Handbook of Research on

Advanced Trends in Microwave and Communication Engineering

Ahmed El Oualkadi and Jamal Zbitou

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some narrowband systems also operate in this frequency like WiMAX, WLAN and X-Band satellite downlink communication band etc. cause interference in UWB range. To overcome any interference with these systems it is desirable to design UWB antenna with band notches. However, most techniques of obtaining notches uses antenna design specific approaches therefore EBG structures can be used to obtain single and multi-notch antennas. The technique used for obtaining notches using EBG is antenna design independent and can be applied to most of the antennas without compromising antenna performance.

Chapter 3

In this chapter, a compact dual band notched Ultrawideband (UWB) antenna with fractal shaped Hilbert curve slots (HCS) is presented. The antenna covers the frequency band from 2.5 GHz to 12 GHz for VSWR$\leq$2 and also shows stable radiation patterns throughout the operating frequency band. By introducing Hilbert Curve fractal Slots (HCS) in the antenna, band notch characteristics have been achieved. The HCS renders the capability to reject 5.15-5.825 GHz band assigned for IEEE 802.11a and HYPERLAN/2 and also 7.9-8.4 GHz band assigned for X-Band uplink satellite communication systems where the gain is suppressed very well in the desired WLAN and X-Band. The antenna gain varies from 3dBi to 5dBi over the operating band. Novelty of this design lies in achieving miniature notch structure which has higher degree of freedom for adjusting notch parameters and unsusceptible to coupling with other notches. The antenna can be used for various mobile communication services such as DCS, IMT-2000, UMTS, DMB and UWB.

Chapter 4

A new technique is presented to determine the complex relative permittivity of each layer of a bi-layer dielectric material. The bi-layer material sample is loaded in a Ku-band rectangular waveguide and its two port S-parameters are measured as a function of frequency using a Network Analyzer. Also, by applying the mode matching technique, expressions for the S-parameters of the bi-layer dielectric material as a function of complex relative permittivity of each layer are developed. To estimate the complex permittivity of each layer for a bi-layer dielectric material, the square sums of errors between the measured and calculated S-parameters are minimized using a nonlinear optimization algorithm. The complex permittivity of each layer for a bi-layer dielectric material such as FR4-Teflon, FR4-Delrin and Delrin-Teflon are determined at the Ku-band frequencies, the average relative errors between the individual dielectric materials and those of each layer of bi-layer dielectric materials are calculated.

The localization of EM sources has become an interesting object of study in the past several decades. An important aspect is to reduce the search time and the maintenance of acceptable receiving levels between transmitters and receivers. The strong signal attenuation introduced by the transmission through walls plays a determinant role, as well as a suitable probing technique able to furnish good resolution. This chapter introduces a new probing technique based on artificial neural networks (ANNs) to detect and localize an ultra-wide band (UWB) pulsed EM source placed behind a wall. The main purpose is to study the performance of this technique in order to obtain a good compromise between two principal goals: accuracy on the reconstruction of the source position as high as possible and a probe dimension as small as possible. The use of ANNs for the resolution of the inverse scattering problem provides several advantages, such as short computation times, low computational burden, and the opportunity to reformulate the problem by considering only a few unknowns of interest.

Section 2
MMIC, RF Circuits, and Devices for Wireless Communication

In this chapter, three planar diplexers based on microstrip resonators are presented. An overview on diplexers is introduced. Then, two designed and fabricated microstrip diplexers with compact size and good performances are exposed. The first diplexer is designed using open loop resonators while the second circuit is achieved based on triangular loop resonators. The third structure represents a compact diplexer designed by using a pair of H-shaped resonators coupled with a coupling patch and two Input/Output (I/O) feed lines. The incorporated slots in the ground plane of the proposed circuit allow the control of the resonant frequencies and enhance its electrical performances. Furthermore, the introduction of these slots represents an interesting solution to miniaturize the microwave filter and diplexer. An analytic method is applied to extract the equivalent LC model of the band pass filters and diplexer. A full wave electromagnetic Analysis is achieved to evaluate the electrical performances of the proposed diplexers by using ADS and CST-MWS.

low power challenges. To address these challenges, in literature there are many LNA architectures such as simple cascode topology, Current reuse topology etc. The major advantage of current reuse topology is its load transistor shares the same bias current of driver which results in reduced power dissipation by maintaining the maximum gain. The main objective of this chapter is to address gain, power dissipation and linearization challenges by reviewing the different current reuse architectures and linearization techniques used to implement 60GHz LNA.

