

Preface

The Earth is a blue planet. Approximately 71 % of the Earth's surface is covered by ocean, which corresponds to an area of 361 million km^2 and a volume of 1.3 billion km^3 . Most of this vastness is unexplored and remains a mystery. To explore the intriguing world undersea, the need for robust and reliable underwater wireless networks is rapidly growing. Among the various means of communications, underwater acoustic communications (UAC) is widely considered as the most feasible option at reasonable distances. The earliest UAC arises from the military need. During World War II, UAC is used for communications among submarines, and the analog single-sideband suppressed-carrier amplitude modulation is adopted. In the 1980s, the noncoherent frequency shift keying (FSK) digital modulation is widely used. However, FSK has very low data rate. In the 1990s, to achieve higher data rate, UAC research is gradually shifted to the phase-coherent communications with high receiver complexity to handle the large delay spread of underwater acoustic (UWA) channels. Over the last decade, the advance of UAC includes the implementation of the multiple-input and multiple-output (MIMO) communications which can improve the data rate and the reliability of UAC and orthogonal frequency-division multiplexing (OFDM) communications due to its low receiver complexity, capability of inter-symbol interference (ISI) removal, and robustness against large delay spread. This monograph focuses on another promising technique for the future UAC, namely, cooperative communications with the benefits of improving the transmission reliability and distances. With OFDM adopted as the physical layer transmission technique, many different aspects of cooperative UAC are covered by this monograph such as power allocation, decomposed LT (DLT) codes design, and packet transmission reliability.

The chapters of this monograph are relatively independent with each other. The readers can go directly to the chapter(s) of interest. The monograph starts with the motivation and the literature review of cooperative OFDM UAC in Chap. 1. The UWA channel modeling is introduced in Chap. 2. The adaptive system design including optimal power allocation and distribution for the short-range relay-aided (RA-)UAC is studied in Chap. 3. The medium-long-range asynchronous relay selection protocol is investigated in Chap. 4. The energy-efficient hybrid (h-)DLT

codes design for RA-UAC is presented in Chap. 5, and this chapter also includes a statistical polynomial decomposition algorithm to facilitate the h-DLT codes decomposition. The effective mirror-mapping-based ICI cancellation for OFDM transmission in RA-UAC is provided in Chap. 6.

This monograph is designed for professionals and researchers in the field of UAC. Advanced-level students in electrical engineering or computer science will also find this monograph useful.

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