I. Aim of the project

The general goal of the project is a comprehensive study of forward scatter micro radar (FS MR) and MR network for ground targets automatic detection, trajectory (position) estimation and classification. This system is intended to provide the situational awareness in the remote areas where access may be restricted or dangerous for manual installation.

- Network is supposed to detect targets such as personnel and vehicles.
- Automatic detection, trajectory (position) estimation and classification.
- Typical length of a perimeter protection - 5 km with distance between nodes 50-200 m.
- SMS IRIDIUM modem (340 byte each 15 min). Installed in all nodes.
- Head of MISL: Dr M. Gashinova, m.s.gashinova@bham.ac.uk, +44(0) 121 414 7594

II. FSR signal analysis

The output signal of the receiver $S(t)=s(v,x,y)$ is a function including velocity, trajectory angle $\phi$ and initial target position $\phi_0, x_0, y_0$.

$$s(v,x,y) = s_0 + s_{d} + s_{n}$$

Where $s_0$ is the carrier; $s_d$ is the delay time of the signal from moving target $s_n$ is the delay time of the signal from moving target $\phi$.

The input signal of the receiver is composed by the leakage signals along the baselines and scattered signal from the moving target.

$$s = A_0 \cos(\phi_0) + A_d \cos(\phi_0 + \phi) + A_n \cos(\phi_0 + \phi_d)$$

The basic formula for the detection process is:

$$P_d = \frac{1}{1 + \left(\frac{A_0^2}{A_d^2 + A_n^2}\right)^2}$$

where $P_d$ is the probability of detection, $A_0$ is the amplitude of the direct path signal, $A_d$ is the amplitude of the scattered target signal, $A_n$ is the amplitude of the direct path signal, $\phi_0$ is the initial target position and $\phi$ is the trajectory angle.

III. Signal processing

A simplified block diagram of signal processing scheme

IV. Threshold and detection

The basic CFAR process is to form an estimate of the noise and interference level in the cell where target detection is being attempted, and to set the detection threshold based on that estimate, rather than at some constant level determined in advance of operation. In our case, threshold level is estimated by averaging over adjacent reference cells.

- CFAR (Constant False Alarm Rate) adaptive threshold
- Performance of non-coherent and coherent detections
- Simplified flowchart of detection confirmation for coherent detection

For more enquiries, please contact:
Dr M. Gashinova, m.s.gashinova@bham.ac.uk, +44(0) 121 414 7594

www.eee.bham.ac.uk/misl