

Foreword

Investigators have contributed greatly in the field of terrestrial sensor networks and nowadays the investigators are pioneering their efforts towards Underwater Wireless Sensor Networks (UWSNs) being a forthcoming area of research. The major similarity between these two sensor-based networks being the composition of network consisting of sensor nodes to collect information and forwarding it to the sink. The major difference lies in terms of communication method of acoustic signal, cost of expensive sensors, greater memory space to save data, power for communication, and dense deployment of sensors. Further, realization of UWSN has fair amount of challenges like large propagation delays, limited link capacity, narrow bandwidth, shadow zones, harsh geographical atmosphere, attenuation, comparatively smaller network scale, high bit error rates, limited energy and temporary losses of connectivity. Since many years various UWSN protocols have been designed and/or existing protocols have been improvised for effective and efficient communication. This book indeed provides very useful insights of the communication issues in underwater sensor networks.

Chapter 1 describes about issues and challenges while designing routing protocols in UWSN. In this chapter, an overall survey of various routing protocols along with pros and cons are explained with challenges for designing new routing protocols for vast and enormous UWSNs. Chapter 2 details the node deployment plans on the basis of various quality parameters. The core idea in this chapter is to design a strong and reliable model under the water that revolves around the master plan of sensor deployment. Chapter 3 focuses on the different methods of node deployment and present a generalized model for ensure the reliability while node deployment. A view of analyzing the deployment of sensor nodes is also shown in the example by following the recent researches in the domain. Chapter 4 tries to cover stationary and mobile localization algorithms along with hybrid methods which are further subdivided into Distributed and centralized. The discussion includes various nodes that is anchor node, unknown node, sink node, and reference node. Chapter 5 elaborate challenging aspect of underwater data fusion for intelligent traffic control and underwater vehicle navigation systems. This chapter provides an insight into basic concepts about multi-sensor data fusion and detailed review of most popular data fusion architectural models available for UWSN.

Chapter 6 analyses in the process of transmission and reception of acoustic waves that it is the only best method to communicate under the water. In this chapter, the congestion control mechanism for sensor nodes in UWSN is described. Chapter 7 presents a survey of available fault management techniques and their pros and cons for further advancement in underwater sensor networks to highlight new research trends. Chapter 8 demonstrated firewall as a major tool for network security system to control and monitor incoming and outgoing network traffic. In this chapter, it is shown that how various applications of firewall can help the UWSN in protecting the sensor nodes where a huge amount of sensitive data is

communicated. Chapter 9 offer a review over various error control and reliable data delivery schemes in UWSN. The research community has developed different methodologies over the past few decades to address these issues and challenges. Chapter 10 launches the need for higher data rate transmission for UWSN communications using Industrial, Scientific and Medical (ISM) bands. The underwater problems can be mitigated by installing wireless sensors which are placed closed to each other and hence for accurate measurements, higher communication bandwidth is required.

Chapter 11 presents the need for secure communication techniques for UWSN. This chapter presents an expansive analysis of challenges, attacks and security techniques of UWSNs. Chapter 12 highlights the issues those surround the problems due to cyber-attacks and the need of cyber security in underwater communication. Furthermore, some organizations like Google kept their servers below the water because it reduces the cost of getting it cool which in turn increases the efficiency too. Chapter 13 shows the mechanism to use machine learning (ML) techniques for operating collected data from UWSN. Various ML techniques have been explained to enhance the operational performance of WSNs; especially in UWSNs. Chapter 14 intricate the deep reinforcement learning methods for energy efficient underwater wireless networking. The underwater environment has almost the same infrastructure and functions with ground environment with some limitations, such as, processing, communications, and battery limits.

Chapter 15 expands the reliability in underwater wireless sensor networks where numerous reliability models for underwater networks have been designed to incorporate the parameters and performance metrics in optimized manner. The chapter deals with focusing on such models and their efficiency in terms of battery life, packet loss, error handling mechanism and network delays. Chapter 16 explains the importance of real time data in marine environment for plenty of applications and discuss the major issue in efficient data communication. Chapter 17 reviews applications surrounding demur and routing protocols with applications in UWSN for smart city. This chapter investigate how to be profited by the Internet of Underwater Things (IoUT) to gain from, adventure and safeguard the normal submerged assets and we bring up the contrasts among UWSNs. Chapter 18 conclude the concepts of risk analysis due to underwater deployment of the cables for data transfer. Underwater cable deployment facilitates the coverage and speed of internet all over the world for various applications like international trade, various communication transfers, and other daily end user requirements. Chapter 19 finally concludes and presents the application area of UWSN in forming the smart city below the water. The exploration of the undersea is booming in the science community, which shows the path for underwater cities, underwater museum, and underwater hotels.

I appreciate the efforts put in by the authors for bringing out recent trends in the upcoming area of underwater network illustrating variety of applications like pollution monitoring especially chemical waste, monitoring of the population of underwater flora and fauna, the examining of the health of rare marine creatures, mine reconnaissance, disaster prevention, assisted navigation, nutrient production, oil leakage detection, distributed tactical surveillance, oceanographic data collection, target detection, tracking and underwater military applications etc.

I am delighted to see the domain knowledge of Editors being fructified in the form of this book. Their sound knowledge of the subject matter has indeed made it simple to present the text which can be used as a text book for students and a reference guide for researchers. I wish them all the very best in their future endeavors.

Mayank Dave

National Institute of Technology, Kurukshetra, India