Project # 5: Simulation-Based Impact Analysis of Signalized Intersections

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Abstract

Microscopic traffic simulation models are computer models that "mimic" the movements of individual vehicles traveling around a roadway network and effect of traffic control operations. Many simulation models have been developed to assess operational performance of traffic control systems. The results from these simulation modules can also be applied to analyze air pollution impact of traffic operation. This project offers opportunities for the RET Site teachers to get hands-on experience in conducting such an impact analysis using simulation models. The goal of the project is to provide the teachers a research experience including field data collection and using this information to create contextual math and science lessons in their math and science courses upon return. To meet this goal, following objectives are identified:

(1) Learn the fundamentals of signal control and methods for evaluating the performance of different traffic signal control schemes and experimental methods for analyzing their potential impact on ambient air quality (carbon monoxide – CO, in this study).
(2) Learn field data collection techniques and using of microscopic traffic simulation software to conduct the "what-if" type impact analysis for a given intersection.
(3) Learn techniques to identify traffic problems at a signalized intersection, explore alternative solutions by using the simulation-based analysis procedures, and find the best solution.

Content training activities will include learning of the fundamental traffic flow theories, data collection techniques, and use of simulation software. The teachers will be first introduced to the fundamentals of traffic flow theory and simulation by using the Highway Capacity Manual (HCM) software. For a selected intersection in Cincinnati, geometric and field traffic flow data will be collected and input in this software to investigate what variables impact traffic operation performance and delays. Data analysis will include basic concepts of algebra (different distributions of speed data) and statistics (probability, queuing, and delay). Next the teachers will be taught how the VISSIM software is used to analyze performance of different traffic control schemes for varied traffic conditions. They will also learn techniques to measure CO and estimate traffic contribution to ambient CO level. This knowledge will be further used to investigate the environmental (air quality) effect of a specific signal control scheme. Computer simulation software produces digital data which is generally displayed in visual form as graphs, charts, and animated traffic flow patterns, just like video games. Results for different simulated signal control schemes can be quickly produced, thus, enabling one to make decisions without running risks. The graduate student mentor will assist the faculty mentor to provide the above training to the teachers and to act as a guide for daily activities.

A field trip to the Advanced Regional Traffic Interactive Management & Information System (ARTIMIS) in Downtown Cincinnati will be arranged to make the teachers to get a first-hand experience in learning how a real traffic management system is used to control traffic flow in a metropolitan city and address emergencies.

The schedule for the six weeks is tentatively arranged as follows:

Week 1:	Training on fundamental of traffic theory and traffic data collection.
Week 2:	Traffic and CO data collection.
Weeks 3 to 4:	Training on simulation software and data analysis.
Week 5:	Conduct "what-if" type analyses and design hands-on examples for classroom implementation.
Week 6:	This week will be devoted to preparing the final presentations, final reports, posters, and project summary.

Possible Ideas for Classroom Implementation

The teachers could develop a lesson plan on the basic theme of *"Traffic: does it impact your daily life (and/or living environment)?"* The students could analyze a transportation condition at an intersection near their school and make recommendations, which is a fundamental part of an engineer's job. This activity will use traffic data to: create scatter plots, determine best fit line/curve and its geometric characteristics; describe and compare various types of studies (survey, observation, experiment) and identify possible misuses of statistical data; conduct data analysis to better understand traffic impact on their life; make inferences about relationships in data, and recognize the difference between evidence of relationship (correlation) and causation; and represent and analyze data using appropriate graphical displays with and without technology. Thus, students will learn the use of science, engineering and technology (STEM) to study a real world transportation engineering problem that is relevant to their daily lives. The "E" in STEM will hopefully become apparent to them.

This Project Offers Opportunities to Learn Simulation-Based Method for Traffic Analysis of Concerned Transportation Infrastructures

Advanced Regional Traffic Interactive Management & Information System (ARTIMIS) provides incident, congestion, and freeway management for the Cincinnati-Northern Kentucky Region