Martello: Marconi’s transportable 3D

Marconi Radar is the UK’s biggest supplier of ground-based air-defence and commercial surveillance radars, and probably the largest company in the business outside the US. Until recently the company has persevered with two-dimensional plus heightfinding radars while most of its competitors have been selling systems which can measure height, bearing and range from a single antenna. Martello, a transportable three-dimensional radar, is Marconi’s venture into the 3D market.

Marconi first showed interest in 3D about 13 years ago, when an internal market forecast concluded that three-dimensional radars would become fashionable by the late 1970s. “It may seem strange that there should be such a thing as a fashionable radar,” says Marconi development manager Nigel Ellis-Robinson, but one can trace design trends which show how some key decisions in radar procurement have set new styles. Three-dimensional radars were first put into production over two decades ago, but it has only been as techniques have improved that the market has come to regard them as the latest style.

Martello uses a new technique evolved over a long series of research programmes to obtain height information. Marconi’s experience with earlier two-dimensional radars, its S600 series in particular, has gone into a company-funded antenna which is claimed to be more resistant to electronic countermeasures (ECM) than any previous design. Ellis-Robinson believes that stopping troublesome radiation from entering the receiver is the best way to achieve good radar performance against ECM.

Good ECM resistance calls for low sidelobes—and hence as much forward-directed energy as possible—so that an enemy cannot cause the radar to respond to ECM when it is not looking directly at the jamming source. Ellis-Robinson claims that a simple horn feed and reflector antenna will invariably have large sidelobes. The horn has to be large to cover the whole reflector area—resulting in sidelobe-generating edge spillage—and the waveguides are an obstruction which degrades main beam performance, adding further sidelobes. These problems can be significantly reduced by using a planar-array antenna, in which the combined output of a large number of radiating sources produces a strong main beam with relatively small sidelobes. Marconi decided to use such an antenna, even though the production cost is usually higher than that of a simple reflector.

There were several other reasons for this choice. The flat planar-array antenna can be transported more easily than a curved reflector. It is less frequency-sensitive, so that the radar wavelength can be varied over a wider bandwidth to complicate the task of enemy jammers, and it is not “frequency-dedicated” at a given elevation angle. It is on the latter grounds that Marconi criticises several existing three-dimensional radars. In these designs the change of frequency during each radiated pulse causes returns to be frequency-coded according to elevation angle. Jamming on a particular bandwidth thus interferes with a set of elevation angles without totally disabling the radar.

Martello radiates eight vertically stacked beams. Measurement of received signal strength in each beam gives a fine measure of the elevation angle as well as its range. These values can then be converted to altitude. The concept is very well established and is used in many British air-defence radars, some as much as 25 years old. Martello scores over these designs because its phased-