ABSTRACT

Identification of congested traffic signals that require capital investment to increase capacity has historically been a time-consuming labor-intensive process. Signalized intersections that pose congestion challenges are first analyzed to see if they could be improved through retiming. This analysis usually requires data collection on turning movement counts, followed by simulation. If it is observed that retiming is infeasible or ineffective, only then is an intersection further considered for capital investment.

The emergence of connected vehicle (CV) trajectory data provides quickly obtainable signal performance measures (SPMs) that allow for prompt screening of such intersections that need capacity improvement with minor manual labor. One such CV-derived SPM is the percentage of split failures (SF). A split failure indicates when a vehicle fails to traverse a signalized intersection within one signal cycle length. SF has already been used for identifying intersections that can potentially be improved through retiming. This method is expanded in this thesis to identify intersections with capacity problems that cannot be improved through retiming.

The methodology checks for SF values on a critical path of turning movements. This process filters out cases that can be improved by retiming, isolating intersections where the only likely option is to increase capacity with infrastructure upgrades. The proposed technique has been applied statewide for over 2,300 intersections managed by the Indiana Department of Transportation (INDOT) to identify locations needing added capacity. Subsequently, a ranking metric of CV split failure counts on the critical path of movements is developed to prioritize capital investments.

The results were validated with field visits to three highly ranked intersections. These field visits confirmed expected split failure occurrences on multiple movements on the same critical path, making retiming infeasible. This suggests that the proposed methodology provides reasonable capacity improvement candidate intersections. It is important to note that the proposed methods and ranked lists should only be used as a tool to screen intersections that need additional capacity. Further evaluation is necessary on a case-by-case basis to determine whether a location merits a capital investment project, and if so, the capacity improvement strategy that should be implemented.