DRISI

CALTRANS DIVISION OF RESEARCH, INNOVATION AND SYSTEM INFORMATION

TRANSFORMING IDEAS INTO SOLUTIONS

Research Notes

Complete Cities: Bicycle Network Connectivity Evaluation Methodology

Develop a simple bicycle network evaluation methodology for practitioners and researchers.

Transportation Safety and Mobility

MAY 2023

Project Title:
Strategies for Reducing Pedestrian and Bicyclist Injuries at the Corridor Level

Task Number: 3935

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Completion Date: December 31, 2023

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WHAT IS THE NEED?

While the Complete Streets concept has quickly grown from an initiative to a widely accepted design principle, it often is not always practical. Not every street can, nor needs to be, made complete for pedestrians and bicycles. Instead, it is equally important, if not more, that cities and towns ensure there is a complete network for bicycles and pedestrians where it is most needed, rather than various disconnected and isolated bicycle and pedestrian streets. For example, expending considerable resources reconstructing road geometry along a major thoroughfare to accommodate all modes will yield little value if the greater bicycle network fails to adequately connect to this new link.

Once weak or critical links in a bicycle network are identified, there exists a plethora of possible improvement strategies. Such as innovative bicycle-specific signal phasing, or even the pedestrianization of streets altogether to prohibit automobiles. However, practitioners and decisions makers are often reluctant to implement bicycle and pedestrian improvements without quantifiable benefits to the network.

Many municipalities and regional agencies lack simple and reliable tools to objectively evaluate their street networks. Those that do, often rely on bespoke tools that makes competing for funding difficult if other locations rely on a different set of incomparable values. Existing methodologies are often purely academic, complex, subjective, or locally specific. However, several methodologies could be combined or simplified, such as level of traffic stress (LTS), bicyclist tolerance typologies, and classical graph theory measures of network connectivity.

WHAT ARE WE DOING?

This research aims to provide the quantified network connectivity measure for network-scale level of service (LOS) evaluation.

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To achieve the goal, research will be conducted in the following steps:

1. Literature review – thoroughly review research and practice literature for two key components (see Figures 1 and 2):
   a. Statistical network connectivity measure (e.g., from graph theory)
   b. Infrastructure scoring/weighting algorithm
2. Model development: combine or develop a unified methodology for evaluating a network.
3. Testing and evaluation: test the proposed methodology using available data.
4. Reporting: document the methodology, findings, and recommendations.

WHAT IS OUR GOAL?

The goal is to develop a simple bicycle network evaluation methodology for practitioners and researchers alike, and that is not only applicable across different regions, but normalized to be comparable between regions. The proposed methodology will meet the following criteria:

- Easy to use by non-technical practitioners,
- Allows a minimum infrastructure for user representation to be defined,
- Minimal data and computational requirements,
- Universally normalized, providing a value that can be compared across different cities, and
- Accounts for both coverage and connectivity.

WHAT IS THE BENEFIT?

The benefit of the proposed methodology research is to provide a fundamental key performance indicator for bicycle network connectivity. Not only can it yield an improved bicycle network, but also potential cost saving benefits by avoiding unnecessary infrastructure expenditures.

WHAT IS THE PROGRESS TO DATE?

The following tasks have been accomplished within this period:

Task 2: Literature Review
We conducted a detailed review of existing literature and practice for bicycle network evaluation methodologies. We also presented the findings from the literature review at the California Department of Transportation (Caltrans)project meeting and prepared a technical memorandum. This task is completed.

Task 3: Model Development
We selected several models/algorithms used for obtaining measures for network connectivity based on past research findings. We tested all the algorithms and selected the most promising algorithm for connectivity measurements. We presented the findings in our last project panel meeting and prepared a working paper describing the work performed to date. This working paper was updated based on the comments received from the project panel. This task is also completed.

Task 4: Testing and Evaluation
We completed testing of bicycle network connectivity for the Bay area counties. Currently we are testing the bicycle connectivity of the State highway system based on the Caltrans request.

Task 5: Final Report
Prepare a detailed report documenting the work performed and the project findings.

IMAGES

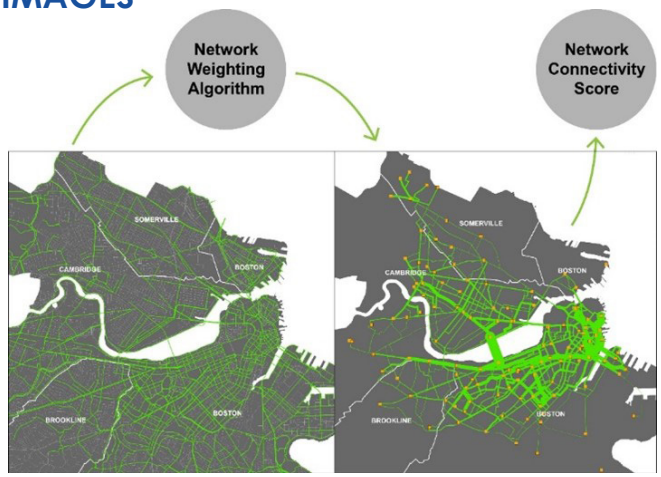

Figure 1: Conceptual framework

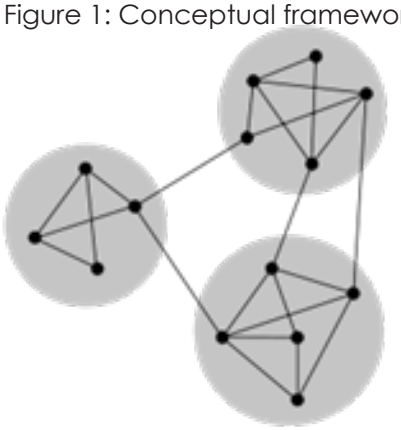

Figure 2: Sub-graph connectivity