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Project Title:
400 South Corridor Assessment

University:
University of Utah

Principal Investigator:
Dr. Xuesong Zhou, Assistant Professor, University of Utah
Email: zhou@eng.utah.edu
Phone: 801-585-6590

Co-Principal Investigator:
Dr. Milan Zlatkovic, Postdoctoral Fellow, University of Utah
Email: milan@trafficlab.utah.edu
Phone: 801-819-5925

Research Needs:
Light Rail Transit (LRT) is the fastest growing rail transportation mode in urban environments in the US. LRT usually operates in a semi-exclusive right-of-way (ROW) at street grade with different separations and protections from other traffic, but can sometimes operate in exclusive, fully grade-separated, or non-exclusive, mixed traffic ROW. Operating LRT in semi-exclusive or non-exclusive ROW can cause some safety problems, mainly caused by turning vehicles, pedestrians at LRT/pedestrian malls, and/or complex intersection geometry. Major characteristics of transportation technology, specifically designed for rapid transit modes which should be followed during design/implementation, include special guideways and crossings, upgraded widely spread stations, upgraded vehicles, off-board fare collection, high capacity, Transit Signal Priority (TSP) of preemption, and speed competitive to private cars. In order to make LRT faster, more reliable and competitive, as well as to resolve some safety problems, it is necessary to provide certain priority or preemption to Light Rail Vehicles (LRVs). Depending on the specific location, traffic operations and safety requirements, either preemption or TSP for LRT are implemented (off course, there are situations when none of these techniques is used).
TSP is an operational strategy that facilitates the movement of in-service transit vehicles through traffic-signal controlled intersections. It makes transit faster, more reliable and more cost-effective. Expected benefits of TSP vary depending on the application, but include improved schedule adherence and reliability and reduced travel time for transit, leading to increased transit quality of service. Potential negative impacts consist primarily of delays to non-priority traffic, and these impacts depend on the characteristics of the implemented TSP strategies.
Utah Transit Authority (UTA) is expanding its LRT service in the Salt Lake Valley. There are currently three LRT lines that connect Downtown Salt Lake City (SLC) with Sandy, West Valley City, Daybreak, and the University of Utah Campus. Another LRT line that connects Downtown with the Salt Lake City International Airport is currently in the testing phase, and is expected to start operation in April 2013. The introduction of the new line will provide LRT frequencies in

the downtown area of more than twelve LRVs per hour. While this will significantly improve the quality of transit service in the downtown area, it will undoubtedly have impacts on other vehicular and pedestrian traffic. The highest impacts are expected along the 400 S corridor, which is one of the major East-West arterials that connect Downtown SLC with the University of Utah campus, and along Main Street through the heart of Downtown.

For that reason it is necessary to assess all impacts and benefits of the proposed LRT system, and design optimal operational strategies that would provide more balance among different transportation systems in this area. The TSP strategies need to provide certain priority for LRT, improving its efficiency and safety, with minimal impacts on other traffic. This cannot be done without careful planning, designing, and evaluating different alternatives, which are the main objectives of this study. The study will provide detailed analysis, guidelines and recommendations to UTA, Utah Department of Transportation (UDOT) and the City of Salt Lake about the implementation of the LRT system. Because of the increasing importance of LRT in many metropolitan areas which are facing similar problems, the study will also be useful for planners and engineers on the national level.

Research Objectives:

The main research objectives of this study are as follows:

- Gather, organize, and analyze existing data into compatible formats;
- Assess weaknesses in existing data to set scope for future data acquisition;
- Compile past and new data into applicable baseline compatible with traffic simulation software;
- Improve efficiency of intersections and the corridor using micro-simulation;
- Create simulations for future growth and transportation projections (estimated 5, 10, and 20 year projections);
- Deliver information compatible with UTA and SLC Transportation Department resources;
- Propose recommendations to improve multi-modal corridor movement in conjunction with UDOT, SLC, and UTA.

The study will also be used as a test-bed of the cross-resolution modeling software which is being developed under the University of Utah lead. This software will enable much faster and more efficient assessment of existing and future traffic and transit operations on different levels (from planning – macro, to detailed intersection analysis – micro levels).

