

# Roundabout Capacity Survey Method Using Vehicle Trajectory Data and Gap Acceptance Cycles

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## A new method for calibration of roundabout gap acceptance capacity models

### INTRODUCTION

A new method for conducting **roundabout capacity surveys** using detailed **vehicle trajectory data** has been developed under funding by SIDRA SOLUTIONS.

The method observes **gap acceptance cycles** based on the **traffic signal analogy concept developed by Dr Rahmi Akçelik** for modeling roundabout entry lane capacity.

Unlike previous methods, this method derives estimates of key gap acceptance parameters (**follow-up headway and critical headway**) and blocked and unblocked times (**virtual red and green times**) at the same time as **roundabout entry lane capacity**.

The new method based on observation of gap acceptance cycles allows application of gap acceptance **surveys at all levels of demand flows**.

The survey method is proposed for use in **calibration of roundabout and two-way sign control capacity models in particular**. It is applicable to all gap acceptance situations including permitted turns, unsignalised bypass lanes and right turn on red at signalized intersections.

### SURVEY METHODOLOGY

This new survey method uses **digitized vehicle trajectories** to observe gap acceptance parameters and capacity of entry lanes **simultaneously on a cycle-by-cycle basis** without requiring long periods of continuous queued vehicle departures typically used by traditional gap acceptance capacity survey methods.

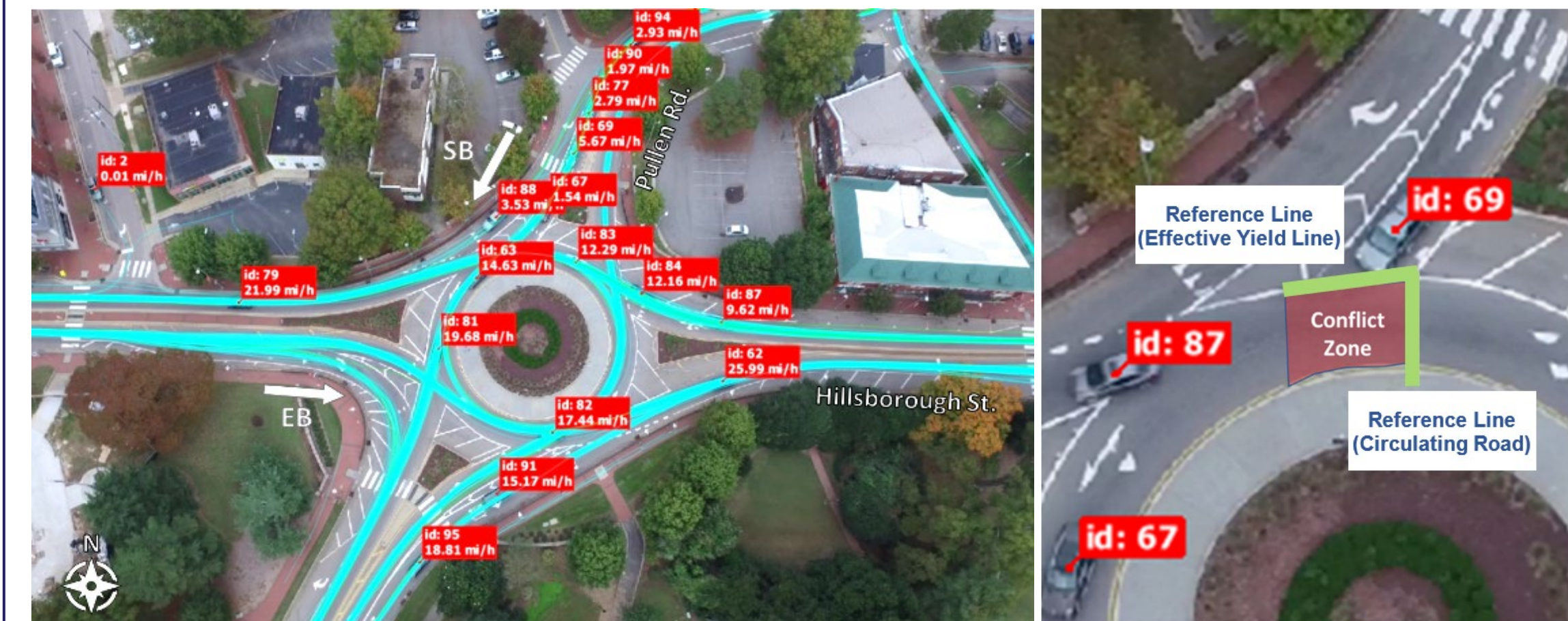
Data were collected at two approaches of a single-lane roundabout in **Raleigh, NC, USA**, using drones (**Figure 1**). Video processing was outsourced to DataFromSky™.

