Preface

The field of communication is at the helm of affairs now-a-days. With the advancement of modern technology especially the advent of multimedia, bioinformatics and big data analytics, there has been a rapid evolution of data in these domains. Researchers have invested a lot of efforts for evolving intelligent solutions for the future in these domains. The efforts in this direction have proceeded at an explosive rate. Data processing procedures in the communication arena can greatly benefit the utilization and exploration of real data. But it is a genuine fact that most of these underlying data are unusable and imprecise in nature, thanks to the inherent uncertainty. The field of computational intelligence is blessed with several tools and techniques for handling the real life and real world uncertainties prevalent among these data sets in the communication arena. It may be noted that several classical techniques for handling this problem are reported in the literature. However, most of the classical techniques suffer from uncertainty, imprecision and vagueness. Conventional computing paradigms often fall short of offering solutions to them. Computational intelligence offers a wide range of solutions which addresses these issues to a considerable extent be it in the computational domain or in the communication networks domain. Moreover, the rapid advancement in communication sensor technologies is also a praiseworthy matter.

Computation has been one of the most astounding inventions of the present century. The communication networks are coming with flying colors. Both these fields are complementary to each other. The essence of computation lies in the dissemination of fruitful information through/via secured communication channels. Hence, the advancement of one is a boon in disguise to the advancement of another. A mammoth development has taken place in both the fields over the recent years.

As far as the field of computation is concerned, the most notable invention is the advent of intelligent machines in the form of robots which mimic human intelligence. Added to it, one can think of enormous and rapid development in data processing and mining techniques in the form of big data analytics. The advent of quantum computing has speeded up the processing capabilities of naive algorithms to a great extent. So much so forth, high performance computing (HPC) has given rise to a new era of computing paradigm where a large amount of data processing can take place effectively and efficiently. Needless to state, all these fields are motivated by the tools and technologies offered by the field of computational intelligence.

On the other hand, information networks exist to build, maintain, and develop social relationships among people, things, and places. People's behaviors are affected by information; if information contains errors or delivered information is delayed, people might not behave appropriately. Therefore, information networks are one of the most important infrastructures for our society. Information networks are built on device networks and device networks are built on energy networks. In this direction, the communication networks also have developed to a great extent. Gone are the days where it took several days to transmit

information. Now, information gets transmitted at lightning speed, thanks to the advent of fiber optic communication. Mobile computing and mobile communication has also assisted mankind to communicate effectively. All these facets of communication have been mainly possible by the advancement of the underlying technology ranging from antenna design to streamlining waveform propagation characteristics. Added to these are the advancements in hardware realizations of network devices and structures.

Above all, the security of information dissemination in this information technology arena is an essential criterion. An outstanding and perpetual research initiative has always been invested in this direction resulting in robust and secure communication channels for dissemination of information.

This book is intended to encompass the recent advancements in computational intelligence as it applies to communication networks.

The proposed book would come to the benefits of several categories of students and researchers. At the students' level, this book can serve as a treatise/reference book for the special papers at the master's level aimed at inspiring possibly future researchers. Newly inducted PhD aspirants would also find the contents of this book useful as far as their compulsory course works are concerned.

At the researchers' level, those interested in interdisciplinary research would also be benefited from the book. After all, the enriched interdisciplinary contents of the book would always be a subject of interest to the faculties, existing research communities and new research aspirants from diverse disciplines of the concerned departments of premier institutes across the globe. This is expected to bring different research backgrounds (due to its cross platform characteristics) close to one another to form effective research groups all over the world. Above all, availability of the book should be ensured to as much universities and research institutes as possible through whatever graceful means it may be.

The edited volume comprises 21 well versed and self-contained chapters from diverse research domains ranging from fundamentals of communication systems to intelligent antenna design along with some reporting on recent computing paradigms.

Chapter 1 presents a cyclostationary analysis of modulated signals in modern communication systems. It elaborates the different techniques which are applied to the spectral correlation function (SCF) of signals for extracting features on the basis of which decision of detecting a signal or noise is made. The chapter also presents a comparison of several signal detection techniques on the basis of utilizing unique feature exhibit by a normalized vector calculated on SCF along frequency axis.

Cognitive radio is now acknowledged as a potential solution to meet the spectrum scarcity problem in radio frequency range. To achieve this objective proper identification of vacant frequency band is necessary. In Chapter 2, a detection methodology based on cepstrum estimation has been proposed that can be done through power spectral density estimation of the received signal. The detection has been studied under different channel fading conditions along with Gaussian noise.

