FILTER BANK TRANSCEIVERS FOR OFDM AND DMT SYSTEMS

Providing key background material together with advanced topics, this self-contained book is written in an easy-to-read style and is ideal for newcomers to multicarrier systems.

Early chapters provide a review of basic digital communication, starting from the equivalent discrete-time channel and including a detailed review of the MMSE receiver. Later chapters then provide extensive performance analysis of OFDM and DMT systems, with discussions of many practical issues such as implementation and power spectrum considerations. Throughout, theoretical analysis is presented alongside practical design considerations, whilst the filter bank transceiver representation of OFDM and DMT systems opens up possibilities for further optimization such as minimum bit error rate, minimum transmission power, and higher spectral efficiency.

With plenty of insightful real-world examples and carefully designed end-of-chapter problems, this is an ideal single-semester textbook for senior undergraduate and graduate students, as well as a self-study guide for researchers and professional engineers.

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To our families
— Yuan-Pei Lin and See-May Phoong

To Usha, Vikram, Sagar, and my parents
— P. P. Vaidyanathan

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Preface

Recent years have seen the great success of OFDM (orthogonal frequency division multiplexing) and DMT (discrete multitone) transceivers in many applications. The OFDM system has found many applications in wireless communications. It has been adopted in IEEE 802.11 for wireless local area networks, DAB for digital audio broadcasting, and DVB for digital video broadcasting. The DMT system is the enabling technology for high-speed transmission over digital subscriber lines. It is used in ADSL (asymmetric digital subscriber lines) and VDSL (very-high-speed digital subscriber lines). The OFDM and DMT systems are both examples of DFT transceivers that employ redundant guard intervals for equalization. Having a guard interval can greatly simplify the task of equalization at the receiver and it is now one of the most effective approaches for channel equalization. In this book we will study the OFDM and DMT under the framework of filter bank transceivers. Under such a framework, there are numerous possible extensions. The freedom in the filter bank transceivers can be exploited to better the systems for various design criteria. For example, transceivers can be optimized for minimum bit error rate, for minimum transmission power, or for higher spectral efficiency. We will explore all these possible optimization problems in this book.

The first three chapters describe the major building blocks relevant for the discussion of signal processing for communication and give the tools useful for solving problems in this area. Chapters 4–5 introduce the multirate building blocks and filter bank transceivers, and the basic idea of guard intervals for channel equalization. Chapter 6 gives a detailed discussion of OFDM and DMT systems. Chapters 7–10 consider the design of filter bank transceivers for different criteria and channel environments. A detailed outline is given at the end of Chapter 1. This book has been used as a textbook for a first-year graduate course at National Chiao Tung University, Taiwan, and at National Taiwan University. Most of the chapters can be covered in 16–18 weeks. Homework problems are given for Chapters 2–10.

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