

Advanced Trends in Microwave and Communication Engineering



Ahmed El Oualkadi and Jamal Zbitou

Handbook of Research on Advanced Trends in Microwave and Communication Engineering

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This chapter presents two new microstrip multiband antennas based on fractal geometry. The purpose is to study the behaviour of structures when applying a fractal aspect. The first antenna is designed and optimized by using Sierpinski triangle technique, it's validated in the ISM "Industrial Scientific and Medical" band at 2.45 and 5.8 GHz bands which was designed to be suitable for wireless power transmission use, while the second proposed antenna structure is based on the hexagonal geometry, it's validated and tested for DCS (Digital Cellular System) at 1.8 GHz, for 2.45 GHz and for 5.8 GHz, as an example of application wireless mobile system is an application field.

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Since 2002, when the Federal Communication Commission (FCC) released the bandwidth 3.1-10.6 GHz, there has been increasing interest in the use of UWB systems because of their low power consumption, low cost, precise positioning and promising candidate for short-range high-speed indoor data communications. Planar circular monopoles like designs are a good example for UWB applications due to their merits such as ease of fabrication, Acceptable radiation pattern, and large impedance bandwidth. However,

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.

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<i>Jaouad Terhzaz, Centre régional des métiers de l'éducation et de la formation (CRMEF), Morocco</i>	
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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.

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Salvatore Caorsi, University of Pavia, Italy

Claudio Lenzi, University of Pavia, Italy

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.

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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.

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This chapter will treat firstly a summary of the filters synthesis by using Butterworth and chebyshev techniques. After that, a second part will be devoted to the design of planar filters using different techniques; this section will present some examples in bibliography. The aim of this part is to understand the different methods and steps followed to design planar filters, in the same time to discover and to define the different parameters which characterize a filter structure. Therefore, we have chosen some new research studies on low pass filters. The last part will present our contribution in designing planar filter. The first filter structure is a dual bandpass microstrip filter operating for DCS and Wimax applications, this section will introduce the different steps followed to achieve such filter. The second circuit is a novel design low cost microstrip lowpass filter with a cutoff frequency of 2.3 GHz. At the end, we will present a transformation of the microstrip filter to a CPW lowpass filter making it easy for integration with passive and active microwave components.

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Echchakhaoui Khalifa, Hassan 1st University, Morocco

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In this chapter, microwave power attenuator and limiter theory and technological realization are presented. The chapter is divided in two sections, first section is dedicated to attenuator circuits and the second section is dedicated to power limiters circuits. Authors describe, in first section, principles characteristic and fundamentals of attenuator and detail of the most common topologies such as T-attenuator, PI-attenuator and bridged-attenuator. After a presentation of important equations needed to calculate attenuation rate provided by each of these previous cited topologies, authors present the variable attenuator based on active component (PIN diode, Transistors). In second section, authors present power limiter characteristic and fundamentals. Afterward, they present a state of arts of technological solution to design power limiter based on solid state components such as PIN diode and Schottky diodes.

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Siva Sankar Yellampalli, UTL Technologies Ltd, India

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In the extremely high frequency radio spectrum of 30-300 GHz, the band from 57-64 GHz has been de-regulated. The biggest challenge in designing products at this frequency is the design of CMOS based transceiver circuit components. This chapter deals with the review of 60 GHz LNA design. LNA was chosen as this is the first component of the receiver circuit and its performance affects the transceiver efficiency. In this chapter the review is done on 60GHz LNA's design addressing the linearization, and

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.

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Mohamed Adel Sennouni, Hassan 1st University, Morocco

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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.

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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.

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Karan Verma, Central University of Rajasthan, India

Vehicular Ad-Hoc Network (VANET) is a subset of Mobile Ad-Hoc Network (MANET) and it is considered as a substantial component of Intelligent Transportation System (ITS). DoS attacks on VANET are varying and may be overwhelmed by VANET protocols, such as TCP or UDP flooding attacks. Different secure communications models can be used to detect and prevent IP spoofing DoS attacks, by which the attacks are committed by fraudulent and malicious nodes. In this chapter, an efficient detection method has been proposed to detect UDP flooding attacks, called Bloom-Filter-Based IP-CHOCK (BFICK). A prevention method using IP-CHOCK has also been proposed to prevent DoS, called Reference Broadcast Synchronization (RBS). In principle, the combined method is based on the IP-CHOCK filter concept of packets during an attack incident and with busy traffic condition. Fake identities from malicious vehicles can be analyzed with help of the existing reliable IP addresses. Beacon packets were exchanged periodically by all the vehicles to announce their presence and to forward it to the next node.

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Walaa Abd el Aal Afifi, ISSR-Cairo University, Egypt

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The clustering routing protocols attract many research papers that result from their well topology control, less demand resources, and less energy dissipation. The cluster routing protocols consist of single hop communication and multi hop communication. Single hop is applied between sensor node and its related cluster head. Multi hop is applied between cluster heads to base station. The previous two communication modes depend on the cluster head election. Appropriate cluster-head election can drastically reduce the energy consumption and enhance the lifetime of the network. The fuzzy models are used frequently for cluster head election. The fuzzy models can be built either expert's knowledge or numerical data. The authors propose fuzzy model using adaptive Takagi-Sugeno for wireless sensor network protocol (FATSN). The FATSN protocol is implemented by modified merging algorithm of fuzzy clustering with expected value (MCFEV). The FATSN protocol compares with the famous cluster routing protocol LEACH, EEUC, CHEF, and FCM protocols. The results show that FATSN protocol is efficiency

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MANETs (Mobile Ad-Hoc Networks) are an infrastructure-less network where attackers can easily attack on the network from any side. Amongst innumerable attacks is 'Sybil attack' that causes severe hazard to the network. It is an attack which uses one/many identities at a time. The identities used by

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.

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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.

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Miroslav Škorić, IEEE Section, Austria & NIAR, India

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Section 4

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Hari Kishan Kondaveeti, Andhra University, India

Valli Kumari Vatsavayi, Andhra University, India

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.

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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.

Chapter 19

Mammogram Classification Using Support Vector Machine 587

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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.

Chapter 20

An Accurate and Efficient Analytical Method to Extract the Parameters of the Single and Double Diode Photovoltaic Cells Models	615
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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.

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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.