

1 INTRODUCTION

The most common type of vehicle detection device in use at signalized intersections today is the inductive loop. This is a loop of wire imbedded in the pavement carrying a small electrical current. When a large mass of metal passes over the loop, the electric field is disturbed and generates, or induces, current in the wire. This current is then amplified by the detector amplifier and signals the controller that a vehicle is present.

Because of the mature technology of inductive loops as vehicle detectors, inductive loops show strong capabilities in collecting traffic data and can provide direct measurement of a wider variety of traffic parameters, such as density, vehicle presence, volume, and speed. But as an intrusive technology, the inductive loop has some disadvantages. Depending on when they are installed, loop detectors are cut into the pavement, often resulting in premature pavement failure. When the roads or intersections are under construction, the inductive loop may not work as usual. Under these conditions, alternative technologies should be provided to maintain the traffic data collection and signal actuation at signalized intersections.

New technologies have emerged to replace inductive loops temporarily at signalized intersections. Non-intrusive technologies have gained popularity because of the advantages in installation, detection and maintenance compared to conventional vehicles as inductive loops. Non-intrusive detection devices are those devices that cause minimal disruption to normal traffic operations and can be deployed more safely than conventional detection methods. Based on this definition, non-intrusive devices are devices that do not need to be installed in or on the pavement but can be mounted overhead, to the side, or beneath the pavement by “pushing” the device in from the shoulder. So when highways and intersections are under construction, the performances of non-intrusive technologies are affected little because they are installed over road or roadside.

1.1 Objectives of the Guideline

- ✓ Develop a handbook describing the various vehicle (and pedestrian) detection technologies currently available today.
- ✓ Provide contractors the guideline for choosing and using a particular “non-intrusive” vehicle detection device to maintain actuation at a signalized intersection during construction.
- ✓ Provide the general procedure for contractors to select particular non-intrusive vehicle detectors at signalized intersections.

1.2 Methods and Approaches

When a particular non-intrusive technology is selected to maintain the signal actuation at intersections, many factors should be considered. The capabilities of non-intrusive technologies are the main factors. That is, the selected non-intrusive technologies should have the same capabilities to collect traffic data as the inductive loop that will be replaced. Otherwise, the

selected non-intrusive technology cannot deliver the correct traffic information to the signal controller as inductive loop. In addition, some other important factors also should be considered. Every technology has its own advantages and disadvantages. For example, some non-intrusive technologies can keep the great performances when the volume in the intersections is high and the weather conditions are inclement. But some other vehicle detectors may not hold these kinds of characters. If these kinds of factors also can be considered completely, the selected non-intrusive vehicle detectors can deliver the traffic information to signal controllers correctly.

The following figure shows the outline of the project and the main factors considered in the guideline.

