OgierElectronics

CASE STUDY

Stopped Vehicle Detection (SVD) using Radar

This case study describes a long-term trial of the Ogier Electronics SVD radar on the M6 motorway in the UK. The purpose of the trial was to demonstrate the performance of radar under heavy traffic loads in all weather conditions. The radar was shown to have excellent performance and the collected data was invaluable to allow us to design an enhanced version for longer-range operation.

Background

A large number of vehicles break down or run out of fuel on motorways every day. In cases where radar is not used to detect stopped vehicles, the response time can be extremely slow, leading to increased risk of collisions with other vehicles.
In 2016 a Highways England report showed breakdowns on all-lane-running sections of the M25 took an average of 17 minutes to be detected.
We decided we could improve this situation by using our radar expertise to develop a Stopped Vehicle Detection (SVD) radar product that would dramatically reduce response time from minutes to seconds. Rapid detection is important in most situations, but especially on Smart Motorways where there may not be a hard shoulder.
Smart Motorways can use radar alarm data to automatically control variable speed limits and electronic signage to alert other road users to the location of the obstruction, thus reducing collisions and improving road safety.

Our Solution

Our SVD radar was developed from our existing field-proven Scan-360 product. Scan-360 was designed to locate moving targets and ignore stationary targets, so we inverted the processing technique to detect stationary targets instead.

We used computer simulations to confirm the software routines would behave as expected before undertaking some basic tests on roads near our offices to confirm the theory. We undertook a series of high-speed measurements on a disused runway to confirm we could detect stranded vehicles in the presence of other vehicles.

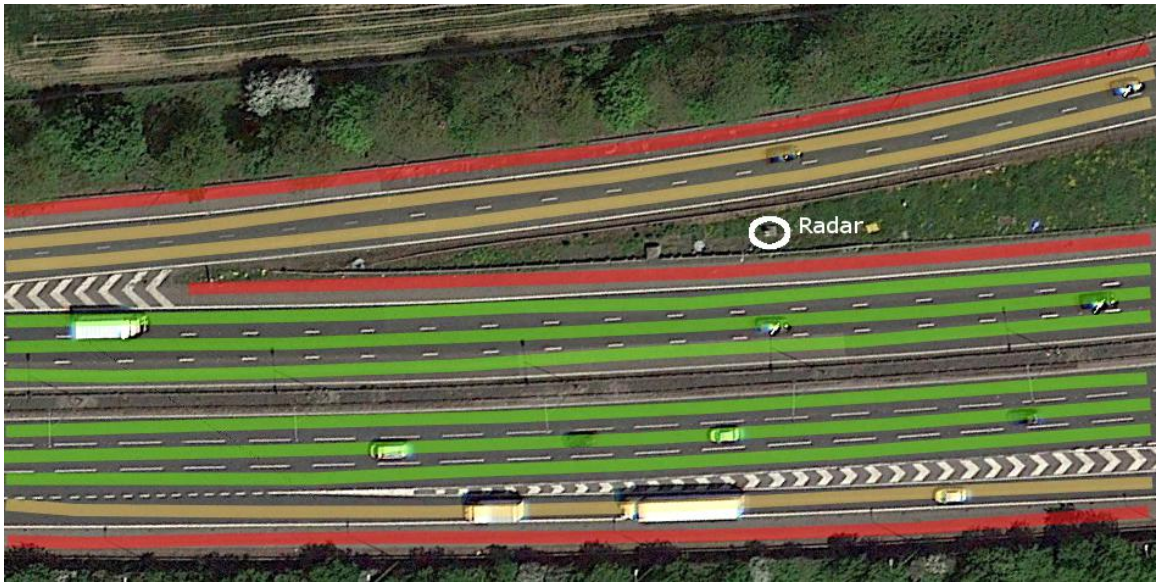
To demonstrate the equipment’s suitability a long-term trial was undertaken.
The initial deployment used a modified version of our Scan-360 radar with new software to identify stopped vehicles. The system was configured to monitor the lanes on all carriageways, covering a total of 400m of roadway, including adjacent slip roads and hard shoulders.

Radar was mounted very high to improve coverage by eliminating obscuration by high-sided vehicles.

