Project LISA

Level of Intersection Stress Analysis

Project LISA aims to assist transportation engineers as a tool for the creation and calibration of behavior models of bicyclists through virtual cityscapes.

SANTOS FAMILY FOUNDATION

District Department of Transportation

U.S. Department of Transportation Volpe Center

Olin College of Engineering

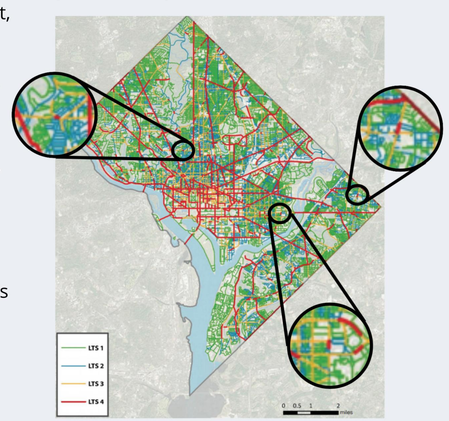
Context

Bicycle culture is growing as biking is increasingly recognized as a healthy, safe, and sustainable form of transportation. According to the American Community Survey, many cities reported a triple-digit growth in bicycle commuters from 1990 to 2013. The District Department of Transportation (DDOT) has built 75 miles of marked bicycle lanes, 6 miles of cycle track, and 3,000 bicycle racks to address a 498% increase in bicycle commuting.

Image courtesy of the Washington Area Bicyclist Association

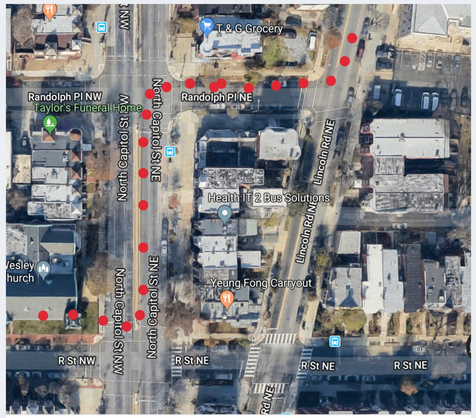
Current Strategy

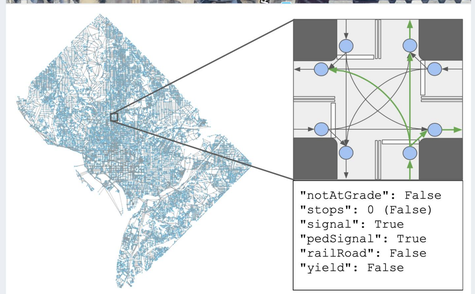
City transportation departments need a mechanism for pinpointing locations that maximize the impact per dollar spent on infrastructure investments for bicycle safety and accessibility. Currently this is often assisted using Level of Traffic Stress (LTS) analysis to rate roadway accessibility based on attributes like lane count, speed limit, bicycle lanes, etc. The resulting LTS map is visually or computationally inspected to identify hotspots. Transportation engineers then recommend changes on a case-by-case basis through manual research.



LISA's Approach

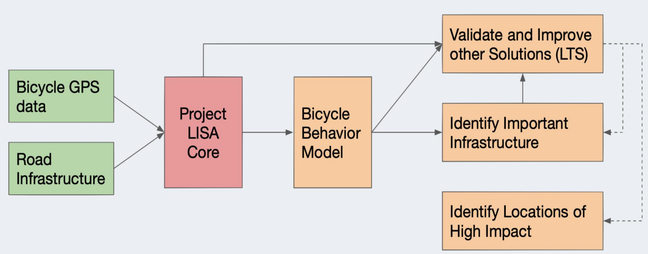
Project LISA provides an alternative method for rating both intersections and segments in addition to producing a cyclist behavior model which can be used to simulate the impact of future infrastructure changes on cyclist routing in a city. It does so by combining GPS traces of dockless bikeshare routes with a graph representation of roads and intersections. Intersections have been deconstructed into a set of internal connections between entry and exit points allowing attributes to be associated with specific turning patterns (for example a two stage left turn box for left turns), and for separate ratings of those patterns. LISA uses a linear combination model to calculate the relative weights (importance metrics) of each attribute in cyclist decisions.





The Software

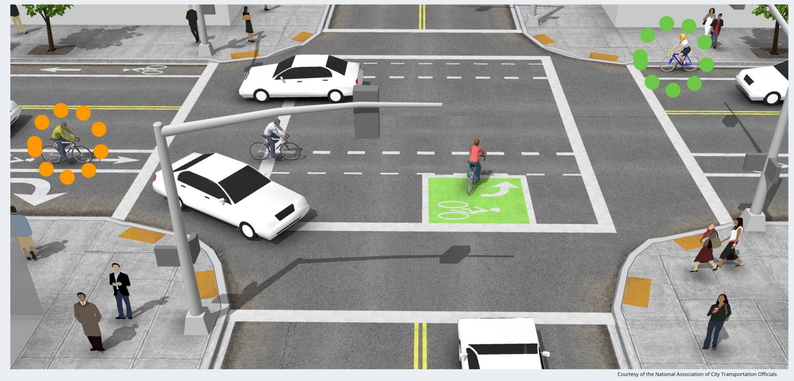
The LISA system is designed for open source publication and ongoing development with a national audience in mind. The software is modular in nature with the desire to support experimentation with and customization of the individual pieces. The prototype constructed by our SCOPE team will be taken over and further developed by DDOT and Volpe.



Check out LISA's codebase! github.com/lisa-team/lisa

Present and Future Data

LISA has been designed for a future where infrastructure data is readily available in high detail across whole cities–a data set which takes time to develop. Because the software can only indicate the relative importance of infrastructure criteria types for which data is provided, the value of this approach will only grow as future data sets are constructed. DDOT's Model Inventory of Roadway Elements (MIRE) is in development as one such a data set, but yields limited results in its current form.



Courtesy of the National Association of City Transportation Officials

The intersection pictured above illustrates how higher resolution data sources will improve predictive power in the future. Current data from MIRE is summarized below, alongside proxy data from future collection efforts. Notice that with higher resolution data LISA is able to distiguish between approaches and therefore account for behavioral differences with greater accuracy. By design, incorporation of these new factors will require little adjustment to the code however, meaning that LISA can be cited as a value promise when considering investment in further data collection.

```
Current MIRE data:          Future Data:                    Future Data:
  "notAtGrade": False         "bicycleSignal": False          "bicycleSignal": False
  "stops": 0 (False)          "twoStageTurnQueueBox": True    "twoStageTurnQueueBox": False
  "signal": True              "bikeBox": False                "bikeBox": False
  "pedSignal": True           "bufferedSeparation": False     "bufferedSeparation": False
  "railRoad": False           "rightTurnPocket": True         "rightTurnPocket": False
  "yield": False

                            Classification:                 Classification:
                              low stress /                    higher stress
                              high accessibility              lower accessibility
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LISA's Future

Cities' continued development of complete data layers for more infrastructure element types over the coming years can only expand the predictive power of LISA's approach and its value as an informative tool for investments.

	Traditional	LTS	LISA
Identifying problematic intersections	anecdotes & visual inspection	aided visual inspection	quantitative analysis
Planning infrastructure investments	manual research	manual research	iterative testing with simulation
Predicting investment impact	cross-reference similar scenarios	cross-reference similar scenarios	numerical predictions with simulation

The LISA Team

A warm thank you to everyone who supported this project including our Olin faculty advisor and liaisons from DDOT and Volpe, and especially to the Santos Family Foundation without whom this project would never have begun!