The research work involved development of:

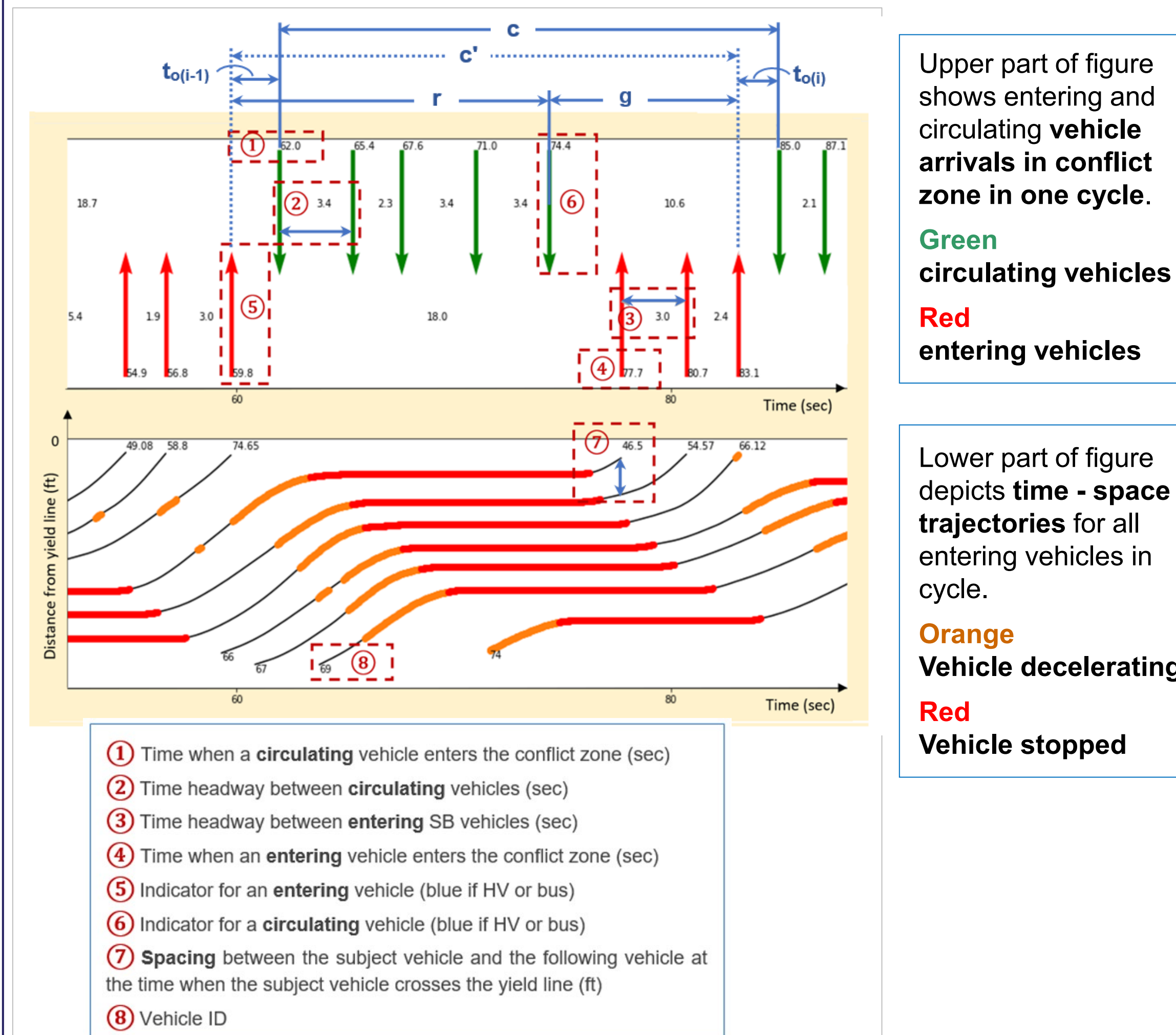
- **time-space representations of vehicle trajectories** from drone videos (**Figure 2**), and
- definition of **reliable gap acceptance cycles** for accurate measurement of follow-up headway, critical gap (headway) and capacity **cycle by cycle** by observing **saturated unblocked periods** occurring when all **entry vehicles are queued** (**Figure 3**).

Cycles involving **heavy vehicles and pedestrian effects** were excluded from the analysis to enable model comparisons.

