Book Reviews For Fall 06’ ELEC6270 Low-Power Design of Electronic Circuits
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Reviewed in this issue:


This book is well-organized, well-written and very easy to be understood. As the title of this book called ‘practical digital design’, not only it documents many particular results collected from some low power design projects, but also the basic principles, methodologies and techniques that are common to most CMOS digital designs are highlighted. Also, the advantages and disadvantages of a particular low power technique are discussed. Besides the classical area-performance trade-off, the impact on design cycle time, complexity, risk, testability, reusability is also discussed. Due to the wide impacts that make the low power problems challenging and interesting, this book supply a very good source to practice the low power techniques using current (1998) generation design and process technology.

Also, in this book the author intend to cover wide ranges of design abstraction levels spanning logic, circuit, architecture and system. Actually, maybe because this book is written years ago, some technique scope is out of date and not very detailed illustrated. But, this is still a good book for students or engineer to start their study on low-power VLSI design. The Dynamic power, short circuit power and leakage power stuff which will be mentioned in most low-power books is well described in the first chapter. Dr. Yeap (author of this book) propose these knowledge as the background for low power design in the introduction chapter. In this chapter, it is presented that the VLSI low power problems can be classified into two: analysis and optimization. All the following content is based on this classification. On the other hand, the needs for low power design and the low power figure of merits are discussed.

The first important contents, the simulation power analysis is presented in chapter 2. Most simulation programs operate on mathematical models which mimic the physical laws and properties of the object under simulation. The SPICE model power analysis, gate-level power analysis and architecture-level power analysis are well-discussed. At the sections of this chapter, the data correlation in DSP system in low-power designer’s view and Monte Carlo simulation (statistical power analysis) are discussed, both of them expend our knowledge scope on low power design.

Due to using the simulation based approach to analyze the power dissipation is very computation intensive, the probabilistic power analysis is discussed in chapter 3. The benefit of probabilistic power analysis is the statistical quantities to be analyzed are generally orders of magnitude smaller than the number of events to be processed compared to the simulation approach.
After finishing discussion on those theoretical foundations for analysis of power dissipation, in chapter 4 the optimization and trade-off techniques that involve circuit power dissipation are discussed. The techniques like reduction of operating voltage, transistor network partitioning, using special latches and flip-flops, adjustable device threshold voltage are presented. The disadvantage of this chapter is, some new-coming techniques such as dual threshold device are not included.

Chapter 5 discusses using additional hardware logic to suppressing unnecessary activities which may also cause the area increase. Also, how to choose the logic encoding, data representation and Boolean function implementation to get the minimum power dissipation is presented. In chapter 6, some so-called special techniques are discussed. Those are clock networks optimization, dealing with CMOS floating node, low power bus and techniques for SRAM. Some of those techniques are widely used and great improved those days.

In chapter 7, architecture and system level power dissipation reduction is discussed. Low power architecture design techniques are important because the design analysis, verification and automated synthesis begin at this level. The choice of clocking strategy, parallelism, pipelining, component, component organization etc., are issues to be considered at this level.

Overall, this book highlights the basic principles, methodologies and techniques that are common to most CMOS digital designs. The advantages and disadvantages of a particular low power technique are discussed.

The biggest advantage of this book is it concentrates on digital VLSI low power design, and every chapter is not that hard to understand once you have some relevant background like VLSI design and some basic device knowledge. Also, most techniques described are very mature and ready for industrial use when this book was published (1998), so the reader can get much practical design view from this book. So, this book is not a bad choice for our low power class, because those principles discussed are some general rules for low power design which every people who want to work on low-power design should manipulate. Our reader can get the starter level knowledge of the low-power design from this book. The biggest disadvantage is it did not include some new coming techniques in the current digital VLSI design and in some chapters when the reader try to present the logic level optimization, the basic graphic theory and some important algorithms should be presented. But it is indeed not a bad choice to have this book as our textbook for low power design class once we combined more recently techniques in low power design.