Saturday the 19th of October

Topic 1: Introduction to Radar Systems

Hugh Griffith, University College London, UK

This presentation provides an introduction to many of the concepts that are important in understanding radar systems - both to introduce the topics and terminology that will be covered in the rest of the Autumn School, and in the conference itself. The style is deliberately pictorial rather than deeply mathematical.

Topic 2: Estimation/Detection

Jean-Philippe Ovarlez, ONERA/DEMR & CentraleSupélec/SONDRA, France

Topic 3 : Tracking

David Bourgeois et Olivier Rabaste, ONERA, France

In this short course, we present an overview of the main problems encountered in radar tracking and of the respective methods existing in the literature to solve them. The problems considered here range from the target state parameter estimation, to the false alarms and missed detections issues, considering also the problems created by the presence of multiple targets and/or maneuvering targets, and the need for track initiation and termination algorithms. The basic building blocks of all the considered solutions is the well-known Kalman Filter and its extensions. The solution presented in this course to solve the multiple measurements problem corresponds to the PDAF (Probabilistic Data Association Filter), and we will deal with track initiation and termination via a "P over Q" algorithm. An example of tracking result on real data is provided at the end of the presentation.

Sunday the 20th of October

Topic 1 : Introduction to Radar Cross Section

Genevieve Maze-Merceur, CEA, France

This presentation is an introduction to Radar Cross-Section (RCS). This physical quantity represents the signal scattered by an object when illuminated by a wave in the microwave range. An object is said to be stealthy when it diffracts a signal at such a low level that it cannot be detected by radar.

Some keys to designing a stealth object will be presented, and concrete examples will be given.

The use of signal processing will show how RCS can be interpreted.

The specifics and requirements of numerical modeling and measurements of a stealth object will be presented. The need for massively parallel computing architectures will be justified. Finally, the importance of controlling calculation and measurement uncertainties, and using them to validate the design of an object, will be emphasized.

In particular, measurement techniques will be detailed, through the illustration of the different steps leading to the calibrated RCS of particular objects.

Topic 2 Passive radar

Fabiola Colone, DIET Dept., Sapienza University of Rome, Italy

By exploiting illuminators of opportunity typically selected among the available radio transmitters for broadcast services or networking, passive radar offers a number of advantages over conventional active radar systems, among which low environmental impact and covert operation. Passive radar has rapidly reached a point of maturity in many surveillance applications, with much of the research rooted in air traffic control systems. However, in the last years, many advanced solutions and emerging applications have been also proposed; both are aiming to increase the reliability of systems, to improve their potentialities, and hence widen the range of uses.

This talk focuses on the basic concepts of passive radar and is intended for beginners and those eager to expand their knowledge. Specifically, the talk starts from the principles of operation passive radar by discussing the possible illuminators of opportunity, the impact of the bi/multi-static geometry, as well as the passive radar equation. A typical signal processing scheme is introduced and effective solutions are illustrated for the signal processing techniques to be implemented at each stage, there including clutter filtering, cross-ambiguity function calculation, target detection, direction of arrival (DoA) estimation, bistatic/Cartesian tracking. In addition to the theoretical aspects, the talk provides examples from real-world implementations of passive radar. Walking through these results gives the chance to describe in more detail some technical aspects related to system design issues and signal processing techniques as well as to understand the current limitations and future perspectives of passive radar sensing.

Topic 3: Electronic warfare

David Brown, Southwest Research Institute, USA

Electronic Warfare (EW) is an umbrella term used to describe a group of technologies and systems designed to preserve the friendly use of the electromagnetic spectrum while denying its use to unfriendly agents. Though EW includes many RF signal types, this presentation will focus on EW relative to radar operation. A brief historical development of the modern EW field will be presented to provide context. Concepts of radar signal detection, identification, and surveillance will be discussed along with approaches to deny proper operation of adversary radar systems. Finally, examples of advanced research in EW, including advanced receiver design and the application of artificial intelligence algorithms, will be presented.