Passive Radar Systems for Detecting Airplanes

Introduction

Conventional radars transmit electromagnetic waves and decipher information about objects by computing the reflected signal. Passive radar technology on the other hand uses the reflected FM radio, television and cell phone signals that are already present in the atmosphere.[1] Thus this system only requires a receiver and no transmitter. It has extensive potential in different industries (military, air traffic control etc) to detect parameters such as distance, height, shape and velocity of objects, namely, aircrafts, motor vehicles and ships. This paper gives a brief overview on the commercial applications, the underlying work and the building blocks for implementing the passive radar technology to detect airplanes within a 150 – 250 mile radius. [2]

Commercial Applications of Passive Radar

Radar is used globally to detect range, speed, and altitude of airplanes in the region. They maybe used by the military to track down enemy planes or by local commercial airports to conduct safe take offs and landings. The use of conventional radars still prevails which uses a transmitter as well as a receiver as compared to passive radar that only has a receiver and uses other transmitters in the territory such as those of FM channels and TV broadcasters. Passive radar technology relies a lot more on the software which is used for signal processing rather than hardware (antennas). This proves to be a lot cheaper as well. Transmitters for commercial use are high in elevation with respect to the ground and hence are subject to a lot of deliberate interferences from other electromagnetic signals in the atmosphere. A passive radar system on the other hand is concealed, which makes it attractive for military purposes. It is also able to detect targets in higher altitudes. [3] Lockheed Martin’s Silent Sentry, have already developed mutistatic radars to detect and track aircraft. [2]

Another use of passive radars that was proposed by Peter B. Davenport, Director, National UFO Reporting Center (Seattle, Washington) was using the passive radar
system for the remote, real-time detection of UFO’s in proximity to the Earth at heights of up to 28,000 km from the Earths surface. [6]

**Underlying Technology Work**

Since in passive radar systems there is no assigned transmitter, the receiver uses transmitters of radio channels (100MHz), TV band (50MHz) and sometimes even cell phone band (1GHz). Passive radar has no frequency allocation and thus can use frequencies over a wide range for acquiring accurate data. [2] The receiver measures the difference in the time of arrival of the signal arriving straight from the respective transmitter and the signal arriving via the reflection of the object, which is under consideration. Multiple secondary transmitters may also be used at the same time to get a more accurate reading of the range, direction etc. By measuring the Doppler shift of the echo (from the object), the velocity of the object can also be determined. Considering that the frequencies being dealt with are fairly low (55-885 MHz), amplifiers are needed to enhance the signal before processing it with the software. Due to this reason, the target must be tracked over a longer period of time so that the reflected signals (from the target) are detected over a range of angles. To increase detection accuracy of the passive radar systems and gain the confidence of the information that is sent to the PC, an interdependent structure is setup. Through this structure, all the passive radars broadcast signals to other passive radars when a target is detected. By using the broadcasted signals, the other passive radars can adapt receiver parameters such as amplitude and wavelength in order to perform more precise pin pointing of the target [4].

**Implementing Passive Radar Technology**

Detecting airplanes using passive radar requires the use of intricate software and various front end equipment. A combination of different antennas is used in order to pick up the direct signal from the secondary transmitters as well as the reflected signal from the object. Microwave lightening antennas are also used to protect the system from lightening. They have built in filters which select only the desired band of frequencies to pass through to the software. Before this happens, a set of A/D converters and amplifiers are used to digitally encode the signal and enhance the signal. As compared to
conventional radar, passive radar uses Digital Signal Processing (DSP) techniques along with Moore’s law to interpret the data after which the data can be analyzed in real time using MATLAB. [5]

Citation