Preface

The need for real-time, high performance computational algorithms, architectures, and implementation has been one of the driving forces of modern signal processing technology. Advances in VLSI signal processing technology have made possible the realization of low cost and powerful multimedia and wireless communication systems. The goal of this two-volume series is to provide a collection of state-of-the-art reprinted papers in this field. Since the early 1980s when VLSI technology was already established, this area has been extremely active both at the university and industrial R&D levels. One of the major breakthroughs in VLSI technology has been its ability to implement signal processing algorithms and architectures onto cost-effective ASIC and DSP chips. Complex and computationally intensive signal/image algorithms can then be practically used to satisfy high-performance and high-speed requirements. Now, signal processing technology has become an integral part of modern engineering, ranging from defense to commercial applications. There is worldwide interest in this technology.

Works in this area are highly interdisciplinary; they involve interaction among areas such as VLSI and circuit design, computer architecture, signal processing, communications, and computer-aided design. Major publications are scattered among many international journals. It is extremely difficult for working engineers, researchers, and students to keep track of these publications. Due to the diversity of this area, there is no single book that covers all aspects of this area in detail. There are many possible reasons, one being that this area is quite young with most works completed only in this past decade. Indeed, now is the best time to publish such a book. Presently, the most well-known book in this area is that of "VLSI Array Processors," by S. Y. Kung. This is an excellent research monograph/textbook covering some of the state-of-the-art research materials up to about 1988. Since then there has been much activity in this area, particularly with multimedia applications and cellular communications. Therefore, many of us working in this area feel there is a strong demand for a book that collects major contributions from all the research topics reflected in the VLSI signal processing area. With such a book, one cannot only comprehend the major contributions that have been achieved thus far, but also find new directions and trends. For those who are not familiar with this area, this book will also serve as an excellent source to readily understand the basic issues and enable participation in the growth and applications of this dynamic and important technology.

This book is designed to collect all the research efforts and findings that have made the high performance implementation of signal processing possible in the last decade. We hope that this effort will help facilitate that basic understanding of different subareas because workers interested in this area may have diverse analytical, system, software, or hardware backgrounds in signal/image processing, circuits and systems, telecommunications, and computer fields. Traditionally, there has been a lack of common basis to bring together workers in these fields. This book can provide a possible bridge.

The book intends to address the important aspects of high-performance signal processing with a focus on the recent development of VLSI technology for signal processing. It not only serves as a basic reference to the major works in the area but also provides the future research directions and development trends. Whenever a working engineer or a researcher wants to get started or examine some issues in detail, there is a tremendous problem getting started in the area. The diverse technical nature of the works and the scope of publications available have a negative effect on the growth of this area. The availability of this book will serve the needs of workers in this area and promote its future dynamic growth. The intended audience is those who have interest in high-performance implementation of signal/image processing, including those with analytical, system, software, or hardware interests in this area. This book is especially appropriate for someone who has a basic understanding of signal processing.

During the preparation of this book, the most difficult task was the discriminative selection of papers to be included. It is difficult for one person to become an expert in the entire large and interdisciplinary field. In our paper selections, we have focused on innovative architectures and associated algorithms for VLSI implementations. We have omitted many excellent signal processing algorithmic papers not having such direct implications. We have also selected only journal publications, which generally offer more permanency and which pass through greater critical reviewing than conference proceedings. Our choice of papers to include was motivated by subjective preference but mostly a desire to balance and represent different activities. Input from colleagues and reviewers also played an important role in the paper selection.

Volume 1 covers issues related to system design and methodology, and Volume 2 covers aspects of algorithms, architectures, and applications. There are five chapters in Volume 1. Chapter 1 is a collection of papers about array processors and mapping and deals with the fundamental concepts and designs of systolic/wavefront, concurrent, and parallel VLSI array processors which serve as the platforms for high-performance signal processing. In Chapter 2, methodologies concerning systematic transformation and mapping, from algorithms to architectures, and techniques used to improve concurrent pipelined processing are considered. Computer-aided designs which develop automatic design tools for signal processing are considered in Chapter 3. Implementational schemes and computing system designs suited for signal processing architectures is presented in Chapter 4. Chapter 5, the last chapter of Volume 1, considers fault-tolerance techniques which improve reliability of VLSI signal processing systems.

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