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An Eberle Design, Inc. White Paper

001- Bike Detection Using Inductive Loop Technology

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Introduction

As much as some people believe that loops are going away, the fact is loops are still being installed and at a greater number than ever. The technology has changed significantly aging well and increasing in sophistication. All the other technologies, as great as they are, still compare themselves to loops. Why is that? Loops are still very accurate and very reliable when installed correctly.

Loops technologies are evolving; and although they may not be flashy, technologically advanced, or wiz-bang, they still get the job done and at a level of reliability and accuracy still not achieved by other technologies.

Problem Statement

Due to changing attitudes for Green Awareness, health and fitness, and concerns that gas and gas taxes are getting out of hand, more people are taking to the streets with pedal power. Because of this, the Transportation industry is adopting new ideas for this increased mode of transportation including designated bike lanes, bike paths, separate bike roads, and other means to provide safer operations as well as entice bicycles to ride more places.

The most intense focus for traffic signal operations is that for Bicycle detection. There are new requirements and regulations that the transportation industry is developing to promote safer operations at the intersection for bicycles and pedal powered vehicles. This is due to the increased number of bicyclists each year riding and traveling on city and rural streets.

Previous Options

Loops have always been a good choice for detecting vehicles. For over 40 years loops have been in the ground and detecting vehicles very well. While bicycles have always been able to be detected, it was not so easy to do because loop sensitivities were adjusted so high that other issues arose. Today's technology allows for much smaller signals and wider ranges of sensitivities to be used to detect wider ranges of vehicles.

A long standing issue is that bicyclists have been ignored at most traffic signals while only cars (motorized vehicles) and pedestrians were given means of detection by various technologies. Bicycles have not been focused upon or recognized mostly because they tend to ride on the side of the road and detection was hard to install in these locations, and that the population of bikes vs. other vehicles was extremely small. Normally, bicyclists only got the green lights when other vehicles were present. Push buttons were another option but very inconvenient to the bicyclist. This is all changing.

Another long time view is that loops are hard to install and fail easily. Loop installation had been done the same for years with the same equipment and hardware with little advancement. Again, new technologies are now available and they no longer should be considered to be "old technology" or "buggy whip technology". When done right, these new loops can last the lifetime of the roadway. Even with older technology loops, what most people don't know is that it is a very rare occurrence that a loop "fails" on its own. Most cases of loop failure are due to contractor's digging up a loop, or failure of the roadway itself, and often poor installation practices.

Solution

This paper will look at the challenges of detecting bikes both reliably and accurately. There is a need to make sure bikes are identified correctly, not as a car, not as a motorcycle or even a scooter; and, also make sure that all attempts are made not to miss a bicycle. The latter is to insure that bicycles riders don't run red lights or disobey traffic signals. Safety is the prime objective. After all they are supposed to obey the same rules that motorized vehicles have to obey.

Bike Detection

Bike detection in loop detectors has really always been around. The problem is that the sensitivity of the loop has to be set so high to properly register a bike that it can cause the loop to "cross talk" or interfere with an adjacent loop, or pick up vehicles in adjacent lanes. This creates issues for most intersections.

California was one of the first states to adopt legislation to insure that bikes can be detected at all intersections that use detection, otherwise the intersection must be put into recall or be fixed time.[1] AB1581 (Assembly Bill 1581) insures that all new intersections and those retrofitted more than 50 % all get bike detection at each approach. What was not defined was the ability to differentiate a bicycle from a car or other motorized vehicle including motorcycles and scooters.

Bicycle proponents are asking Traffic Engineers for safer operations at intersections with the use of additional timing parameters to specifically handle bicycle needs. The Controller manufacturers are adding "bike timing" to their controller to meet this need. Now detection manufacturers have to come up with a way to determine a bike is at the stop bar and is not a motorized vehicle, thus giving the controller the ability to provide the timing appropriately.

Bike detection utilizing loop detection has been available for several years using amplitude of a signal to determine a bike versus a car or larger vehicle. But, it is not so accurate against a scooter or small motorcycle. However, with increased processor power the capability of signature recognition and analysis now allows the detector to distinguish between a bicycle and a scooter or motorcycle very reliably.

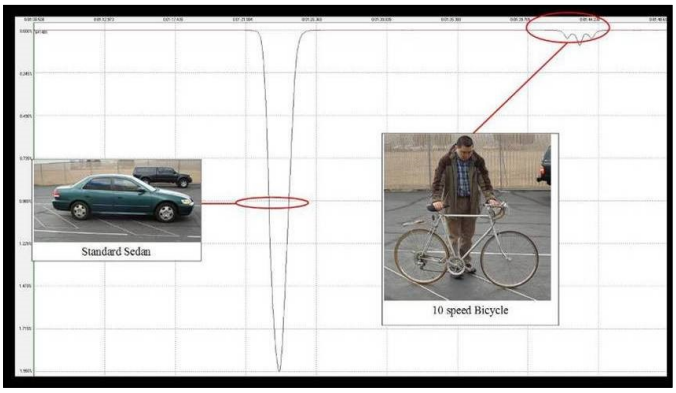
The development of newer high processing detectors now includes this technology into the latest line of loop detector. The signature of a bicycle is very distinct, and when it is recognized, and only when a bike is recognized, will the detector output a call. The detector also has internal "bike minimum time" and "bike extension time" settings so that the bicyclist will be insured enough time to cross the intersection, and addition bikes will get continued greens if needed, up to the maximum time allowed. To do this a specially designed loop configuration is needed and a prefabricated loop is highly recommended for accuracy.

