Supervisor: Diego Giuliani - UNITN

Co-supervisor: Maurizio Napolitano - FBK

Student: Leonardo Venturoso - UNITN

Graduation date: Feb-Mar 2024

Title: Level of Traffic Stress Bike Planning and Infrastructure Network Design for Safe and Accessible Cycling

Alternatives:

* "LTS-BikePlan: A Comprehensive Tool for Assessing Cycling Infrastructure and Level of Traffic Stress in Italy"
* "Mapping the Path to Sustainable Mobility: Network Analysis and Level of Traffic Stress Assessment in the Italian Road Network"
* "Towards a Sustainable Cycling Network: Integrating Level of Traffic Stress and Network Analysis in Italy"

Abstract: LTS-BikePlan is an advanced analysis tool developed to identify safe and accessible cycling routes by integrating diverse data sources and establishing a comprehensive planning framework for bicycle infrastructure. The tool utilizes the concept of "Level of Traffic Stress" (LTS) to evaluate comfort and safety levels for cyclists. It considers various data, including OpenStreetMap (OSM) data, geographic information system (GIS) data such as Digital Elevation Model (DEM), and relevant data from Public Administration sources. By amalgamating these datasets, LTS-BikePlan provides valuable insights and recommendations to enhance the cyclability of the Italian road network. The tool contributes to the promotion of sustainable mobility and facilitates tactical urbanism initiatives aimed at improving cycling infrastructure, connectivity, and overall bikeability. The effectiveness of LTS-BikePlan is demonstrated through case studies that assess both poor and good cycling conditions, further validating its utility and practical applicability.

Keywords: Network Analysis, Level of Traffic Stress, Clustering, OSM, GIS, Gravity Models, Geospatial Analysis, Sustainable Mobility

Structure:

Introduction:

The pursuit of sustainable transportation has emerged as a critical global challenge in recent years, as cities and nations seek to address environmental concerns, improve public health, and enhance the overall quality of urban life. Among the various modes of sustainable transport, cycling offers numerous benefits, including reduced emissions, improved physical fitness, and enhanced accessibility. Encouraging cycling as a viable and safe mode of transportation requires an in-depth understanding of the existing cycling infrastructure and the identification of areas that impede optimal cycling experiences.

In the Italian context, the development and promotion of sustainable mobility have gained significant traction through the implementation of strategic frameworks such as the Biciplan and PUMS. The Biciplan, or the National Cycling Plan, serves as a comprehensive guide to promote cycling as a key component of urban and interurban mobility, emphasizing the need for infrastructure improvement, policy support, and public awareness campaigns. Complementing the Biciplan, PUMS embodies local-level urban planning strategies, focusing on sustainable mobility and encompassing measures to improve cycling infrastructure, reduce congestion, and enhance overall transportation efficiency.

To effectively contribute to the realization of these strategic objectives, this research project seeks to develop a sophisticated tool that analyzes the cyclability of the Italian road network. By considering the current legislative references, including the Biciplan, PUMS, and relevant Italian decrees, the tool aims to provide actionable insights and valuable information for cities that respond to the requirements outlined in these frameworks. Central to this analysis is the concept of "Level of Traffic Stress" experienced by cyclists, which refers to the discomfort or perceived danger cyclists encounter when navigating the road network that may influence the choice of using a bicycle as the main mode of transportation in urban contexts.

The proposed tool will offer a comprehensive assessment of cycling conditions, taking into account various factors that contribute to traffic stress levels, such as road connectivity, traffic volume, slope, presence of dedicated cycling lanes, proximity to amenities, and overall safety measures. By incorporating these indicators, the tool will enable an accurate evaluation of the existing cycling infrastructure and identify areas where interventions are necessary to enhance bikeability. Unlike other existing application cases that are to our knowledge, a critical aspect of the tool's development is its capability to cover the entirety of Italian territory. Italy's diverse topography, urban landscape, and regional characteristics necessitate a robust model that can account for these variations and provide localized recommendations. Therefore, the tool will incorporate geographic information systems (GIS) and spatial analysis techniques to ensure comprehensive coverage and accurate results across the entire country.

Furthermore, the tool's findings will prove invaluable for implementing tactical urbanism strategies in areas characterized by inadequate cycling infrastructure or "bad bikeability." Tactical urbanism refers to short-term, low-cost interventions aimed at improving the urban environment and addressing immediate needs. By utilizing the insights provided by the tool, urban planners and policymakers can strategically allocate resources, design appropriate cycling infrastructure, and implement targeted interventions to enhance the cyclability of urban centers.

The work will be divided in three main steps:

1. Creation of the state of the art on Level of Traffic Stress and relative technical implementations, OSM, GIS, DEM, tactical urbanism, gravity models, italian and european legislation (PUMS, Biciplan, 30 km/h zones), collaboration with local bicycle-related associations (FIAB) and urbanists to identify and take into account other useful information for the model and establish a connection to receive future feedback and communicate the results.
2. Second Phase: We aim to craft an innovative cycling map that integrates fresh Low Traffic Stress (LTS) indicators, comprehensively reflecting the intricate morphology of Italy's road network. This endeavor will predominantly utilize data sourced from Open Street Map and Digital Elevation Models (DEMs). However, our approach maintains the flexibility to assimilate additional data as it becomes available. As for the technical aspect, our planned strategy involves deploying a blend of Python and JavaScript (React) programming languages.
3. Third Phase: this phase is designed to examine varying instances of both 'sub-optimal' and 'exemplary' bikeability within the Italian context. Our intention is to delve deeper into the urban milieu, selecting cities of comparable size and structure to ensure the reproducibility of data. Beyond these two case studies, we believe the inclusion of a third city for examination would be advantageous in evaluating the efficacy of our tool. In these case studies, our frame of reference - the map - would be enriched by incorporating data from Public Administration. Our aspiration is that through a meticulous analysis of the urban road network and by identifying clusters, connectivity gaps, and islands, we can pinpoint locations requiring priority interventions, such as enhancements in micro-mobility and accident-prone zones (eg. 30 km/h zones) in line with PUMS.

In line with this objective, we plan to employ local gravity models and weight analysis to identify zones where, in everyday contexts, significant travel ensues, and where stress levels are likely to peak.