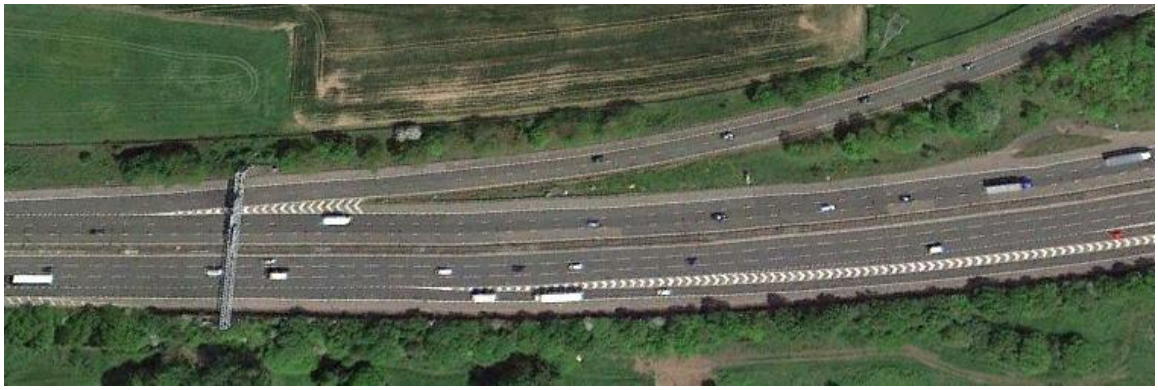
In collaboration with our partners, P&D Specialist Services, our radar was set up on the M6 close to the busy Coleshill interchange so we could evaluate performance under heavy traffic conditions.

To aid analysis, two PTZ cameras were co-located so radar detections could be confirmed with video footage.

Large amounts of raw radar data were saved to allow the detection algorithms to be fully evaluated and refined using “real world” data.



The radar was positioned so that a large number of lanes would be monitored at once. This presented the radar with a very high number of vehicles within the field of view to make the detection algorithms work hard to highlight if there were any flaws in our approach. There were three hard shoulders (red), three slip roads (yellow) and six running lanes (green), giving a total coverage of 12 traffic lanes for a single radar sensor.



The approximate coverage area is shown above. A number of large trees were next to the hard shoulder and allowed us to evaluate how the system would work when vehicles stopped next to the trees.
A large gantry was situated around 130m from the radar and allowed us to evaluate the radar's ability to ignore very large static objects in the environment.

Radar Performance

The long-term testing showed that the radar hardware with special SVD software had good performance in a real motorway environment.
There were a surprisingly high number of stopped vehicles observed during the test period, which gave us ample opportunities to observe radar performance.

The ability of the radar to slew a PTZ CCTV camera proved to be invaluable and produced lots of footage to demonstrate the system performance in a variety of road and weather conditions.

Footage from this trial is available on our website:

www.ogierelectronics.com

Many stopped vehicles were identified correctly and rapidly, with minimal false alarms, demonstrating the suitability of our radar to the application. The camera footage showed how the radar was able to detect stopped vehicles at long ranges as well as almost directly underneath the sensor.

Radar performance was encouraging and showed that the essential requirements could be met using our 24GHz radar technology. All processing was undertaken within the radar itself; no external signal processors or additional hardware was needed.
These trials demonstrated that the radar could be used with low bandwidth networks.

Throughout the trial period we utilised the firmware update facility of the radar to check that changes to the detection routines modified the real world performance as predicted by our theoretical understanding and simulations.
This aspect of the trial gave us great confidence that we could accurately predict the radar performance based on our simulations and confirmed to us that we had a good understanding of the nature of stopped vehicles in a live environment.

Enhancements Based on Trial Data

During the trial many gigabytes of raw radar data were recorded.
After careful analysis of the many weeks worth of data, we identified the key areas where the radar hardware design could be improved. With our new insights we re-designed the equipment to increase the detection range and improved the antenna design to further reduce false alarms. This enhanced version is better suited to Smart Motorways where the traffic density is very high and the false alarm rate needs to be low enough for automation with minimal human intervention.

Conclusion

SVD radar is a key technology to improve road safety because it is able to operate in all weather conditions with a low false-alarm rate. Our long-term trial has shown that we have a SVD radar solution with good performance and a high detection probability in a challenging environment.
Our hardware is robust and reliable, with straightforward configuration, low power consumption and simple network requirements, making it ideal for use on remote roadside areas with limited infrastructure.

Our radar will automatically detect stopped vehicles and control PTZ cameras to point at them. It can also be integrated easily with third-party equipment to send the vehicle co-ordinates, so could, for example, be used to activate electronic road signs to quickly alert other drivers to the hazard.

Please visit us online at www.ogierelectronics.com to discover more about our radar solutions and to discover why roadside SVD radar is superior to other technologies, including radars fitted to vehicles and video analytics.