Research Problem Statement

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I. TITLE

17-061 An Integrated Analysis of Bicycle Ridership, Bicycle Level of Traffic Stress (BLTS), and Bicycle Crashes for Safety and Planning Applications in Oregon

II. PROBLEM

Bicycle riding is on the rise in Oregon and the U.S. (Citations) Unfortunately, so are bicycle fatalities. The USDOT reports that bicycle fatalities "have steadily increased since 2009" as shown in Figure 1 (USDOT 2014). While bike fatalities make up a small share of total traffic deaths (around 2%), bicyclists are at higher risk of severe injury or death due to MV collisions than motorists, recent studies indicate cyclists are 12 times more likely to be killed per distance traveled (Beck et al., 2007) than automobile occupants. The U.S. rate of bicycle fatalities is double that of Germany and triple that of the Netherlands, both in terms of number of trips and in distance travelled (Pucher and Dijkstra, 2003). Yet despite the dangers, individuals are increasingly choosing to bike throughout the country and especially in the Pacific Northwest (Milne and Melin, 2014). These national and local bicycle fatality trends are the major motives Oregon have identified bicycle crashes as a primary focus area for investing in safety and infrastructure funding.

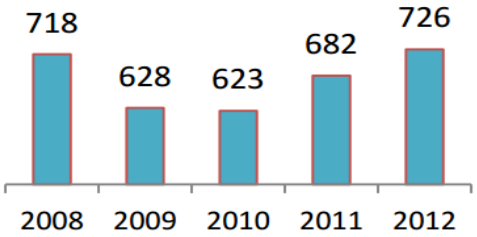

Figure 1 National and Oregon Bicycle Fatalities in Traffic Crashes, 2008-2012 (Source: USDOT and ODOT, 2014)

Engineers and planners face three interrelated challenges when conducting safety or planning analysis for bicyclists: insufficient data about bicycle crashes (i.e., due to underreporting and the low frequency overall of bicycle crashes at any given point on the system), lack of bicycle volume data on a network scale, and the lack of tools to analyze safety improvement and bicycle planning applications. The objective of this project is to conduct an integrated analysis between bicycle ridership, bicycle level of traffic stress, and reported bicycle crashes to produce rates of accidents by auto volume and bike volume on a street network for safety and planning applications for cities in Oregon. These stress analysis methods are preferred by many professionals because of the low data input requirements and clear and useable results. ODOT has been developing a reliable method to identify and prioritize high-risk areas for bicyclists so those areas can be treated proactively, without waiting for crashes to occur. This project will estimate bicycle ridership based on Strava data from different stress routes from (referring to Figure 2) and estimate bicycle volume data on for an entire bicycle network.

LTS	Total Strava Trips	Total Miles	Bike Miles Traveled	BMT per Day	Total Miles PCT	Total Trip PCT
1	1,401.00	21.28	29,811.43	81.68	4.48%	0.06%
2	147,473.00	299.04	44,100,066.19	120,822.10	62.98%	88.75%
3	77,832.00	53.70	4,179,711.25	11,451.26	11.31%	8.41%
4	37,994.00	27.18	1,032,501.02	2,828.77	5.72%	2.08%
0	5,600.00	51.34	287,485.38	787.63	10.81%	0.58%
99*	2,767.00	22.29	61,666.77	168.95	4.69%	0.12%

* Private roads, Appartments, and similar paved areas in Strava data that are not in the LTS study

Figure 2 Strava Bicycle Ridership Data on Different LTS Routes (Source: NHBWA, 2015)

III. PROPOSED RESEARCH, DEVELOPMENT, OR TECHNICAL TRANSFER ACTIVITY

This project would include a geospatial analysis using Geographic Information Systems (GIS) to study the correlation between bicycle level of traffic stress network and reported bicycle collisions in the state of Oregon. The study sites will be selected from City of Salem, a subarea of Portland, and/or Eugene-Springfield. The level of traffic stress analysis will be based on Peter et al.'s (2012) method (using traffic volume, lane width, and vehicle speeds etc.) and the PI has coded the bicycle level of traffic stress network for City of Salem and a pilot study using City of Manchester, NH bicycle level of stress network and reported bicycle crashes as can be seen from Figure 3.

