

# Preface

## Overview

This book grew out of our research enquiry into arithmetic in emerging nanotechnologies. It describes our research starting in early 2008 on design of circuits in Quantum Dot Cellular Automata (QCA) with the objectives of obtaining low-complexity and robust designs for various arithmetic operations. The book investigates systematic reduction of majority logic for realization of multi-bit adders and a multiplier. An extension to computation of a transform is also pursued with a view to examine potential for embedded system design in emerging nanotechnologies. Careful layout design keeping in view high performance is also a goal of the research.

## Organization and Features

Chapter 1 presents the motivation for the work described in this book. This chapter also gives an overview of the literature on the subject. Chapter 2 presents terminology pertaining to quantum dot cellular automata. Chapter 3 familiarises the reader with QCA designs for basic logic elements such as gates and flip-flops. Chapter 4 presents material on majority logic optimization for obtaining efficient QCA designs of single and multi-bit adders. In particular, design of an efficient ripple carry adder as well as various prefix adders are presented in this chapter. Chapter 5 studies the design of a custom adder called the *hybrid adder* for QCA technology. Chapter 6 extends the investigations on adders to the design of a high-performance multiplier in QCA. Chapter 7 is devoted to efficient computation of a discrete orthogonal transform, namely the Discrete Hadamard Transform (DHT), in QCA. Chapter 8 presents a discussion on thermal robustness for QCA designs. Chapter 9 presents a summary of the work described in this book and outlines extensions. An appendix on the steps to generate a layout in the CAD tool QCADesigner is included.

## Audience

This book presents material that is appropriate for courses at the senior undergraduate and graduate levels in the areas of nanoelectronics, computer arithmetic and embedded systems. It can also be used as a supplement to courses on digital circuits and laboratories on digital systems. The book is also suitable for researchers in the areas of computer arithmetic, nanotechnologies and VLSI design. In addition, the book provides examples and tutorials on a CAD tool that would help beginners to get a head start on QCA layout design. Basic familiarity with logic design is adequate to follow the material presented in this book.

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