

# Preface

## Aims

The rapid and successful evolution of digital multimedia systems is indispensable in today's digital world. Ubiquitous multimedia access is no longer a dream and has become a future goal of current technology development. Now, many electronic products and multimedia applications are developed to reach this goal, such as mobile broadcast TV, mobile multimedia services, video phones, digital cameras and camcorders.

In this book, we introduce an important technique of multimedia applications, Discrete Wavelet Transform (DWT), which not only is the key algorithm of signal processing but has also led to revolutions in image and video coding algorithms. This book provides a comprehensive analysis and discussion of DWT and its applications, including the important material and the newest development of wavelet processing. We discuss DWT from its theories, algorithms, to related architectures. The architecture designs of DWT in JPEG 2000 are given as a practical example, and the latest development of DWT, Motion-Compensated Temporal Filtering (MCTF), is also explored in this book. We believe it is an important reference book for related research or courses on DWT.

## Organization

This book is organized as follows. Chapters 1, 2, and 6 are introductions. Chapter 1 describes the roles of DWT in image and video coding systems. Chapters 2 and 6 give the basic introductions of DWT and MCTF. Chapters 3, 4, and 8 are the related analyses and architectures of 1-D DWT, 2-D DWT, and MCTF. Chapter 5 is a practical design of DWT, which is an image encoding system. Chapter 7 is the introduction of motion estimation

(ME), which is the background knowledge of MCTF. Except Chapters 1, 2, and 6, all other chapters focus on specific topics related to DWT or MCTF, so that readers can understand specific topics in one chapter without the knowledge of other chapters.

In Chapter 2, the fundamental theories of DWT are presented and its characteristics are also interpreted from various theorems. In Chapter 3, various VLSI architectures of 1-D DWT are introduced and compared; we focus on area and speed efficiency. VLSI architecture designs for 2-D DWT are presented in Chapter 4. The trade-off between off-chip memory bandwidth and on-chip memory area is the critical issue. After introducing the architectures of 1-D and 2-D DWT, Chapter 5 contains a real design of DWT in the JPEG 2000 encoding system. The design issues of 2-D DWT under the constraints of system scheduling are discussed.

Chapter 6 introduces the algorithms of MCTF and related scalable video coding. Similar to most video coding algorithms, ME is the most critical part of MCTF, and various algorithms, VLSI architectures, and memory management schemes of ME are reviewed in Chapter 7. Finally, some important hardware design issues of MCTF, like memory bandwidth, computation complexity, and so on, are discussed and formulated in Chapter 8.

## **Use of the Book**

This book is suitable for readers with various knowledge and interests. If the readers are not familiar with the basic theorems of DWT, we suggest the readers can study from Chapters 1 to Chapter 8. If the readers only want to study the image applications of DWT, only Chapters 1–5 need to be studied. If the readers are interested in the temporal filtering of DWT, only Chapters 6–8 are required to be read.

For those readers who have understood the basic theorems of DWT, Chapter 2 can be skipped before reading Chapter 3–5. If the reader wants to study the architecture of 1-D DWT, all related materials are shown in Chapter 3. All materials about 2-D DWT are discussed in Chapter 4. Chapter 5 presents design examples of 2-D DWT in JPEG 2000 coding system, so Chapter 5 is recommended to be read after Chapter 4 or for those readers who are familiar with 2-D DWT.

For researchers in video processing, Chapter 6 is a good introduction and survey of temporal filtering and scalable video coding. Chapter 7 is a

basic introduction to Motion-Estimation (ME) from algorithms to architectures, which is a background knowledge of Motion-Compensated Temporal Filtering (MCTF). If the readers are familiar with ME, they can skip this chapter. Chapter 8 discusses the hardware design issues of MCTF, which is recommended to be read after the readers understand the material in Chapters 6 and 7.

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