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AVEILLANT

Holographic Radar™

Target-centric surveillance

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Introduction

Holographic Radar™ technology represents the biggest change in radar technology for over 50 years. It has been designed not merely to detect a target, but to fully understand that target in real time. Based on a static, staring, phased array which can be configured to suit a range of surveillance requirements, it differs from traditional rotating surveillance radars by providing:

- An exceptionally high update rate (up to 4Hz)
- A 3D real-time tracking capability
- Intelligent characterisation and identification of target returns
- Clutter-free surveillance with an extremely high Probability of Detection and low False Alarm Rate

Based on a modular solid state array, Holographic Radar™ provides truly volumetric, continuous 3D surveillance over specified areas. It recognises what it sees and so can provide a clutter-free picture to the radar operator – it is a radar with an inherent situational awareness. It provides this capability by spending 100% 'time on target', unlike rotating radars which lose sight of the target on each rotation and then have to reacquire the target each time. This huge amount of information enables Holographic Radar™ to identify and characterise what it sees, making it ideal for a broad range of surveillance problems and at the same time reducing cost through the use of a single sensor for multiple tasks.

How it works

Holographic Radar™ uses a custom phased array which is fully configurable and forms many beams in three dimensions that allow it to observe, resolve, detect, measure and classify all targets persistently. The array of radar modules can be arranged to view sectors from 60° to 360° out to 40 nautical miles and are housed within a protective radome. 144 azimuth beams (2.5 degrees) are formed and 16 elevation beams, yielding 2,304 search beams altogether. A second tranche of precision beamforming is used for precise target positioning.

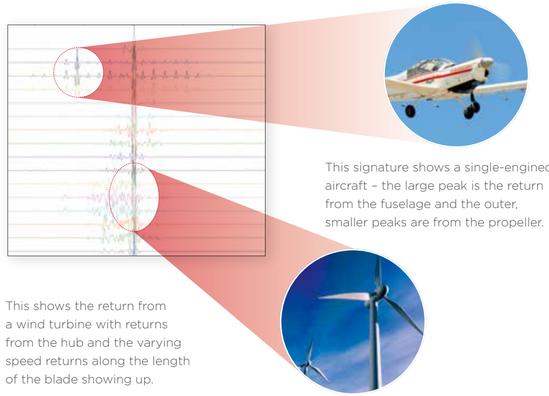
Each receiver array is provided with access to over 1 TeraFlop of processing and the total processing capacity is approximately 50 TFlops, of which the majority is used for beamforming, Doppler processing and range/Doppler filtering for the many staring beams. 24 GFlops is available for detection and track processing and this extensive parallel processing capability provide the real-time monitoring and tracking ability that is unique to Holographic Radar™.

Modular configuration

Holographic Radar™ is highly modular and can be configured as a 360° array, or a single panel monitoring specific airspace. As a deployable unit, it can be used to provide an "infill" to Primary Surveillance Radar and a number of successful installations have been made at UK Airports.

Intelligent characterisation

Holographic Radar™ uses 2,048 Doppler bins (compared with the more traditional 32 bins used by other surveillance radars) to create a target signature. It also monitors this in real time, unlimited by the restrictions of a rotating antenna. Specific target characteristics can be identified from this, enabling intelligent characterisation of each target to be carried out simultaneously.



This signature shows a single-engined aircraft – the large peak is the return from the fuselage and the outer, smaller peaks are from the propeller.

This shows the return from a wind turbine with returns from the hub and the varying speed returns along the length of the blade showing up.

Performance

Item	Value(s)
Range	Circular – 40NM; Networked - scalable
Field of view	90 - 360 degrees
Elevation	>80 degrees
Altitude	> FL 600
Minimum RCS	1 m^2
Reporting interval	0.25 to 1 sec
Probability of Detection (P(d))	>96%
Ratio of misses in long gaps	<0.5%
Position accuracy (RMS)	<300m
Ratio of target in sets of 3 errors >0.3 Nm	<0.03%
Position data	ASTERIX range and azimuth data
Minimum speed	<5 kt
Maximum speed	>600 kt
Transverse acceleration	0 to >6 m/s2
Straight line acceleration	0 to 3 g
Max. vertical rate	>25,000 ft/min
Azimuth bias	< 0.1 deg
Data latency	< 2 sec
Target resolution (overall)	< 1 Nm @ 95%
Target resolution (range)	< 150 m
Target resolution (azimuth)	< 2 deg
Target range rate	< 1 m/s
Reporting capacity (360 deg)	> 500 targets per reporting interval
Reporting capacity (45 deg)	> 250
Cone of Silence	None
False Alerts	< 1/Hour/10km^2

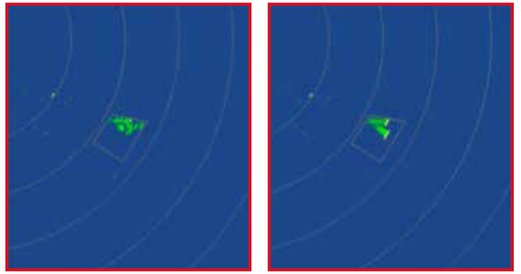
Spectrum release

Many governments now realise the value of the radio spectrum and are setting up charging mechanisms where users of spectrum are charged for the Mhz they use. The UK Government is currently in the process of releasing at least 500 MHz of public sector spectrum holdings below 5 GHz by 2020. This spectrum is most widely used for surveillance radars and so this release of spectrum will have a massive impact on the future of how surveillance radars can be operated.

Holographic Radar™ operates in L Band and so is not impacted by the reduction in availability of S Band spectrum. It is also highly spectrum-efficient, only requiring 2Mhz of spectrum to operate. It can also use the same frequency for adjacent radar installations as there is no interference between the systems – especially important for future networked radars.

Applications

Holographic Radar™ has been proven to solve the problem that wind turbines cause to Primary Surveillance Radars (PSR) used for air traffic control. It is not affected by the range, layout, quantity or size of wind turbines and can provide a clutter-free infill to existing radars or act as a clutter-free PSR in its own right. Extensive trials in both the US and the UK have produced results that show that Holographic Radar™ provides a higher probability of detection of aircraft over the wind farm than a PSR does outside the wind farm.



Actual screenshot showing a PSR display with and without the Holographic Radar™ infill. The left-hand shot shows the display that the controller would see, with the aircraft 'lost' within the turbine clutter. The right-hand shot shows the turbine removed, and a clear display of the aircraft tracks from the Holographic Radar™.

Due to its highly versatile nature and its software configurability, a single Holographic Radar™ sensor can be used to carry out multiple surveillance tasks, previously requiring multiple sensors. By identifying exactly what it is seeing and by monitoring large 3D volumetric areas, a single sensor can monitor ground movements on land, the maritime environment and the surrounding airspace simultaneously.

Holographic Radar™ represents a huge step forward for radar, adding intelligence to the radar picture at source and opening up a whole new range of capabilities through target-centric surveillance.

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