*Sophia Apostolidou*

# Automatic icon placement approach for improved association & walkability on city wayfinding maps

With the evolution of cartography from hand-drawn to digital maps, the task of icon placement has become increasingly complex. Nowadays there is a need to automate this process to produce high quality results in less time. This study aimed to optimize icon placement on city wayfinding maps, addressing challenges of placing icons in high-density areas and maintaining a strong association between icons and their actual locations.

To achieve this, a two-stage approach was employed. Initially, a grid search algorithm was developed to search approximate icon locations. It was implemented by placing icons sequentially in the least disturbing position. After defining three quality metrics of disturbance, legibility and association, the grid algorithm's performance was evaluated based on them and two default parameteres (searchGroundDistance and p.orgX, p.orgY). Eighteen experiments were conducted for the grid algorithm's performance and the best-performing combination, particularly in the association metric, was chosen for further refinement. Subsequently, the Non-dominated Sorting Genetic Algorithm II (NSGA-II) was implemented to further optimize these placements, with respect to the three metrics and the city wayfinding guidelines set by T-Kartor.

The outcome of this optimization process was a Pareto front of non-dominant solutions, with the one excelling in association chosen as the best, given the study's focus on improving this metric. In that way the resulting placements not only aligned with T-Kartor's guidelines but also significantly improved walkability on the maps by balancing association, disturbance, and legibility.

This method offers a systematic approach to producing high-quality urban wayfinding maps, enhancing user navigation. The study marks a significant contribution to cartography, addressing important challenges and a previously under-investigated area of icon placement. Future research could explore improving the computational efficiency of the optimization algorithm, considering different icon shapes rather than square, and developing a user-customizable plugin for varied optimization preferences.

Keywords: Physical Geography, Ecosystem Analysis, Cartography, Icon placement, High density, City wayfinding maps, Quality metrics, Association, Disturbance, Legibility, Cartographic guidelines, Grid algorithm, Evaluation, Multi-objective optimization, NSGA-II, Pareto front, Walkability

Supervisor: **Rachid Oucheikh**
Master degree project 30 credits in Geomatics, 2023
Department of Physical Geography and Ecosystem Science, Lund University.
Student thesis series INES nr 631