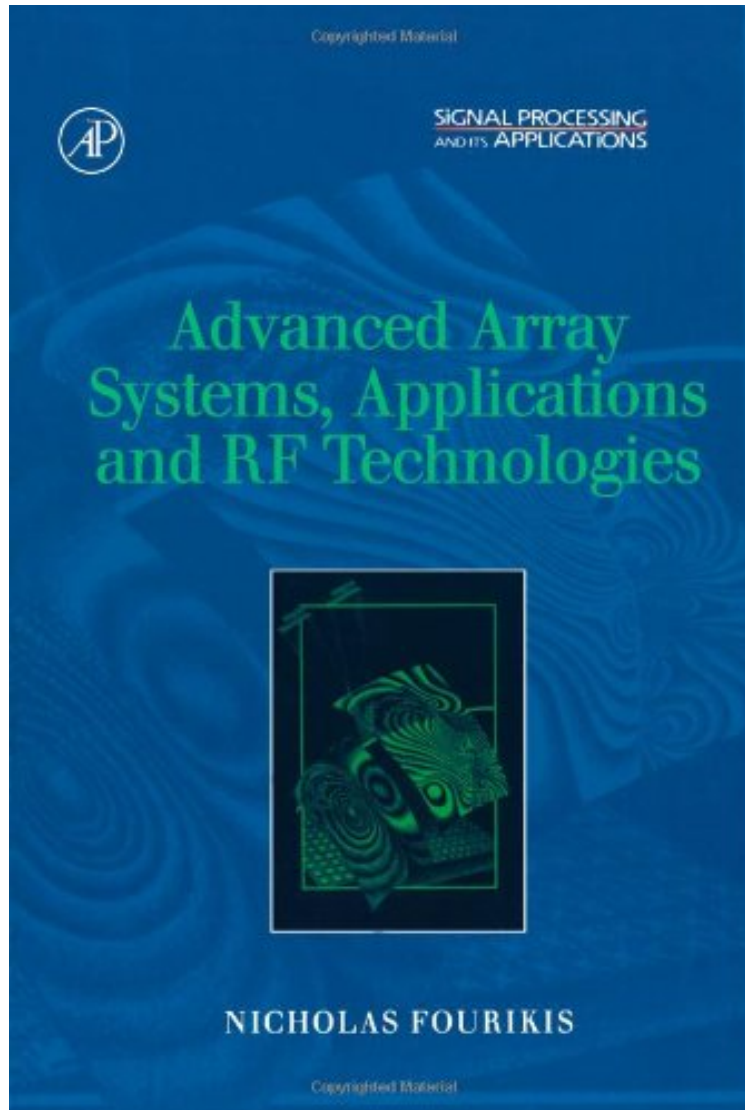


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Advanced Array Systems, Applications and RF Technologies adopts a holistic view of arrays used in radar, electronic warfare, communications, remote sensing and radioastronomy. Radio frequency (RF) and intermediate frequency (IF) signal processing is assuming a fundamental importance, owing to its increasing ability to multiply a system's capabilities in a cost-effective manner. This book comprehensively covers the important front-end RF subsystems of active phased arrays, so offering array designers new and exciting opportunities in signal processing. Provides an up to date record of existing systems from different applications Explores array systems under development Bridges the gap between textbook coverage of idealized phased arrays and practical knowledge of working phased arrays Recognises the significance of cost to the realization of phased arrays Discusses future advances in the field that promise to deliver even more affordable arrays ['intelligent' or self-focussing/-cohering arrays]

