Technical Report

Beyond Stopped Vehicle Detection: New Capabilities

First published: March 2024

Summary of New Capabilities

The SVR-500 radar was originally intended only to detect stopped vehicles, so was designed to filter-out fast moving vehicles to reveal the non-moving objects. We have now designed an improved radar that measures all vehicle speeds and positions with very high accuracy. This enables many new capabilities, such as detecting wrong-direction "ghost" drivers, pedestrian, animal and bicycles, speeding motorists, and for the generation of live traffic statistics for intelligent transportation systems (ITS). Our novel measurement technique results in the most cost-effective and low risk radar solution, by working alongside our existing stopped vehicle detection technique.

SVR-500 Development History and Background

A few years ago it became apparent to us that commercially available sensors for stopped vehicle detection (SVD) were inadequate to meet the UK's SVD requirements.

We decided that our field-proven Scan-360 security radar could be adapted for the SVD task. We wanted to improve safety on road networks, especially where hard shoulders were being removed for smart motorway or similar schemes. The initial development of the SVD radar was self-funded, with a simple aim to reliably detect stopped and stranded vehicles.

The resulting SVR-500 product was soon deployed for long-term testing on live highways to assess the performance and refine the detection algorithms.

Photograph of SVR-500 radar

Footage from one of the test scenarios

In 2021 we were invited to an off-road test day arranged by a European highway authority, where the SVR-500 was evaluated alongside multiple other sensor products.

The SVR-500 demonstrated by far the best performance in the various SVD test scenarios.

We are now working toward the first large scale deployment of the SVR-500 on their road network.

During 2021, we also undertook an intensive 18-day trial on the M4 motorway in England to evaluate the performance against the National Highways' SVD requirements for smart motorways in the UK. During this period there were 977 potential incidents. These were all checked manually using camera footage and compared against the SVR-500 to generate statistics for detection probability and false alarm rate.

T: +44 (0) 1727 853 521
E: enquiries@ogierelectronics.com
W: www.ogierelectronics.com

Unit 13 Sandridge Park,
Porters Wood, St Albans,
Herts, AL1 6PH, UK

OgierElectronics

The trial results showed the SVR-500 easily exceeded the SVD requirements:

	UK requirement	SVR-500 2021 trial result
Detection probability	> 80 %	96.3 %
False alarm rate	< 15 %	8.8 %
Detection time	< 20 seconds	< 20 seconds

Photograph of SVR-500 on M4 motorway

Following these trials, the processing has been revised significantly, for example: to detect and mitigate traffic congestion, to improve the reported vehicle location accuracy and to increase the detection probability still further.

After each change, the system was re-tested using computer simulations and live tests at one of our long-standing UK motorway test sites to ensure its performance was not degraded.

By the end of 2023, the SVR-500 was a proven, reliable SVD solution. However, the basic SVR-500 is only suitable for stopped vehicle detection and is not designed or optimised for other highway applications where moving vehicle speeds and direction must be measured accurately.

New developments for precise speed measurement

We have devised a novel, and we believe unique, technique to enhance the SVR-500 beyond the basic SVD measurement to allow it to measure the speed of all vehicles and pedestrians even in very dense traffic.

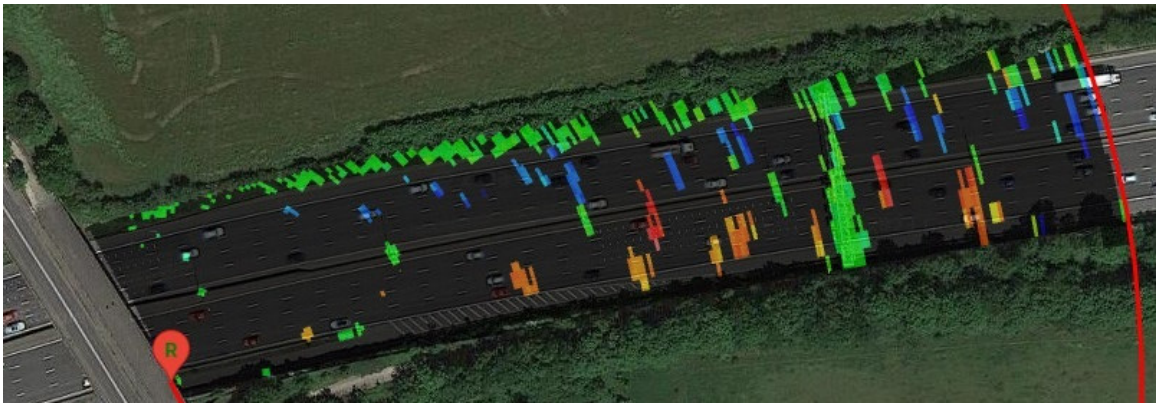
Computer simulations showed that the SVR-500 would need some additional hardware and software to be added to the transceiver to perform instantaneous speed measurements. The new technique does not require an excessive increase in processing speed and power or faster scan rates. It also does not necessitate complex vehicle tracking software using powerful computers that can result in errors and require more vulnerable high data rate communications and expensive equipment. As a result, we believe this novel approach has substantial benefits compared to all other techniques.