Chapter 10

This chapter focuses on the concept of transmitting power without using wires that is also known as Wireless Power Transmission (WPT). This chapter attempts to present the most important and relevant works in this field of research in order to develop a topical 'overview', present the current results, and also share some contributions and 'vision' for the future. The technological developments in Wireless Power Transmission is also presented and discussed. The advantages, disadvantages, biological impacts and the most potential applications of WPT are also presented. This chapter presents also new and efficient designs of a rectifying antenna (rectenna) involved to be used at low and high input power levels constraints at microwave frequencies of ISM band in particular at 2.45 GHz and 5.8 GHz. The rectennas have been developed were based on microstrip technology incorporating a new class of phased antenna arrays with circular polarization associated with a new RF-to-DC rectifiers.

Section 3
Wireless Communication Systems, Wireless Sensors, and Vehicular Ad Hoc Networks

Chapter 11

In cellular wireless communication systems, the current and future networks are promising to provide multimedia services at the cell edges and beyond the cell boundaries efficiently and cost effectively. The relay assisted MIMO networks have got much attraction to meet the requirements by providing high capacity, link reliability and high quality of service. The performance of the relay assisted networks is maximized by making the use of beamforming design at the relay nodes. This chapter describes the recent developments in relay beamforming design for Amplify-and-Forward (AF) relay networks and introduces a new beamforming scheme to improve the network performance in terms of ergodic capacity. The chapter contributes in introduction to basic MIMO channel, various relaying strategies and introduction to relay assisted network topologies. It is followed by critical literature review on AF beamforming techniques. This leads towards the novel and efficient relay beamforming design, its performance evaluation and validity by comparing with various available beamforming techniques.

Sybil attackers are either created by it or uses someone else's identity. This attack can decrease the trust of any legitimate node by using identity of that node and accumulate the secret or important data. Sybil attackers distribute secret data in other networks and it reduces the secrecy of network. This research work implements Enhanced lightweight Sybil attack detection technique that is used to detect Sybil attack in MATLAB. The concern is to improve the security of the network by removing the Sybil nodes from the network. The work has been carried out using four parameters namely - Speed, Energy, frequency and latency. During the research work, experiments were carried out to observe the trend of SNR with BER; Throughput with SNR and Throughput with BER.

Chapter 15

Like the other emerging technologies such as computer evolution and embedded machines, the Vehicular Ad Hoc Networks (VANETs) have also gained much attention from various manufactures and academia. Moreover, we have several on board sensors installed inside the vehicles, responsible for sensing different activities within the vehicle and surrounding such as temperature, intruder detection and so on. Recently, those sensors/actuator systems became responsive to the physical world by enabling real time control emanating from conventional embedded systems, thus emerging a new research paradigm named Cyber-Physical System (CPS). Likewise, other applications for CPS, we have Vehicular Cyber-Physical System (VCPS) that is not a new concept. For now, VCPS may refer to a wide range of transportation management system that is integrated strongly and should be highly accurate, real-time, and efficient. This chapter provides readers with the details of the term "VCPS" followed by the historical overview of this new emerging field including research challenges and future aspects of the VCPS.

Chapter 16

This chapter presents software and hardware solutions for interconnecting an existing VHF amateur packet radio infrastructure with 'Winlink 2000' radio email network. Having in mind that a number of households, schools, and offices are equipped with Internet connections, and that many radio amateurs at such locations are active on their VHF (or UHF) digital networks on a daily basis, the connectivity between the two systems will increase the chances for citizens who suffer after disasters such as earthquakes, heavy rains and floods, followed by malfunction in commercial communicating services – to remain electronically wired with the rest of world by email. The chapter provides a tutorial on constructing, installing, and testing a simple packet radio repeater station, additionally equipped with computer programs with 'Winlink 2000' compatibility.

Section 4
Radar, Signal and Image Processing, and Power Electronics

In this chapter, Inverse Synthetic Aperture Radar, a special type of active microwave synthetic aperture radar is introduced and its applications in military surveillance are presented. Then, the basic principles involved in data acquisition and image generation are explained. The issues and challenges involved in processing the ISAR images for autonomous target detection and identification are discussed later. The proposed classification method is explained and its accuracy is evaluated experimentally against the conventional classification method in the rest of the chapter.