Research Methods:

The study will use the collection and analysis of the existing field data, such as traffic volumes, travel speeds and corridor levels of service for vehicular traffic and transit, traffic signal operations, intersection delays and intersection levels of service for different modes, transit ridership and pedestrian activity. Based on the regional MPO planning models, the study will assess future conditions under the projected traffic and transit demand and perform analysis for different alternatives.

Traffic simulation software (macro, meso and micro) will be used extensively over the duration of the study. It will enable researchers to assess different aspects of traffic operations for all modes and provide tools for testing different alternatives. The use of high-end applications, such as traffic signal control software-in-the-loop, will ensure the credibility of the used methods and obtained results. It will also provide excellent learning tools for students involved in the project. Under the lead of the University of Utah, a new data hub and cross-resolution modeling software is being developed to be used by transportation planners and operation engineers. This study will be an excellent test-bed for the new software, especially because of the diversity of transportation modes in the analyzed network. This new software will enable faster and more efficient assessment of existing and future traffic and transit operations on different levels.

Expected Outcomes:
The first outcome of this study will be complete sets of traffic and transit data collected under the existing conditions. Since this will be a joint effort between the University of Utah, UTA, UDOT and SLC, the data will be useful for planners, engineers and educators from all these institutions, and can be used in potential future projects. The second outcome will be the assessment of current traffic conditions for different transportation modes in the analyzed network. The current traffic conditions will be the starting point for comparing different alternatives. It will also provide clues for potential problems in current operations, and the ways to eliminate these problems. The study will describe current conditions, impacts, and mitigation recommendations considering the increased LRT service.

The third outcome will be an analysis of future traffic conditions, based on the projections of traffic growth over the next twenty years. These results will be based on the evaluations of different alternatives, and the study will assess all impacts and mitigation recommendations under these conditions.

The next outcome will be a development and calibration of the cross-resolution modeling software capable of performing fast and effective analysis of different transportation modes, on different levels. Software of this type will help researchers and practitioners perform quick analysis of networks of different sizes, on the level they need.

Since the major portion of the study will use microsimulation and traffic control software-in-the-loop, it will equip practitioners with a useful tool for detailed analysis of traffic control and TSP strategies in a high-fidelity simulation environment. The traffic models that will emanate from this study can further be used for many other types of operational analysis.

Relevance to Strategic Goals:
Since the project is dealing with a development and improvement of an LRT system in the downtown area, it is closely related to the majority of the strategic goals. A well planned and designed LRT system is capable of improving safety for all transportation users. If the LRT system can satisfy most of the demand, it will minimize the use of private cars in the downtown area. Less cars on the streets and parking lots mean more space for business development, more space for pedestrians, and much less conflicts among different modes, leading to increased safety for all users. Since one of the elements of the LRT system is an upgraded transit station, it provides more convenient and safe space for waiting passengers. Carefully designed TSP strategies also help reduce conflicts between LRVs and any other system users.

A good public transportation system in the downtown area has the ability to attract more people. Combining this with the previous potential goal in increasing business development, it has a big potential for economic development, making this area more competitive.

LRVs are powered by electricity, so they do not emit any pollution. This is especially important in downtown areas. By helping to reduce the use of private cars, a good LRT system is very environmentally friendly. It has the capability to provide people in downtown areas with a safe and healthy environment. A good LRT system is a very firm base for Transit Oriented Development (TOD), creating livable communities within its area of influence. The future LRT system in Downtown SLC will provide all aspects of a TOD, increasing the livability of this area.

Educational Benefits:
Students will be involved in all aspects of this study, and it will provide a good course material for classes in public transit, traffic operations, transportation planning, and traffic simulation. The students will perform main tasks in field data collection, from actual traffic counts and measurements, to surveys and the use of online tools, which will provide them with a practical experience for their future career. The data analysis will include a lot of operations research and statistical tests, again giving the students an opportunity to expand their knowledge in these fields. They will have the opportunity to learn and work with traffic simulation software, which is more and more being used by companies and agencies, giving them an excellent starting point on any related job. For those interested in traffic operations and signal control, the study will provide an opportunity to work with actual traffic control software and use the guidelines and manuals, helping them understand how they work in the field, which has many practical benefits.

