Use of SmartSensor Matrix to Detect Bicycle Traffic

SmartSensor Matrix has been successful in detecting vehicular traffic at the intersection stop bar, and additional investigations have shown that SmartSensor Matrix is also effective in detecting the presence of bicycles both in dedicated bicycle lanes and in lanes for mixed bicycle and motor vehicle traffic. This document presents the scenarios in which SmartSensor Matrix effectively detects bicycles, as well as the limitations of bicycle detection.

Detecting Bicycles in Vehicle Lanes

Testing has shown that the sensitivity of the SmartSensor Matrix is such that bicycles are effectively detected and tracked with similar accuracy to motor vehicles. The SmartSensor Matrix, therefore, is effective in systems that must detect bicycles and provide traffic signal service to the bicyclists.

Bicyclists that arrive on approaches on which vehicles are located in adjacent lanes may not be detected independently from the vehicles. This effect is not due to the sensitivity of the sensor but to the measured distances between the bicycle and the vehicle. As shown in Figure 2, the radar response from a vehicle comes primarily from the near surface of the vehicle. Thus, the distance measured by SmartSensor Matrix is the distance to the vehicle’s near side. As shown in the figure, the measured distance to a bicycle that is adjacent to a vehicle in the next lane out may be too small for the bicycle and the vehicle to be distinguished as separate vehicles. A bicycle on the far side of a vehicle, however, will have a greater measured separation and will be detected separately, provided the vehicle that does not occlude the bicyclist.

Figure 1 – Bicycle alone. In this example, the bicycle is detected.
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Figure 2 – Difference between center of vehicle and radar range for bicycles and cars

**Note.** Distances in this diagram are estimates only and will vary based on vehicle types and mounting locations.

Since SmartSensor Matrix detects lone bicycles reliably, and since a bicycle-vehicle merged detection still results in a detection, the impact of bicycle-vehicle merging on intersection performance is minimal, as shown in Figure 3.

Figure 3 – If the bicycle and vehicle are both in through lanes, it doesn’t matter if detections are merged because either way, there will be a call placed for a green light.

On an approach with a through phase and a left-hand turn phase, the one scenario that will effect intersection performance is when a bicyclist is located in a left-hand turn lane and a vehicle is located in an adjacent through lane, as shown in Figure 4. In this case, a call may not be placed for the left-hand turn phase until the through phase receives the green and the vehicle leaves the approach. At this point, the bicyclist would be detected and a call will be placed on the left-hand turn phase.

Figure 4 – If the bicycle is in a left-turn lane and its detection is merged with a nearby vehicle, then it might not be detected, and a call might not be placed for the left-turn lane, until the vehicle leaves the approach.
Detecting Bicycles in Dedicated Bicycle Lanes

Approaches with a dedicated bicycle lane can be configured in the SmartSensor Matrix software by either configuring the bicycle lane alongside the vehicular lane or by widening the vehicular lane so that the bicycle lane is included. If a separate bicycle lane is configured, keep in mind that, as discussed in the previous section, bicycles that are adjacent to vehicles may not be detected separately. For this reason, a detection zone in a bicycle lane that is adjacent to a vehicle lane should be mapped to the same channel output as the adjacent vehicle lane. This can be accomplished by either creating a single detection zone that includes both the vehicle lane and the bicycle lane or by mapping the bicycle lane detection zone to the same channel output as the detection zone in the vehicle lane.

If a bicycle lane is separated from the nearest vehicle lane by ten feet or more, then bicycles in that lane will be detected independent of vehicle traffic and the output of a detection zone in that lane can be mapped to a separated channel output.

Since lanes configured in SmartSensor Matrix are directional, only bicycles moving in the defined lane direction will result in a detection call. Bicycles moving against the defined lane direction will not be detected. Stopped bicycles will create a detection.

Conclusion

SmartSensor Matrix is effective in detecting bicycles and providing traffic signal service for the bicyclist in many scenarios. Some special considerations must be made when determining if SmartSensor Matrix will work in a specific bicycle detection application.