SIGNAL PROCESSING FOR PASSIVE BISTATIC RADAR SYSTEMS USING FM AND DVB-T SIGNALS

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Abstract: The interest for bi- and multistatic radar systems has gone in cycles of approximately 15 years. Currently we are at the peak of such a cycle, which mainly is driven by the interest for Passive Bistatic Radar systems. This dissertation firstly describes the basis of passive bistatic radar (PBR) systems, in which broadcast, communications or radionavigation signals are used as the illumination sources for bistatic radar. The nature of a range of such signals (including FM radar, analogue TV, digital radio and TV, and cellphone transmissions) is described, characterising their performance by means of the ambiguity function. It is shown that for analogue modulation formats the ambiguity performance depends strongly on the instantaneous modulation. For digital modulation formats the ambiguity performance is much more constant with time, and does not depend on the programme content. It is shown how the detection performance of PBR systems can be predicted. Finally, some examples are presented of various experimental PBR systems, indicating the achieved performance in each case. The signal processing described in this dissertation was built on a low budget and is one of the simplest architectures that can be used to explore this technology. A block diagram of the processing algorithm is shown in Fig. 4.1. The signal is collected by a digital receiver system comprising of at least three channels. This allows for one reference channel and two surveillance channels for direction finding. An adaptive filter is applied to the two surveillance channels to reject the unwanted transmitter signal and then the digital data from the three channels are fed to the Ambiguity processing that outputs two amplitude–range–Doppler (ARD) surfaces by studying Ambiguity function. A conventional constant false alarm rate (CFAR) detection scheme is then applied to each ARD surface to determine the range and Doppler of each target The complex amplitude of a target's echo received by each surveillance channel is then fed to the direction finding processor.With only two surveillance channels the direction finding system uses phase-interferometry to estimate the target DOA At this stage in the processing the system has determined the range, bearing and Doppler of a number of targets for target tracking work. We have also studied actual FM and DVB-T transmitters located in Hanoi to evaluate the ability of deploying Passive Bistatic Radar Systems in Hanoi.

Keywords: Passive Bistatic Radar, Radar Ambiguity Function, FM and DVB-T Signals