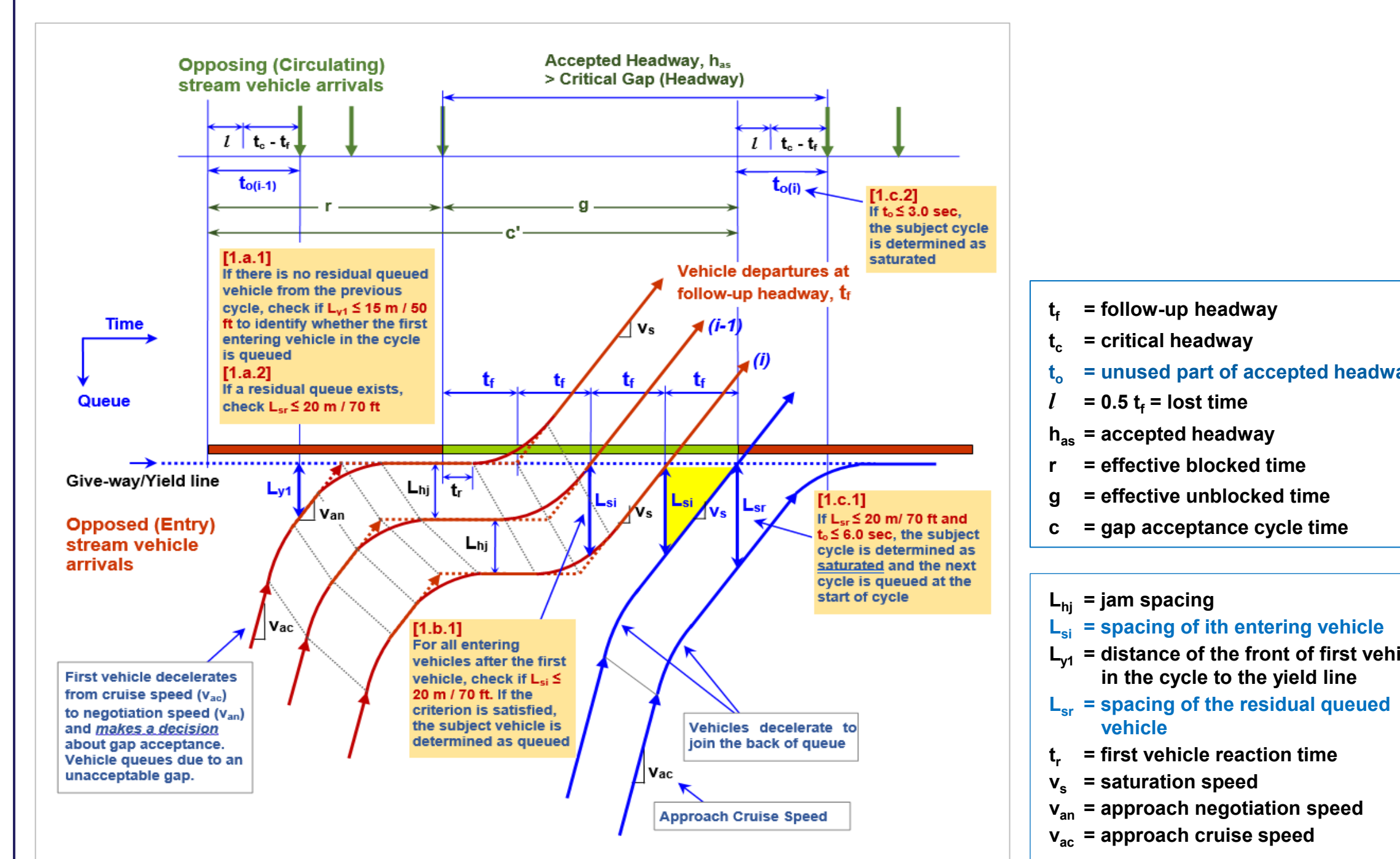
**Figure 1**  
Data collected at a single-lane roundabout in Raleigh, NC, USA, using drones



