

Preface

Traditional technologies are increasingly beginning to suffer from the increasing miniaturization and the exponential growth of the number of transistors in integrated circuits. The high rate of power consumption and the emergence of quantum effects for highly dense integrated circuits are the biggest problems in system design today and will be in the future. Reversible logic provides an alternative to face the upcoming challenges. One of the main benefits that reversible logic brings about is theoretically zero power dissipation. In order to reduce power consumption, physical processes have to be logically reversible. Every future technology will have to use reversible logic circuits in order to reduce power consumption. In the area of quantum computation and low-power design, very promising results have already been obtained today. Nevertheless, research on reversible logic is still at the beginning stage.

This book provides several novel contributions to reversible logic synthesis. Twelve reversible logic synthesis methodologies are presented for the first time in a single literature. Evaluations for the comparative advantages and disadvantages of these methodologies are also provided. Reversible sequential logic circuits are discussed, with new designs of reversible sequential elements.

The tendency of current technologies is towards the nanoscale. Therefore, there is a need to incorporate the physical quantum mechanical effects that are unavoidable in the nanoscales. Representations and operations in quantum computing that use theorems of reversible computing and reversible structures to compute functionalities using quantum logic are introduced. Applications of wavelet and multiwavelet transformations to quantum computing structures are discussed. New techniques to implement the Daubechies wavelets and multiwavelets using quantum circuits are proposed.

Finally, highlights of novel contributions that are presented in this book and the future directions of research are provided.

In this context, the contributions to this book provide a good starting point. It is hoped that this book will help to spur further research in the field of reversible and quantum computations. In fact researchers in academia or industry and graduate

students, who work in this field, will be interested in this book. Books that are concerned with reversible synthesis of logic functions are rare. Therefore, there is a need to publish books in this field. The first book [1] presented for the first time comprehensive and systematic methods of reversible logic synthesis. It is hoped that this book will be more valuable, because 12 methods of reversible logic synthesis are introduced here, while only five are in Ref. [1]. Also, for the first time the sequential reversible logic circuitries are discussed in a book.

This book opens the door to a new interesting and ambitious world of reversible and quantum computing research. It presents the state of the art, with some new proposals.

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Reference

1. A.N. Al-Rabadi, *Reversible Logic Synthesis: From Fundamentals to Quantum Computing* (Springer-Verlag, 2004)



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