MULTISTATIC PASSIVE SURVEILLANCE SYSTEMS

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The importance of passive radars in today's electronic war continues to grow especially for hidden activities, prevention of own radiation, use of appropriate parts of the frequency spectrum properties and also because of providing very comprehensive and extensive information about the objects of interest under conditions of difficult revelation of the own activities [1–3].

The aim of the research is search of ways raise efficiency of a detection problems solution problems and measurement radio emission radiants spatial co-ordinates in multiple objective circumstances.

Material and methods. The basic method of research is the mathematical simulation modelling of work time different of arrival, goniometric and composite multipositional passive coherent locators at presence a considerable quantity of observation plants in a working zone. Modelling was spent in media of programming Mathcad 15 and Embarcadero® C ++ Builder® 2010.

Results and their discussion. Passive radar systems encompass two classes of radar systems [4–6]. First class of them detects and tracks objects by processing reflections from non-cooperative sources of illumination in the environment, such as commercial broadcasts and communications signals [7]. It is a specific case of bistatic radar, the latter also including the exploitation of cooperative and non-cooperative radar transmitters.

In a passive radar system, there is no dedicated transmitter. Instead, the receiver uses third-party transmitters in the environment, and measures the time difference of arrival between the signal arriving directly from the transmitter and the signal arriving via reflection from the object. This allows the bistatic range of the object to be determined. In addition to bistatic range, a passive radar will typically also measure the bistatic Doppler shift of the echo and its direction of arrival. These allow the location, heading and speed of the object to be calculated.

Second class includes electronic support measures systems. These systems use own target radiation (such as radar, communications, or transponder emissions) for spatial detect and track aircrafts. In addition, these systems do not exploit reflected energy and hence are more accurately described as ESM systems. Well known examples include the Czech TAMARA and VERA systems and the Ukrainian Kolchuga system.

A passive radar typically employs the following processing steps:

- Reception of the direct signal from the transmitter(s) and from the surveillance region on dedicated low-noise, linear, digital receivers;

- Digital beamforming to determine the direction of arrival of signals and spatial rejection of strong in-band interference;
- Adaptive filtering to cancel any unwanted direct signal returns in the surveillance channel(s);
- Transmitter-specific signal conditioning;
- Cross-correlation of the reference channel with the surveillance channels to determine object bistatic range and Doppler;
- Detection using constant false alarm rate (CFAR) scheme;
- Association and tracking of object returns in range/Doppler space, known as “line tracking”;
- Association and fusion of line tracks from each transmitter to form the final estimate of an objects location, heading and speed.

Passive radar performance is comparable to conventional short and medium range radar systems. Detection range can be determined using the standard radar equation, but ensuring proper account of the processing gain and external noise limitations is taken. Furthermore, unlike conventional radar, detection range is also a function of the deployment geometry, as the distance of the receiver from the transmitter determines the level of external noise against which the targets must be detected. However, as a rule of thumb it is reasonable to expect a passive radar using FM radio stations to achieve detection ranges of up to 150 km, for high-power analogue TV and US HDTV stations to achieve detection ranges of over 300 km and for lower power digital signals (such as cell phone and DAB or DVB-T) to achieve detection ranges of a few tens of kilometers.

Passive radar accuracy is a strong function of the deployment geometry and the number of receivers and transmitters being used. Systems using only one transmitter and one receiver will tend to be much less accurate than conventional surveillance radars, whilst multistatic systems are capable of achieving somewhat greater accuracies.

When multiple transmitters are used, a target can be potentially detected by every transmitter. The return from this target will appear at a different bistatic range and Doppler shift with each transmitter and so it is necessary to determine which target returns from one transmitter correspond with those on the other transmitters. Having associated these returns, the point at which the bistatic range ellipses from each transmitter intersect is the location of the target. The target can be located much more accurately in this way, than by relying on the intersection of the (inaccurate) bearing measurement with a single range ellipse. Again the optimum approach is to combine the measurements from each transmitter using a non-linear filter, such as the extended or unscented Kalman filter.

Conclusion. Faced with the prospect of aerial stealth proliferation, contemporary military science is looking for antistealth defense options. Passive radar is a receive-only system that uses transmitters of opportunity and own target radiation for those tracking. Integrating a system of netted receivers, passive radar can detect, track, and target piloted and unpiloted stealth systems and provide cuing for antiair weapons systems. A passive radar system emits no radio energy and can be well camouflaged in both urban and rural landscapes. The threat system produces no indications on friendly radar warning receivers and is difficult to locate and target. Faced with a passive radar threat, the airpower may find itself unable to achieve air superiority at an acceptable cost. Ongoing advances in passive radar will deny traditional means to defeat enemy air defenses, make air superiority difficult to achieve against a passive radar opponent, and require changes in thinking to maintain air offensive power projection capability. Ongoing surge in passive radar relates to advances in signal processing and sensor fusion. The overwhelming offensive power of the airplane will largely be mitigated by the deployment of radar and modern air defenses. Airpower will not prove an all-powerful offensive weapon that could not be countered, and the bomber will not always get through.

Stealth is the centerpiece of the modern USA's and NATO's military aircraft industry and air superiority strategy. But stealth technology does not make an aircraft invisible. The tactical advantage accrued by being able to detect, close, and attack from a covert stance completely dominates all other factors in any encounter algorithm. In Serbia in 1999, a SAM battery commander attacked from a covert stance and won the tactical advantage over F–117 "stealth fighter" (more known as "Nighthawk"). It was a missile shot heard around the stealth world.

Development of Multistatic Passive Surveillance Systems is the end of the Stealth superiority era.

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