Work Plan:
The work plan is divided in three phases, with each phase consisting of one or more tasks. The phases and tasks are as follows:

Phase 1: Preliminary findings for the 400 S corridor
The research team will gather traffic data on the following three intersections (at a minimum) to assess and determine impacts of the existing LRT lines. The team will then analyze the impacts of integrating an additional LRT line along the corridor. Critical intersections to be studied in Phase 1 include:

- 400 South and Main Street
- 400 South and State Street
- 400 South and 700 East
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The research team will use VISSIM software to determine possible delay of multi-modal traffic at these intersections. The study should look at best-and worst-case scenarios, including varying the number of cars on each LRT line (i.e., 2-car trains, 4-car trains).
The research team will develop operational improvement recommendations and mitigation suggestion to build several scenarios within the model. Possible mitigations include at a minimum:

- Signal timing
- Preempting pedestrian phase of signal
- Closure of certain vehicular traffic movements
- Modification of pedestrian signals and timing
- Modification of transit preemption and timing

The research team will deliver a technical memo describing conditions, impacts, and mitigation recommendations for the initial phase. The research team will also present the findings at various locations to educate stakeholders. Phase 1 is expected to be completed in February 2013.
Phase 2: Intermediate findings for the 400 S corridor and Downtown SLC

Task 1
Using VISSIM, VISSUM and the software developed by the research team, the following intersections in Salt Lake City, assuming operation of the entire 2015 Program (all current and future LRT lines) will be analyzed:

- North Temple and 400 West
- South Temple and 400 West
- South Temple and Main Street
- 400 South and Main Street
- 400 South and State Street
- 400 South and 700 East
- 500 South and 1300 East
- Gate near 500 South and 1300 East

Task 2
The study will look at automobile traffic, LRT trains, bicycle use, and pedestrian movements in the corridors. It will include gathering counts of multimodal users for any data not already available. All data will be analyzed to determine a circulation plan for vehicles, pedestrians, and bicycles for the downtown area, including gaps in connectivity that need to be addressed.
The study will identify ways to improve efficiency of intersections, including signal timing. It will also include recommendations for improvements.

The study will address the impact of the mid-block pedestrian crossing on Main Street and the implication of backing up trains into the intersection. Mitigations strategies such as removing the mid-block crossing at affected intersections or other train prioritization settings must be analyzed and reported for further discussion.

The study will also identify possible new mid-block crossings along the 400 South corridor for feasibility. Feasible locations include areas near the Library, near 700 East, and near 900 East. The study will identify ways to improve the efficiency of the LRT trains through intersections.

Task 3
The study will create simulations for future growth and transportation projections (estimated 5, 10, and 20 year projections). The study will deliver all information compatible with UTA and SLC Transportation Department resources.

Phase 2 will include an interim report and presentations of the findings to UTA, UDOT, SLC and stakeholders. This phase will include recommendations to improve multi-modal corridor movement in conjunction with UDOT, SLC, and UTA systems. This phase is expected to be completed in September 2013.

Phase 3: Final findings for the 400 S corridor and Downtown SLC

Task 1
The final report will provide raw data including a comprehensive and organized database outlining current conditions in conjunction with all data and simulation models created for future transportation demand.

Task 2
The report will include recommendations for future transit accommodations in the urban transportation network and achievable mitigation strategies to address such recommendations.

Task 3
The report will include recommendations or policies for review and possible adaptation by UTA and SLC for creating efficient multi-modal movement of people and commerce through the corridors as a whole.

Task 4
The research team's lead will be required to present findings at a minimum of two UDOT events including the UDOT Annual Conference and the UDOT Research Library Sessions. Such presentations will include video animations of different scenarios developed of the traffic, trains, pedestrians and bicycles at key intersections.

The final deliverable will include a report with general observations for modeling and analyzing LRT, vehicle, pedestrian, and other modes through the study area as learned from the project. This phase is expected to be completed in May 2014.

The final report of the study will also be provided to MPC with possible seminars via the Transportation Learning Network. The study will be an excellent opportunity for exchange of experiences, ideas and results among the institutions gathered by MPC.

Project Cost:
Total Project Costs: $200,000
MPC Funds Requested: $75,000
Matching Funds: $125,000 Source of Matching Funds: UTA and UDOT

TRB Keywords:
Light Rail Transit, Transit Signal Priority, Corridor Assessment, Simulation, VISSIM, Software-in-the-Loop, Cross-resolution Modeling

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