZoom. [guillaume.touya@ign.fr](mailto:guillaume.touya@ign.fr)

**To apply, please send to the supervisor the following documents before 20<sup>th</sup> 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

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.

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