Network Design and Evaluation for the E-bike City Vision

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1 Introduction

The E-Bike City project is a multi-disciplinary effort to analyze the vision of rebuilding Zurich into a bike-focused city. A central aspect of the E-Bike City project involves designing the bike network using mathematical optimization and evaluating the balance between bikeability and its strains on the car network. Additionally, new evaluation tools and metrics enhance the assessment of the designed bike network.

2 Methods

- Bike network allocation can be viewed as a combinatorial problem with multiple objectives. We develop a linear programming approach that aims to find the best trade-off between bike and car travel times. Our approach yields multiple scenarios representing pareto-optimal solutions.

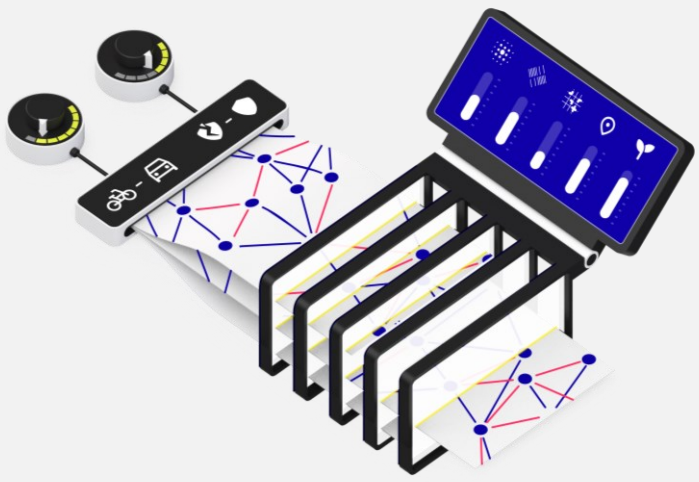

Figure 1: Schematic representation of our pipeline. Based on the input parameters, e.g., the importance of safety for biking, the optimization algorithm yields multiple scenarios. The networks are scanned with selected evaluation criteria.

- We further enhance the evaluation of bike network scenarios by introducing the **VeloNEMO ontology** to systematically structure evaluation criteria and metrics, facilitating the development of multi-criteria evaluation frameworks.

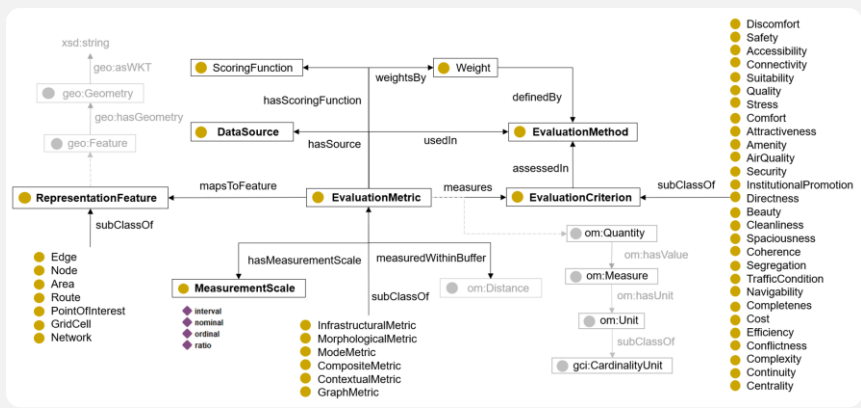

Figure 2: Bike Network Evaluation Metric Ontology (VeloNEMO) concept map depicts the relations between core bike network evaluation concepts and is used to structure existing evaluation metric knowledge bases.

3 Results and discussion

- The optimization approach (blue) outperforms heuristic methods (orange, red, green) in terms of the bike-car trade-off.

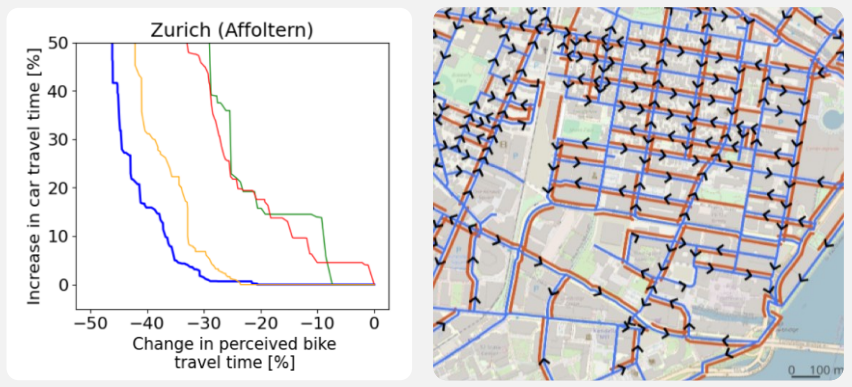

Figure 3. Left: The pareto frontier per method shows the trade-off between bike and car travel times. Every point is a potential bike network. Right: Networks with a low perceived bike travel time are characterized by a dense bike network and many one-directional car lanes.

- We identified 16 key metrics common across different evaluation scenarios.

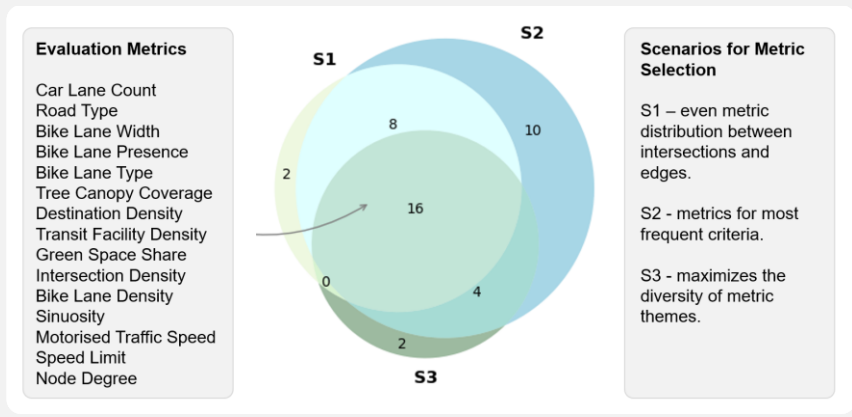

Figure 4. The overlap of 16 distinct bike network evaluation metric types across explorative scenarios.

4 Outlook

- A **web application** that enables users to reallocate road space with multiple optimization strategies and evaluate their effects using metrics for the perceived bike and car network efficiency.

E-BIKE CITY

Figure 5. A user interface for the E-bike City planning and evaluation tool. The tool allows creating and comparing different network optimization scenarios across a set of evaluation metrics.

References

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