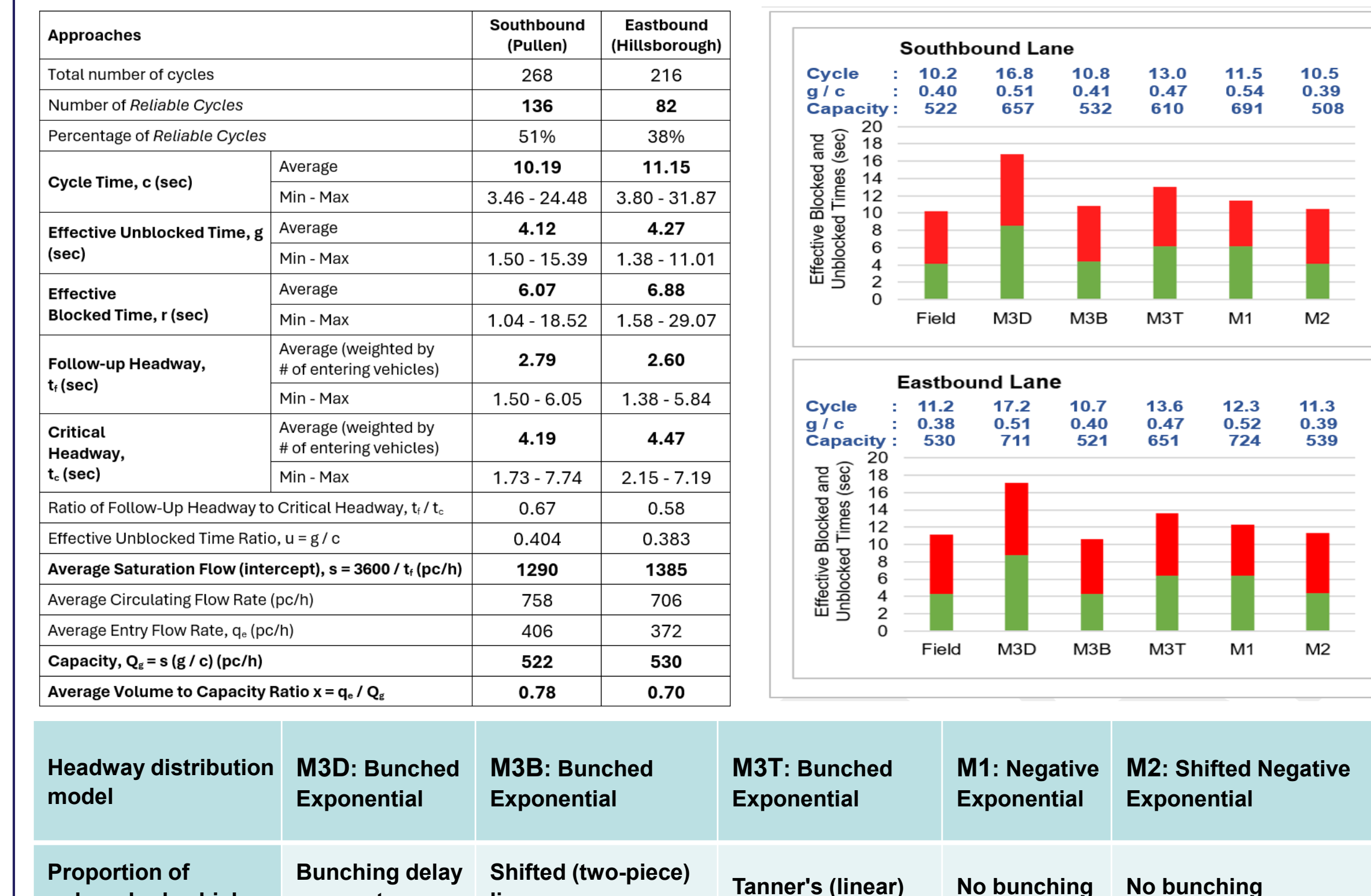
**Figure 2**  
Time-space representations of vehicle trajectories from drone videos



**Figure 3**  
Definition of reliable gap acceptance cycles



**Figure 4**  
Observed gap acceptance parameters, and comparison of observed vs estimated effective blocked and unblocked times (virtual red and green)



## FINDINGS and CONCLUSIONS

The observed **effective blocked and unblocked times** (virtual red and green times) were assessed using well-known **headway distribution models** applied to circulating flows. The results indicated model estimates close to the field values (**Figure 4**).

Preliminary investigation of the inclusion of cycles with heavy vehicles indicated that the survey method can be used for determining **gap acceptance factors** for different vehicle classes in entry lanes.

Roundabout capacity estimates were evaluated for the headway distribution models as well as the roundabout capacity model in the current edition of the US Highway Capacity Manual (**Figure 5**).

The disaggregate gap acceptance cycle data points are seen to form a fanning-out of multiple linear patterns resulting from cycle-by-cycle observations. Data aggregation methods can be applied to improve the quality of fitting of the tested capacity - circulating flow relationships.

A preliminary assessment of **bunching models** for the circulating flows indicated **low levels of bunching** in circulating flows.

The results confirmed the validity of the survey method, supporting the novel signal analogy concept with real-world data. Detailed results of capacity model assessments will be reported at the **TRB 7th International Conference on Roundabouts and Geometric Design, Atlanta, Georgia, USA, June 2025**.

**Figure 5**  
Roundabout capacity estimates for the headway distribution models Highway Capacity Manual