Over the last few decades, optical fiber has become the transmission medium of choice because it provides efficient high data rate transmission at low Bit Error Rate. The optical fiber has a potential capacity of terabits-per-second. Modern commercial transport systems are capable of operating at 10 Gb/s with experimental system clocking 40 Gb/s and 100 Gb/s performance. The present transport networks cannot sustain such a high data rate of terabits-per-second. The fiber dispersion, fiber nonlinearities and electronic switching used in present transport networks, are the main limiting factors. A new generation of optical networks known as 'All-Optical-Networks (AONs)' overcomes this limitation by switching data entirely optically using Optical Switches. However AONs are prone to phenomena known as 'node crosstalk'. This chapter discusses the propagation of light in optical fibers, linear as well as nonlinear impairments and the effects of dispersion & fiber nonlinearities on the system performance of crosstalk limited AONs.

Among the objectives of artificial intelligence techniques, we find computer-aided diagnosis systems that support preventive medical check-ups and perform detection, recognition, and classification patterns. Recently these techniques are emerged in different areas particularly in medical imaging. Medical image is an important source of information, and a golden tool for the diagnosis and assessment of a pathological analysis process. In this chapter Computer-Aided Diagnosis (CAD) system is proposed in detection and diagnosis of breast cancer, it is mainly composed of the following steps: preprocessing mammographic image, segmentation of suspect region on the mammographic image using Chan Vese model, extraction of global and local descriptors and then image classification into malignant and benign mammograms using Support Vector Machine (SVM) classifier. The analysis of mammographic images proposed system with a choice of the subset of local descriptors after tumor segmentation leads to a classification of malignant and benign mammograms. System proposed achieves 92% for accuracy.

For Photovoltaic systems designers and manufacturers, it is very important to develop suitable models to closely emulate the characteristics of PV cells, predict their behavior and evaluate their efficiency. So the main contribution of this chapter is to propose an improved and accurate method for identifying and determining the equivalent circuit elements values of photovoltaic module using only exact analytical equations and four manufacture's data reference, i.e., the open-circuit voltage (VOC), the short-circuit current (ISC), the current and the voltage at the maximum power point (IM, VM). In order to extract the five-parameter Single or Double-Diode models of photovoltaic module, the authors try initially to determine analytically all parameters according to RS (the value of the series resistance). Thus, all these parameters are calculated once RS is determined. Rapid and iterative algorithm is then designed to solve a strongly nonlinear equation in order to extract the value of RS in a precise manner and without any mathematical simplification used usually by many other authors.

Preface

The wireless communication market is undergoing a major expansion with the deployment of new technologies and standards opening the prospect of significant impacts in many application areas. In this context, the growing demand of wireless and mobile application products needs highly integrated and low cost devices with more accuracy and best performance for modern transceivers. Moreover, innovative solutions are required to reduce the degree of complexity and difficulty in the design of wireless communication devices and systems.

The objective of this handbook is to showcase current R&D trends and novel approaches in design, analysis of broadband, multiband, and reconfigurable microwave devices and antennas for wireless and UWB applications, as well as to the advanced trends on emerging wireless communication technologies. This handbook will provide theoretical and experimental approach to some extent which is more useful to the reader and highlights unique design issues to help the reader to be able to understand more advanced research.

This handbook is divided into four sections:

1. Antennas, Electromagnetic Theory, and Applications
2. MMIC, RF Circuits, and Devices for Wireless Communication
3. Wireless Communication Systems, Wireless Sensors, and Vehicular Ad Hoc Networks
4. Radar, Signal and Image Processing, and Power Electronics

Section 1 (Chapters 1 to 5) exposes new techniques in antennas design, propagation and electromagnetic theory and applications. It contains five chapters dealing with topics such as design of new microstrip multiband fractal antennas, developments in efficient antenna designs using EBG structures, design of an UWB printed monopole antenna with Hilbert curve fractal shaped slots for multiple band rejection functionality, new technique to determine the complex permittivity of each layer for a bi-layer dielectric material at microwave frequency, and the assessment and optimization of EM-source localization in indoor environments by using an artificial neural network.

Section 2 (Chapters 6 to 10) presents design techniques of MMIC, RF circuits and devices for wireless communication. This section comprises five chapters which explore the design of new structures of planar diplexers using microstrip resonators, the associated techniques used for the achievement of planar filters, the design of microwave power protectors: attenuators and limiters, the review on 60GHz low noise amplifier design for low power and linearity, and the advances in wireless power transmission technology for autonomous systems.