RFID and MANET become the growing components of Information and Communication Technology (ICT) applications and can be effectively utilized in global operations. RFID and MANET have the potential to increase the efficiency of operations in various industries, improve asset visibility and traceability, decrease reliance on manual processes, reduce operation costs, and provide useful data for business analytics. Chapter 3 describes the various aspects and applications of Radio Frequency Identification (RFID) to the heath care industry, supply chain management and modern business.

Software Defined Radio (SDR) systems can adapt to the future-proof solution and it covers both existing and emerging standards. An SDR has to possess elements of reconfigurability, intelligence and software programmable hardware. The main interest in any communication group is the sure sending of

signals of info from a transmitter to a receiver. Chapter 4 discusses an SDR system built using LabVIEW for a Generic Transceiver.

Optical packet switching is a connectionless networking solution through which we can get high speed data transfer and optimum bandwidth utilization using wavelength division multiplexing technique. A number of optical packet switch architectures are available in market for realizing optical packet switching. In Chapter 5, the authors discuss the overall development of optical packet switching. It also focuses on a comparison between the switches through loss, cost and buffer analysis.

Flexible and wearable technology, having the merits of being light-weight, energy efficient, in addition to low manufacturing cost, reduced fabrication complexity, and the availability of inexpensive flexible substrates is being established as an appealing alternative to the conventional electronics technologies which are based on rigid substrates. Furthermore, wearable antennas have been a topic of interest for more than the past decade, and hundreds of scientific papers can be found on the subject. Chapter 6 deals with an overview of antennas of wearable technologies surmising the advantages, disadvantage and challenges.

The radio frequency (RF) energy harvesting is found as an attractive alternative to existing energy resources. Chapter 7 deals with the design and performance evaluation of different rectifying antenna circuits for RF energy harvesting. This chapter throws light on the different circularly polarized microstrip antennas e.g. shorted square ring slot antenna and crossed monopole antenna with step ground plane. The chapter concludes with a detailed study on the performance of the rectenna circuits evaluated in terms of conversion efficiency.

Robustness and reliability are two essential network parameters to be given priority in Industrial Wireless Sensor Network (IWSN). But at the same time it is difficult to achieve gain in these performance metrics. Since in industries these networks are used for monitoring, control and automation processes, therefore, it also requires robust communication with minimum delay. Considering the need of high QoS in Industrial WSN, protocols and standards were developed to fulfill the requirement of reliable data communication in harsh environment. Chapter 8 discusses about a cross layer cooperative protocol for IWSN.

Chapter 9 presents a dynamic reputation based incentive scheme to encourage selfish nodes in post-disaster situation using Delay Tolerant Network (DTN). A DTN is described by a special kind of mobile ad-hoc network where sparseness, large communication delay and lack of end to end path from source to destination exist. It is evident from this fact that data forwarding is dependent on the cooperation of multiple hops in "store-carry-forward" manner. However, nodes involved in communication may sometimes behave maliciously and may non-cooperate. The primary objective of this chapter is to develop a reliable data forwarding scheme by detecting malicious activities and encourage nodes to participate in Post Disaster Communication environment.

Of late, Flying Ad-hoc Networks (FANETs), enabling ad-hoc networking between highly mobile Unmanned Aerial Vehicles (UAVs), are gaining importance in several military, commercial and civilian applications. The sensitivity of these missions requires precise and prompt data delivery. Thus, the most important communication requirements that need to be addressed while designing FANETs are of high reliability and low latency. In line with these demands, Chapter 10 focuses on the mobility models, MAC protocols and routing protocols for FANETs.

Security and trust are two inevitable concepts for secure MANET. There are various systems used for ensuring security and trust in case of MANET. These systems have several advantages as well as several disadvantages in terms of high communication and computation overhead. The goal of Chapter

11 is to implement a leader election algorithm after proper evaluation of node trust in MANET on the basis of ratio of signal sent and acknowledgement received.

One of the critical and vital parameters of Wireless Sensor Networks (WSNs) is its lifetime. There are various methods to increase WSN lifetime, clustering technique is one of them. In clustering, selection of desired percentage of Cluster Head (CHs) is performed among the sensor nodes (SNs). Selected CHs are responsible to collect data from its member nodes, aggregates the data and finally send to the sink. Chapter 12 presents Fuzzy-TOPSIS techniques based on multi criteria decision making to choose CH efficiently and effectively to maximize the WSN lifetime.

