Introduction
Intersection performance evaluation is very important for transportation authorities, in particular, when prioritizing the allocation of resources for intersection improvements. The performance of signalized intersections is commonly quantified in terms of the average delay and the maximum queue length.

Intersection delay and queue length are generally estimated using software tools, which require empirical data such as traffic counts, signal timings, pedestrian volumes, traffic stream composition, and saturation flow rates. The required data are often unavailable or outdated, which significantly affects the accuracy of intersection performance analysis.

The objective of this research is to propose a methodology to use archived Automatic Vehicle Locator (AVL)/Automatic Passenger Count (APC) data for estimating the delay and queue length at signalized intersection approaches containing a near-side transit station. The proposed methodology eliminates the need for empirical data for intersection performance evaluation.

AVL/APC Data
AVL/APC systems use GPS sensors and passenger counting sensors to:
- Track the position of the transit vehicle
- Create an archived database containing records associated with events of interest

Methodology

Common event types:
- Scheduled Stops: transit vehicle makes a scheduled stop at a transit station and may board and/or discharge passengers
- Unscheduled Stops: transit vehicle stops at a location that is not a transit station
- Drive Through: transit vehicle passes by a transit station without stopping

Intersections with Near-sided Transit Stations

Yang and Hellinga proposed a methodology to use AVL/APC data to estimate the performance of signalized intersections with near-sided transit stations.

AVL/APC Data only provides the total stop time (TS). The dwell time (DW) and the red interval (R) should be estimated indirectly from the data.

Dwell Time Model
There is significant variability in observed average dwell time as function of the number of passengers boarding (NB) and alighting (Ne)
A two-staged dwell time estimation model is proposed

Dwell Time Model (continued)

Second Stage:
- Model the variations in individual observed dwell times using a normal distribution (f(N))
- Adjust the original Poisson model (f(DW)) considering that the dwell time cannot be longer than the total stop time (TS)

Evaluation of the Proposed Methodology

Available Data and Analysis Period:
- Three months of AVL/APC data, in Region of Waterloo, Ontario, Canada
- Data of PM peak period (4:30 to 6:00 pm) for non-holiday weekdays from in-service transit trips
- Five intersection approaches with a near-side transit station
- Each intersection was traversed by at least one route that serviced the transit station, and one route that did not service the station

Conclusions
AVL/APC data can be used to evaluate the performance of intersections within the network roadwork
Evaluation showed delay and queue lengths can be measured accurately
Further evaluation is needed for approaches on which transit vehicles make left or right turning movements and to improve the performance of the boundary line fitting algorithm