From the Back Cover Advanced Array Systems, Applications and RF Technologies adopts a holistic view of arrays used in radar, electronic warfare, communications, remote sensing and radioastronomy. Radio frequency [RF] and intermediate frequency [IF] signal processing is assuming a fundamental importance, owing to its increasing ability to multiply a system's capabilities in a cost-effective manner. This book comprehensively covers the important front-end RF subsystems of active phased arrays, so offering array designers new and exciting opportunities in signal processing. This book: * provides an up to date record of existing systems from different applications * explores array systems under development * bridges the gap between textbook coverage of idealized phased arrays and practical knowledge of working phased arrays * recognises the significance of cost to the realization of phased arrays * discusses future advances in the field that promise to deliver even more affordable arrays ['intelligent' or self-focussing/-cohering arrays] Engineers and scientists in the radar and RF technology industry will welcome the detailed description of array elements, polarisers, T/R modules and beamformers in Advanced Array Systems, Applications and RF Technologies. This book is also appropriate for postgraduate and advanced undergraduate students in electronic engineering, and for technical managers, researchers and students in the fields of radioastronomy and remote sensing. This book is a volume in the Signal Processing and its Applications series, edited by Richard Green and Truong Nguyen. Excerpt. Reprinted by permission. All rights reserved. Chapter 1: Systems and Applications In this book we have adopted a holistic view of array systems that perform the radar, electronic warfare (EW), radiometric, and communications functions. As all array systems share the same theory, this fundamental premise seems eminently reasonable. At a real-world level, it is well known that robust radar systems cannot be realized without knowledge of EW systems that can disable them. Additionally, the survival of a modern high-value platform, such as a ship or aircraft, depends on its radar, EW, and communication systems. Similarly, the efficient management of a busy airport depends on radar and communication systems that monitor meteorological phenomena and manage the traffic on its tarmac and within its airspace. Lastly, a systems designer familiar with these diverse systems can respond to the challenges imposed by the recent trend toward the integration of systems that derive interrelated and interdependent information. While there are many similarities between array systems used by different communities of researchers, the differences between them are also considered and emphasized. It is hoped that our approach enriches and deepens the reader's understanding of array systems and allows a designer imbued in one discipline to utilize the techniques and approaches developed by another discipline. The communications community pioneered the use of phased arrays to improve the communication links between the United States and the United Kingdom for the first time in the late 1930s [1]. Next the radar and radioastronomy communities adopted array systems and we can now state without any reservations that: . * Arrays have redefined radar functions [2]. * Radioastronomy became a respectable branch of science only after it adopted array based radiotelescopes. * Phased arrays continue to provide the impetus for new and significant developments in other sciences. In our coverage of systems we include: Defense radars such as the PAVE PAWS/COBRA DANE, over-the-horizon radars (OTHRs) and airborne early warning (AEW) systems. * Affordable target identification systems. * Flying phased arrays, better known as synthetic aperture radars (SARs) and interferometric SARs. * Bistatic/multistatic radars and low probability of intercept (LPI) radars. * EW and polarimetric systems. * First-generation radioastronomy array systems, radiometric systems, and proposals for second-generation radioastronomy arrays. * Proposals for distributed array radars (DARs), and pseudo-satellites that can provide communication/surveillance functions over an area of 1000 km in diameter on the Earth's surface and are powered by ground-based array systems. * Proposals for wideband, truly multifunction arrays that can perform: (i) the radar/radar-related and other functions essential for the survival of high-value platforms; or (ii) the functions essential for the efficient management of busy airports. Some of the branches of science that benefit from the products of the above systems include: topography, hydrology, ecology, tectonics/erosion, meteorology, oceanography climatology and radioastronomy/planetary radar astronomy. Additionally, the products of some of the systems considered contribute to environmental monitoring, the management of Earth resources, earthquake studies, and global volcano monitoring.

Can we delineate a typical or notional phased array? What are the defining characteristics of arrays? What makes phased arrays so versatile? What are the radar/EW, communication functions and radioastronomy aims? For a book dedicated to phased arrays, the answers to these questions constitute an appropriate starting point. Throughout this chapter, the drivers for future phased array systems are clearly identified and a strong case is made for the evolution of novel systems that meet the challenges of our era.

1.1. Phased Arrays and What They Offer

The collecting area of a conventional filled aperture is a continuous surface, usually a paraboloid, whereas the collecting area of a typical array is made up of several antenna elements that take many forms. If we assume a receive mode of operation and divide the surface of the paraboloid into many contiguous segments, the powers received by all the segments are added constructively at the focus of the paraboloid. Similarly, the powers received by the many array antenna elements are added constructively at a convenient summing point. A corresponding arrangement holds if we assume a transmit mode of operation, and the spatial resolution attained for both systems is governed by diffraction. While the antenna segments of a filled reflector are contiguous, the antenna elements of the array are separated by a distance that can range from a few millimeters to thousands of kilometers. All antenna elements, however, are 'electrically' connected and the received signals are suitably phased before they are combined coherently. Despite the similarities between the two types of apertures, there are fundamental differences between them. Let us assume that the gain, G , of the filled aperture of diameter d is taken as a reference.