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What Detectors Can See, How Well They Can See It, And How A User Knows This

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The long asset lifetimes required for traffic control equipment mean that a lot of detectors currently in use are ten or more years old. These prevailing detectors were designed to perform specific traffic control functions and use on a range of different sensing physics principles to determine whether a vehicle or pedestrian) is in or moving through their detection zone or not and pass this information on. Typically sensors of this type can only provide a modest amount of information about an object, and have limited selectivity over a small number of classifications.

Each of the underlying processes that turn an analogue real-world signal into a detection ‘event’ have their own strengths and weaknesses.

Inductive loops for instance, rely on an induced magnetic response, so can only see objects that have a significant ferromagnetic content. Active infrared devices illuminate the area of interest and look for changes in the returned signal, so are dependent on the reflectivity of the object and on any weather conditions that reduce the beam strength. Similar constraints can affect imaging based technologies. Microwave technologies range in sophistication from simple doppler devices up to multi-object tracking, but their ‘imaging’ detail is constrained by their operational wavelength.

TOPAS is addressing the problem of how to define the capabilities and limitations of different detection technologies, and implement a process that allows manufacturers to specify (and validate) what their products can respond to and how well they respond. Starling is an integral part of the group developing that TOPAS standard.

Having recognised the innate characteristics of different technologies, and the need for detectors to be characterized we can turn to what is achievable. The reason why Starling are involved is that, as presented at JCT in 2022 and 2023, Starling provides detection for pedestrians as well as for other modalities, and does this for approaching pedestrians, those waiting at the kerbside and those crossing the road. Further, Starling detection capabilities deliver optimisation of pedestrian crossings including more complex crossings with cycles. In doing this work, the Starling team have realised and shown that, if it is the field of view, then it can be reported, and the better we can see it, the better we can report it.

We offer two specific examples: In talking with users it has become clear that there is a very strong interest in detecting busses approaching signalised locations, so that local bus priority can be implemented simply and quickly through the installation of the right detector.

Originally and to some extent currently, bus priority was about journeys, so only busses that were late would achieve priority, but when the environmental impact of stopping and re-starting a bus is considered, as well as the economic gain achieved via running a timely service, there is a clear benefit in trying to get all busses through signalised sites on green, regardless of their contribution to moving passengers.

The second interesting use case arises from our users also challenging us, pointing out that our typical field of view for crossing optimisation also gave us a view of the traffic leaving the crossing. UTC SCOOT detection is often placed after a junction or crossing where the leaving traffic has reached smooth flow conditions so can be characterized. The challenge from users was why can't the same detector that is providing kerbside, on-crossing and VA detection functions also give us UTC SCOOT detection data?

Returning to the idea of demonstrating the capabilities of different detection technologies, and noting the caveat, "if it is in our field of view", this warrants a bit more analysis. For a detector to be useful it has to detect the intended objects reliably, reduce both missed detections (negatives) and false positives (incorrectly identifying something as an object when it is not), and do this reliably under all weather and environmental conditions day and night. Further, ideally the detection should contain a mechanism whereby the user can ascertain the accuracy of the data, the detectors 'best guess' as to what it has 'seen' that reflects confidence.

The objective of the TOPAS standard is to determine how to classify acceptable levels of failed detection (negatives) and acceptable levels of mis-identification (false positives) all for different object types at varying ranges under varying ambient conditions. Being able to do this will help users deploy the right detection and gain insights into what detection can do that was not previously accessible.

We are currently deploying detectors to undertake baselined assessment for both the bus detection and SCOOT loop detection functions and will collate and share our data to support the TOPAS process and plan to present it at future JCT symposia for the benefit of this community.