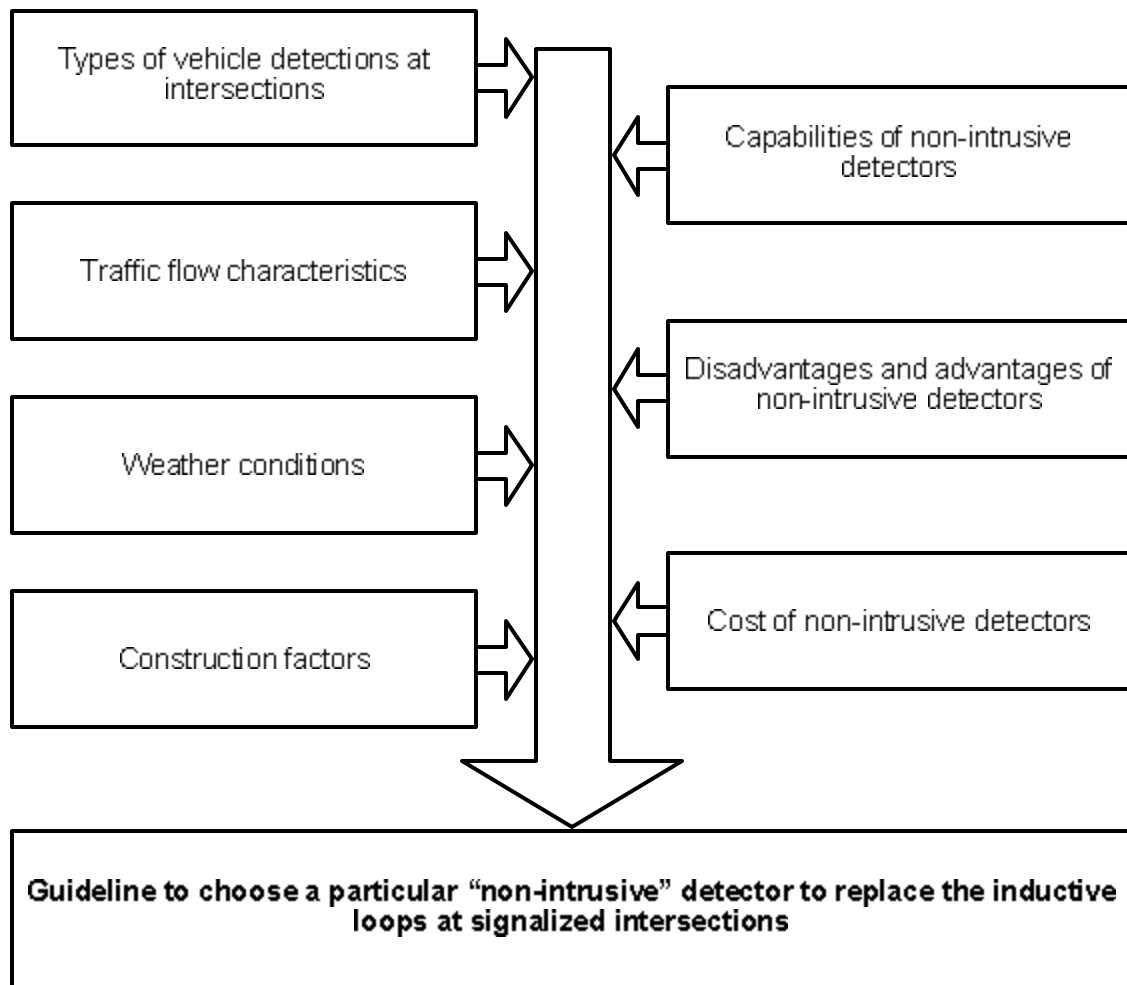


Figure 1-1: Outline of the project

1.3 Architecture of the Guideline

The guideline is divided into several parts based on the requirement of the research.

- **Chapter 1: Introduction** – contains an overview of the guideline and an introduction to methods and approaches used at Maintenance of Traffic (MOT)
- **Chapter 2: Type of Vehicle Detections** – provides the selection of the type of detector in signalized intersections, determined primarily by suitability for the intended purpose. The decision whether a particular detector is appropriate for a certain purpose depends on its operating characteristics, its adaptability to the particular application, and the location specific details of the installation requirements. So these parts mainly discuss traffic data requirements of different types of vehicle detections at signalized intersections.
- **Chapter 3: Factors Affecting Performances of Non-intrusive Vehicle Detectors** – analyzes numerous factors that affect the performances of non-intrusive vehicle detectors, and the change factors in different local environments. When we select particular non-intrusive vehicle detectors to replace inductive loop to maintain signal actuation, we should consider whether the selected vehicle detectors can operate correctly and really maintain traffic signal actuation under local environment. In the guideline, three main factors are considered: Traffic Flow Conditions, Weather Conditions, and Construction Factors.
- **Chapter 4: Capability of Non-intrusive Vehicle Detectors** – introduces the theory of operation of the non-intrusive technologies currently available today. This chapter also includes a variety of tables resulting from different field tests conducted by various research institutions.
- **Chapter 5: Cost Study of Non-intrusive Vehicle Detectors** – provides contractors a reference of the current cost of non-intrusive vehicle detectors, including the price of the devices and software and the cost of maintenance.
- **Chapter 6: General Guidelines for Detector Selection at Signalized Intersections During Maintenance of Traffic** - summarizes the analyses of the parts above and the general procedure of how to select particular vehicle detectors to replace the inductive loops and maintain signal actuation. Such as, (1) Determine the types of vehicle detections and type of data to be collected. (2) Narrow device alternatives to only those devices that can provide the data required. (3) Narrow device alternatives to only those devices that have a good performance in the traffic flow condition at the intersection. (4) Narrow device alternatives to only those devices that can work correctly in the weather conditions during construction at the intersection. (5) Consider the geometric and construction factors in the intersection. (6) Review the convenience of installation of the device in the intersection and the skill level of the maintenance personnel for ability to maintain the device. (7) Conduct cost/benefit analysis on each of the remaining alternatives. (8) Ensure that the device is consistent with the overall vehicle detectors on each approach to deliver the correct traffic information.

- **Appendix A: State of Florida Department of Transportation Non-intrusive Vehicle Detection Systems Standard and Specifications**. – includes Infrared, Microwave, Acoustic, Ultrasonic, Magnetic and Video Vehicle Detection Systems.
- **Appendix B: Survey the Need of Maintenance of Traffic at Signalized Intersections** – contains the result of survey conducted by Florida Department of Transportation – Traffic Engineering Research Laboratory on the Need of Maintenance of Traffic at Signalized Intersections to All States DOT's.

1.4 References for Chapter 1

- [1] Mark D. Suennen, William M. Spreitzer, Joseph K. Lam," A Traffic Detection Tool KIT for Traveler Information Systems", Prepared for 2000 Mentors Program, Advanced Surface Transportation Systems, Texas A&M University, College Station, TX, August 2000.
- [2] Lawrence A. Klein and Michael R. Kelley, "Detection Technology for IVHS, Volume I: Final Report", FHWA-RD-95-100, Federal Highway Administration, December 1996.