Multistatic, MIMO and Networked Radar: the Future of Radar Sensors?

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***Abstract*— A review is presented of work on multistatic, MIMO and networked radar, explaining the current high degree of interest in these subjects. The enhancement of target signatures in the forward scatter geometry is explained, and some of the principles of Passive Bistatic Radar. The challenge here is to identify applications which offer a clear advantage over conventional radar approaches. Finally, some newer, longer term ideas on networked radar as an intelligent, adaptive distributed sensor system are presented and discussed.**

***Keywords*—Bistatic radar, multistatic radar, MIMO radar, Passive Bistatic Radar**

I. INTRODUCTION

Bistatic, multistatic and MIMO radars are presently the subject of a great deal of interest and work. The subject actually has a long history, and numerous experimental systems have been built and evaluated, though there have been rather few operational systems. One of the first bistatic systems was the German WW2 *Klein Heidelberg* which 'hitchhiked' off the British Chain Home radars [1]. This achieved remarkable results, but was too late to have any significant effect on the outcome of WW2. Since then, interest has varied cyclically, with a period of about 15 years. We are presently in the 'third resurgence' and there are now good reasons to believe that the interest will continue and grow [2], [3].

Some of the reasons for the present interest are:

- bistatic radar has potential advantages in detection of targets which are shaped to scatter energy in directions away from the monostatic;
- the receiver is covert and therefore safer in many situations;
- countermeasures are difficult to deploy against bistatic radar;
- increasing use of systems based on unmanned air vehicles (UAVs) makes bistatic systems attractive;
- many of the synchronisation and geolocation problems that were previously very difficult are now readily soluble using GPS, and
- the extra degrees of freedom may make it easier to extract information from bistatic clutter for remote sensing applications.

Fig. 1 shows an attempt to classify bistatic and multistatic radar systems according to their properties. Bistatic radars may be defined as those in which the transmitter and receiver are at separate locations, sufficiently separated that the properties are significantly different to those of a monostatic radar. Radars which use separate but co-sited transmit and receive antennas (*quasi-bistatic* radars) are classified with monostatic radars. Bistatic and multistatic radars are classified into those which use cooperative transmitters under control of the user, and those which use non-cooperative transmitters. These are further divided into those for which the transmitter is a radar, in which case the system may be known as a *hitchhiker*, and those for which the transmitter is a broadcast, communications or radionavigation signal, in which case the system is called a Passive Bistatic Radar (PBR).

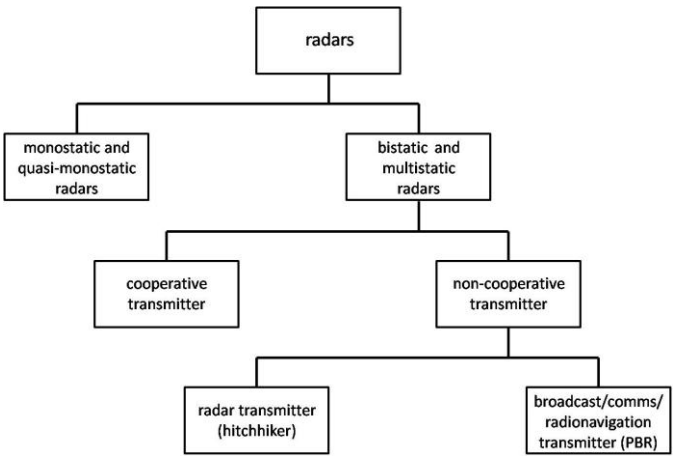

Fig. 1 Taxonomy of bistatic and multistatic radars.

MIMO is a relatively new, fast-changing, and perhaps even controversial subject (as may be seen by the titles of some of the publications on the subject [4]–[6]), and whose origins lie in the communications domain. In the radar domain MIMO should not be regarded as a separate subject, but rather as part of a continuum of different types of multistatic, networked sensing. Almost all work to date has been theoretical or based on simulations. This is perhaps similar to the evolution of work on STAP, in which it was only after several years of theoretical and simulation work that algorithms were evaluated in real environments with real data [7], [8].