With our new scheme, the transmitted signal has frequency modulation applied. The radar's receiver circuitry isolates the Doppler and non-Doppler components from the signals reflected by objects within the field of view. The Doppler-shifted portion of the signal corresponds to the object's speed and direction (toward or away from the radar). Previously, speed and direction could only be measured indirectly, now the range, speed and direction are instantaneously available via direct measurement. Crucially the fundamental SVD detection technique is unaffected by the new frequency modulation so it is a genuine enhancement to a proven system, not a completely new step into the unknown.

Initial measurements and encouraging results

We created a basic prototype of the new radar transceiver and tested it outside our offices to show that the fundamental concept was sound. A few days later the special version of the radar was deployed to the M25 motorway to undertake measurements of live traffic. Analysis of this real-world data showed the system operated remarkably well, being able to distinguish easily the speed and direction-of-travel of all the objects within the field of view.

The engineering prototype measuring vehicles on the M25



The corresponding display of raw radar data from the M25

- **All stationary objects, such as the lamp posts and the gantry sign are shown in green.**
- **Objects having positive speed (toward the radar) are shown in shades of red/orange.**
- **Objects having negative speed (away from the radar) are shown in shades of blue.**

The results generally showed an excellent correlation to the actual environment, however there were some minor issues that would need to be addressed. In particular, some unwanted secondary reflections from static objects within the field of view that would require simple mitigation.

Advantages Compared To Other Radars

Unlike some other radar systems, our improved technique doesn't require processor-intensive vehicle tracking algorithms. This eliminates a significant class of risks and issues that can arise when tracks get confused or corrupted.

We avoid the need for expensive hardware and ultra-fast signal processing, which would be needed if using more conventional "brute-force" methods that are sometimes used for similar applications.

Vehicle speed is measured directly and instantaneously in a single scan. Compared to systems that derive speed from measuring position change from scan-to-scan, our method is not vulnerable to intermittent obscuration from other vehicles.

Our technique does not attempt to correlate opposite polarity Doppler shifts to determine speed, an approach that while simple, degrades rapidly as traffic density increases.

T: +44 (0) 1727 853 521
E: enquiries@ogierelectronics.com
W: www.ogierelectronics.com

Unit 13 Sandridge Park,
Porters Wood, St Albans,
Herts, AL1 6PH, UK

OgierElectronics

Potential Capabilities of Enhanced SVR-500

- **Automatic incident detection**
- **Debris detection**
- **Stopped vehicle detection (SVD)**
- **Wrong-way driver detection (“ghost drivers”)**
- **Behavioural analysis of traffic flow**
- **Queue detection**
- **Hard shoulder monitoring**
- **Wildlife detection on carriageways**
- **Detection of speeding vehicles anywhere within field of view**
- **Statistical analysis: min/max/average speed, density, traffic count, etc**
- **Detection of abnormally slow vehicles and convoys**
- **Pedestrian detection**
- **Traffic jam and congestion monitoring**
- **Road occupancy reporting**
- **Roadworks and contraflow breakdown monitoring**

Summary

By augmenting our existing signal processing with a new separate process, we don’t need to start development from scratch. We retain all the confidence in our SVD system built up over many years of testing, so existing performance isn’t sacrificed. In fact, the speed measurement technique can further reduce the SVD false alarm rate by providing additional context to aid decision-making.

Hardware and software complexity is avoided using the new technique, leading to the simplest possible way forward. This naturally gives benefits of: high reliability, compact size, low power requirements and reduced risk. Compared to other radar techniques, our innovative method provides high performance without an explosion in cost or complexity.

The SVR-500 already has a proven ability to accurately and reliably detect stopped vehicles. We have now shown that we can adapt the SVR-500 to measure the speed of objects reliably, even in heavy traffic. This provides new opportunities for applications beyond SVD without sacrificing existing performance. Furthermore, our field-proven radar technology overcomes the limitations of LIDAR and optical systems, with true all-weather operation.

The enhanced radar is currently undergoing development testing to refine the new detection algorithms. Please contact us if you have a specific requirement, as we may be able to prioritise the development of certain features to suit your application.

T: +44 (0) 1727 853 521
E: enquiries@ogierelectronics.com
W: www.ogierelectronics.com

Unit 13 Sandridge Park,
Porters Wood, St Albans,
Herts, AL1 6PH, UK

OgierElectronics