This new technology is also considered more of a "system" instead of singular parts; it's similar to other technologies where the field equipment is tightly connected to the cabinet electronics. Consider a video detection system where the camera required is from the same manufacturer as the detection processor. Bicycle detection utilizing inductive loops requires that the loop wire and technology used is what the processor requires to detect bicycles.

The loop that is used for detection of bikes is a parallelogram that is set at a 45 degree angle to the direction of travel and has a leading edge-trailing edge distance of 42 inches. This design accentuates the signature of a bicycle and is a key to the operation of this detector. The installation can be anywhere in the intersection to accommodate existing loop installations.

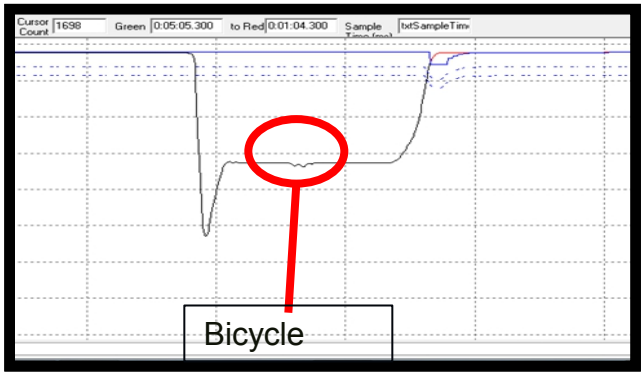
A prefabricated loop is used and required because of several factors that wound loops from a contractor cannot overcome. These are seal loop wires in one single sheath, no vibration between wires and no shift of wires in relation to other wires in the loop.

The reason for this design is to eliminate all the excessive "noise" on the loop. As seen in this picture, the bike signature is very small compared to a car.



Loop Car v Bicycle 1

The precision of the detection is so sensitive that if that same vehicle is sitting on the loop while a bicycle rides over the loop it will still be detected as seen here.



Loop Car v Bike 2

Prefabricated Loops

The key to the success of all loop detection is, of course, the loop. New technologies in materials and manufacturing have made significant leaps in this area. What used to be needed was heavy gauge wire and thick insulating jackets to withstand the stresses of installation and hazards of the road. Now with the lighter more durable materials the loop can be made more resistant to abrasion and chemicals and stress and made less bulky. Also, increases in reliability and performance can come from using prefabricated loops.

Prefabricated loops can be laid into saw cuts, or can be laid after milling prior to a new asphalt layer is applied or can be laid in the sub-base in new installations. Each type of installation requires a different prefabricated loop, all of which can be specifically designed and supplied to contractors as needed.

Prefabricated loops have the advantages over standard contractor wound loops in several areas:

1. First they are made in a controlled and regulated environment using a very precise process to insure that each loop is working correctly.
2. Testing is performed before the loop is shipped to insure that it is ready to go into the ground.
3. The home run is included to make sure that no splices are required between the loop itself and the cabinet.
4. Encapsulation with a water repellent gel of all splices and cable within the protected sheath guarantees that no foreign materials will corrode or degrade the loop after installation.
5. Multiple layers of the material XLPE (Cross-Linked Poly Ethylene) also creates a strong protective boundary.
6. The winding of the loop is encased in one protective sheath which has additional benefits in that the individual wires will not move relative to each other. This is one of the major causes of failure in normal loops.

Failures of loops occur, naturally, when pavement shifts occur and cause individual winds of the wire to shift relative to each other. This shifting of the pavement can cause stretching and cracking of the insulation thus causing water and other foreign materials to invade the wire corrupting the installation. The prefabricated loop with its added protective covering and barriers helps protect against this, increasing the longevity of the loop.

Other failures are due to uncontrollable circumstances such as accidental incursions from back hoes, ditching equipment and other contractor mishaps. These can be repaired and if done right will not affect the loop operation.

Implementation

A complete system should be used when using loop detection. Just as with any detection system, the right installation and right equipment should be used at all times. Installing video detection and not using the approved camera is never an option. Why would a loop detector be used without the right loop? All the components are necessary to make sure that the detection is maximized for both reliability and accuracy.

Choosing the right detector for the job whether it is for standard vehicle detection, bike detection or Automatic Vehicle detection is important. Choosing the right loop to go with that is as equally important. If it is going into a saw cut, then the solution would be to use a saw cut style prefabricated loop. If it is going under a new layer of asphalt overlay, a direct burial loop is more suitable.

With each installation the right loop configuration is also necessary. Bike detection in a bike lane or in a left turn lane should be

designed to optimize the bike detection with the parallelogram designed loop. Placement for bike loops is critical to make sure the detection of the appropriate vehicle is where it needs to be. Surveying and planning are important. Make sure that both are used to determine where the best place for the loop is going to be. The use of plans is not enough to determine where the loops will be needed.

On top of all the hardware and software and installation, training is also important. Properly trained loop crews can install loops in relatively short periods of time. In most cases agencies hire out loop crews, so contractor training should be a part of any project to make sure that the installation is done correctly. There are a lot of myths about loop installation that can make the installation harder than it needs to be, and more costly in the long run.

Summary

Loops have been around longer than any other current form of detection. The gold standard for accuracy is still a loop detector. With the increase in technology such as faster processors and communications, and more advanced materials, loops are seeing a lot of resurgence. There are new features in the old reliable loop detector that are worth looking at again.

Bike detection is using new technology features that are beginning to be available; with more to come as newer, faster processors are utilized. Add to this the added reliability and increased life expectancy of a prefabricated loop. With this combination of functionality and reliability within the full loop detection system, it easy to see why loops have not gone by the wayside as many of the competitive products predicted so many years ago.

References

1. (TOPD 09-06 / California AB1581, 2008)
2. C1101-B / C1201-B Series , Reno A&E, renoae.com
3. Prefabricate Loops , Reno A&E, renoe.com