

INTRODUCTION

This book covers both digital and analogue electronics design and optimizations approaches, which is the key feature that distinguishes it from other existing books. It focuses on theoretical aspects of various designs as well as testing both state-of-the-art digital and analogue integrated circuits and system. Each chapter and subject area is begins with basic principles and fundamentals and goes into further details with selected design examples with an in depth discussions, and up-to-date references.

The first five chapters of this book cover design approaches and performance evaluations of various digital applications. These include an efficient design approach for partial product in multiplication operations and the design concept is proven by implementing the system on Xilinx Virtex-II Pro FPGA development board. The performance optimization strategies of 4-bits Carry-Save Adder (CSaA) is discussed with simulated results are analysed and compared in terms of delay, power consumption and area consumption.

The performance evaluation of a Quadrant-Based Multi-Octagon search (QBMO) algorithm against existing motion estimation algorithms, design and development of an encryption chip design using the Information Concealment Engine (ICE) encryption algorithm is presented. From the experiment results, the QBMO algorithm is able to reduce the computation time by up to 18.21% in comparison to the conventional UMHexagonS algorithm. This improvement is achieved without scarifying the motion estimation accuracy or bitrate significantly. Finally, the generic structure of an FPGA fabric for modern FPGA architectures and FPGA reconfiguration strategies are presented. The performance comparison of FPGAs as compared to other computing platforms includes General Purpose Processor (GPP), Graphic Processor Unit (GPU) and Application Specific Integrated Circuits (ASICs) including the CAD tools available for FPGA-based designs.

The subsequent chapters present the basic of Low Noise Amplifier (LNA) design and the performances criteria of LNA are introduced to describe the fundamental of LNA design for wireless sensor networks. The design and implementation of LNA includes a schematic design, component values and layout with simulation results is given. An analogue

baseband chain for a synthetic aperture radar receiver is presented in a 130 nm CMOS technology. The circuit design of each block such as the variable gain amplifier, the low-pass filter and the output buffer are given with the measured results of the baseband chain are reported. The designed double stage differential to single-ended MMIC low noise amplifiers using novel high breakdown InGaAs/InAlAs/InP pseudomorphic is presented. The MMIC LNAs are analysed to explore the effect of topology on noise and gain, and on the system as a whole. Subsequently, the performances achieved by the LNAs are compared with the differential LNA obtained by other researcher.

The development of a low-frequency noise measurement system is presented by the utilization of a cross-correlation technique on two channels. The system also includes a customized two-channel low-noise amplifier with a biasing circuit. This measurement system can be used to study the noise properties of any electronic device at low frequencies which is one of the important parameters in evaluating the noise performance of the device.

The Floating-Gate MOSFET (FGMOS) transistor and its applications in various analogue signal processing circuits are introduced with the model of FGMOS transistor. The multiple inputs of FGMOS transistor provide advantages of tenability, simplicity and low voltage/low power operation. The design of FGMOS based low voltage cascode current mirror, FGMOS based tenable grounded resistance, Gaussian function generator, differential voltage squarer and current conveyors is presented. A brief overview of current trends in the development of low voltage design techniques prevalent today for analogue circuits in the wireless applications is presented. In what follows are different analogue design techniques being implemented on separate building blocks of a wireless system such as Low Noise Amplifier (LNA), mixer, Variable Gain Amplifier (VGA), Voltage Controlled Oscillator (VCO), filter and Variable Gain Low Noise Amplifier (VGLNA).