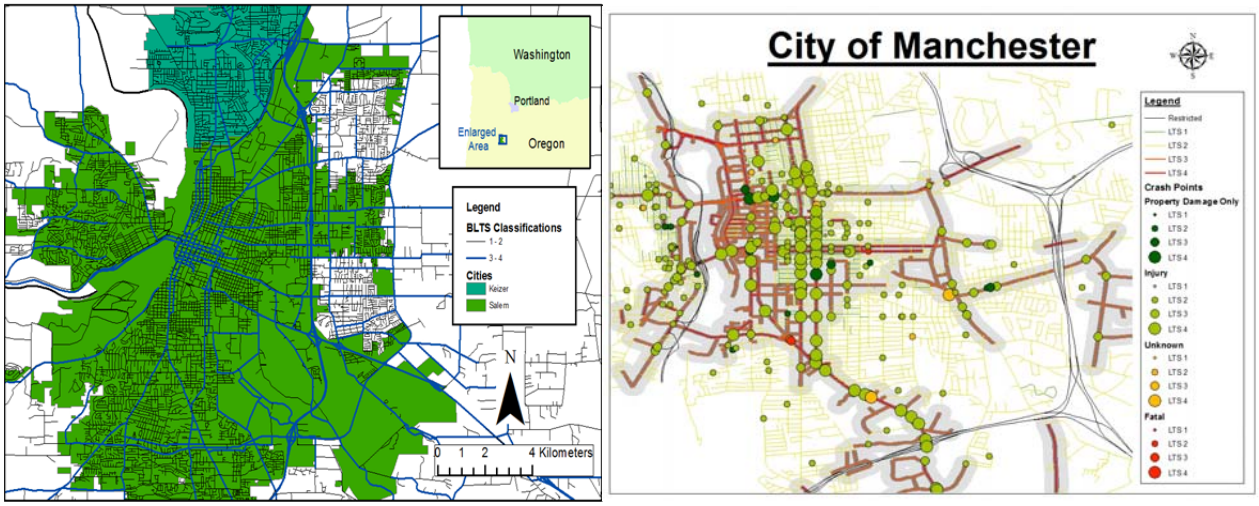

Figure 3 City of Salem BLTS Network (Wang et al., 2015) and City of Manchester Pilot Study (Rachel and Wang, 2015)

Specific research tasks for this project will include;

- Task 1: Literature Review: A thorough literature review of how other state/city DOTs and public agencies are using BLTS as a tool to generate bicycle crash rates at a segment or an intersection level by integrating bicycle ridership, and auto volume, and other potentials for safety and planning applications.
- Task 2: Data Preparation and Collection: Data collection including bicycle ridership, inputs data for LTS for the study sites (Salem, a subarea of Portland metro, Eugene-Springfield) collaborating with ODOT, PBOT, and LCOG to code the BLTS networks for Oregon cities for further analysis.
- Task 3: Bicycle Volume estimation using Strava data: Empirical bicycle volume data is often not available; therefore, bicycle volume estimation will be conducted for an entire network for study sites using (Lowry et al., 2014) method.
- Task 4: Develop a methodology (including necessary models/equations) to estimate bicycle ridership based on Strava data and select bicycle count locations for the study sites to derive scaling factors used to estimate ridership.
- Task 5: Identification of the BLTS and bicycle collisions for selected Oregon cities as is done for City of Manchester, NH by integrating Strava bicycle ridership, auto volume, and estimated bicycle volume on a city street network with bicycle access.
- Task 6: Development of statistical models (i.e., ordered probit model) to quantify the relationship between bicycle ridership (estimated bicycle utilization), reported bicycle crashes, and bicycle LTS and associated risk factors.
- Task 7: Results analysis and final report.

IV. POTENTIAL BENEFITS

Oregon DOT and MPOs will benefit from this project in a number of ways. Fist of all, this project will provide a new methodology to validate the use of Strava data for ridership estimation at selected count locations and quantify the relationship between bicycle utilization, bicycle level of traffic stress, and reported bicycle crashes. In addition, this project will identify differences such as the reliability/margin of error for each subarea by using this method and the identification of how the relationship of count data to Strava data differs between the three of Oregon's major metro area. Last but not the least, this project will validate the use of LTS as a proxy for safety risk regardless the recorded past bicycle crash history. This research will help identify the clustering patterns bicycle crashes for high-risk corridors and bicycle route planning. As a result, low-cost countermeasures or treatments can be made to mitigate the high-risk areas to provide safer routes to cyclists in Oregon to meet the goal of eliminating deaths and severe injuries on Oregon's transportation system.

V. IMPLEMENTATION

This research will produce a new method of bicycle safety and planning analysis by integrating bicycle ridership, reported bicycle crashes, and bicycle LTS that will reduce bicycle fatal and serious injury crashes in Oregon. This methodology could be used as a proxy for future crash risk, whether or not we have recorded past bicycle crashes. Both estimated ridership and estimated risk can be used to inform project selection, prioritization between projects, and/or safety program priorities. This method can be implemented on an entire city network or a sub-area of a large city network where bicycle have access.

VI. LIST OF REFERENCES

http://www.cdc.gov/motorvehiclesafety/bicycle/
http://transweb.sjsu.edu/PDFs/research/1005-low-stress-bicycling-network-connectivity.pdf
http://docs.trb.org/prp/12-4154.pdf
http://bikeportland.org/2012/01/03/oregon-roads-claimed-319-lives-in-2011-bike-deaths-more-than-doubled-64600
http://www.bicyclinginfo.org/facts/crash-facts.cfm

VII. CONTACT INFORMATION

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