Chapter 13 highlights a cost effective, hassle free and secure communication between the cloud and moving vehicles. The goal of this chapter is to give a broad overview of Vehicular cloud computing, vehicular cloud applications, mobile computing, and recent literature covering security of vehicular cloud.

Cloud computing is one of the most vital technology which has become a part of corporate life. It is considered to be one of the most emerging technologies which serve various applications. Generally these Cloud computing systems provide various data storage services which highly reduce the complexity of users. Chapter 14 focuses on addressing the confidentiality of users' data. Since software level security has vulnerabilities in addressing this problem, the authors introduces a hardware level of security in the form of Trusted Platform Module (TPM) which is a chip in computer that is used for secure storage.

Chapter 15 presents an indoor navigation solution for visually impaired pedestrians, which employs a combination of a radio frequency identification (RFID) tag array and dead-reckoning to achieve positioning and localisation. This form of positioning aims to reduce the deployment cost and complexity of pure RFID array implementations.

The two main important features of neural networks are weights and bias connection, which is still a challenging problem for researchers. In Chapter 16, the authors select weights and bias connection of neural network (KN) using modified differential evolution algorithm (MDEA) i.e. MDEA-NN for uncertain nonlinear systems with unknown disturbances and compare it with KN using differential evolution algorithm (DEA) i.e. DEA-KN.

The construction of a practical nanorobot is a definite futuristic reality. However, the development of a Nanorobot is associated with a multitude of challenges and limitations related mainly to its control and behavioral aspects in different dynamic work environments. Chapter 17 discusses different Nanorobot movement control algorithms in dynamic environments. This chapter also includes a description of how nanorobotics technology has been applied in medical field.

Real time analysis and interpretation of fetal heart rate (FHR) is the primary challenge posed to every clinician. Different algorithms had been developed, tried and subsequently incorporated into Cardiotocograph (CTG) machines for automated diagnosis. Chapter 18 proposes an algorithm for extracting the variability of fetal heart. The algorithm's accuracy and degree of agreement with clinician's diagnosis had been established by various statistical methods.

Chapter 19 gives an insight on various methods so far proposed related to DNA cryptography that involves the characteristics of DNA incorporating the traditional cryptographic techniques and a detailed comparison of these techniques thereby proposing the requirements for an efficient DNA-based cryptographic system. These techniques also include the area of steganography that conceals the message within a cover or a career media to eschew the attacks from the intruders.

Underwater networking technologies have brought us unforeseen ways to explore the unexplored aquatic environment and this way provided us with a large number of different kinds of applications for environmental, scientific, commercial, and military purposes. Although precise and continuous aquatic

environment monitoring capability is highly important for various underwater applications, due to the unique characteristics of underwater networks such as low communication bandwidth, high error rate, node mobility, large propagation delay, and harsh underwater environmental conditions, existing solutions cannot be applied directly to underwater networks. In Chapter 20, the authors mainly focus on the use of wireless micro-electromechanical systems for underwater networks and present its advantages. In addition, the authors investigate the challenges and open research issues of wireless MEMS to provide an insight into future research opportunities.

Quality estimation for viability of data processing and delivering through the paradigm of service oriented computing and load balancing cluster based web server for high performance of services against extensive load of consumers is an important concern in the domain of grid and distributed computing, big data analysis and internet of things. As such, Chapter 21 proposes a quality estimation framework considering a prototype architecture for multi service multi-functional web services deploying in load balancing cluster based Apache Tomcat web server and developing a clinical database for processing disease related queries through the architecture.

The primary objective of the book is to bring a broad spectrum of data communication applications under the purview of computational intelligence so that it is able to trigger further inspiration among various research communities to contribute in their respective fields of applications thereby orienting these application fields towards intelligence.

Once the purpose, as stated above, is achieved a larger number of research communities may be brought under one umbrella to ventilate their ideas in a more structured manner. In that case, the present endeavor may be seen as the beginning of such an effort in bringing various research applications in the complementary fields of intelligent communication close to one another.

Siddhartha Bhattacharyya
RCC Institute of Information Technology, India

Nibaran Das
Jadavpur University, India

Debotosh Bhattacharjee
Jadavpur University, India

Anirban Mukherjee
RCC Institute of Information Technology, India