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Routing the Power and Ground Wires on a VLSI Chip

CarTech Inc

This dissertation concerns the problem of routing wires on a single layer of an integrated circuit or printed circuit board, starting from a sketch of the layer. A sketch specifies the positions of layout features and the topology of the interconnecting wires. Efficient algorithms are presented that (1) determine whether a sketch is routable, and (2) produce for a routable sketch a proper routing that minimizes both individual and total wire length. Both algorithms run in time $O(n \log n)$ on input of size n , and both are simple to implement. They can be adapted to a variety of wiring models, and they subsume most of the polynomial-time algorithms in the literature for single-layer routing and routability testing. The algorithms are based on two theorems concerning the routings of a sketch. One states that a sketch is routable if and only if for each cut between fixed features, the total amount of wiring forced to cross the cut is no greater than the length of the cut. The second theorem states that every routable sketch has a routing that simultaneously minimizes the length of every wire, and that it characterizes the wires in this routing. To formalize and prove these theorems, a rich mathematical theory of single-layer wire routing is developed. Its central tool, which is new to the wire-routing literature, is the lifting of wires and cuts to a simply connected topological covering space of the routing region.

Harper's Young People CRC Press

Algorithms for VLSI Physical Design Automation, Second Edition is a core reference text for graduate students and CAD professionals. Based on the very successful First Edition, it provides a comprehensive treatment of the principles and algorithms of VLSI physical design, presenting the concepts and algorithms in an intuitive manner. Each chapter contains 3-4 algorithms that are discussed in detail. Additional algorithms are presented in a somewhat shorter format. References to advanced algorithms are presented at the end of each chapter. Algorithms for VLSI Physical Design Automation covers all aspects of physical design. In 1992, when the First Edition was published, the largest available microprocessor had one million transistors and was fabricated using three metal layers. Now we process with six metal layers, fabricating 15 million transistors on a chip. Designs are moving to the 500-700 MHz frequency goal. These stunning developments have significantly altered the VLSI field: over-the-cell routing and early floorplanning have come to occupy a central place in the physical design flow. This Second Edition introduces a realistic picture to the reader, exposing the concerns facing the VLSI industry, while maintaining the

theoretical flavor of the First Edition. New material has been added to all chapters, new sections have been added to most chapters, and a few chapters have been completely rewritten. The textual material is supplemented and clarified by many helpful figures. Audience: An invaluable reference for professionals in layout, design automation and physical design.

LS Swaps Springer

This text addresses the design methodologies and CAD tools available for the systematic design and design automation of analogue integrated circuits. Two complementary approaches discussed increase analogue design productivity, demonstrated throughout using design times of the different design experiments undertaken.

The Electrical Journal Springer Science & Business Media

This volume of the series ARENA2036 compiles the outcomes of the first Stuttgart Conference on Automotive Production (SCAP2020). It contains peer-reviewed contributions from a theoretical as well as practical vantage point and is topically structured according to the following four sections: It discusses (I) Novel Approaches for Efficient Production and Assembly Planning, (II) Smart Production Systems and Data Services, (III) Advances in Manufacturing Processes and Materials, and (IV) New Concepts for Autonomous, Collaborative Intralogistics. Given the restrictive circumstances of 2020, the conference was held as a fully digital event divided into two parts. It opened with a pre-week, allowing everyone to peruse the scientific contributions at their own pace, followed by a two-day live event that enabled experts from the sciences and the industry to engage in various discussions. The conference has proven itself as an insightful forum that allowed for an expertly exchange regarding the pivotal Advances in Automotive Production and Technology.

A Priori Wire Length Estimates for Digital Design CRC Press

The magazine of mobile warfare.

Pin Assignment and Routing on a Single-layer Pin Grid Array Springer Science & Business Media

Regular Fabrics in Deep Sub-Micron Integrated-Circuit Design discusses new approaches to better timing-closure and manufacturability of DSM Integrated Circuits. The key idea presented is the use of regular circuit and interconnect structures such that area/delay can be predicted with high accuracy. The co-design of structures and algorithms allows great opportunities for achieving better final results, thus closing the gap between IC and CAD designers. The regularities also provide simpler and possibly better manufacturability. In this book we present not only algorithms for solving particular sub-problems but also systematic ways of organizing different algorithms in a flow to solve the design problem as a whole. A timing-driven chip design flow is developed based on the new structures and their design algorithms, which produces faster chips in a shorter time.

Telegraphic Journal and Electrical Review Mit Press

The papers in this book were presented at the CMU Conference on VLSI Systems and Computations, held October 19-21, 1981 in Pittsburgh, Pennsylvania. The conference was organized by the Computer Science Department, Carnegie-Mellon University and was partially supported by the National Science Foundation and the Office of Naval Research. These proceedings focus on the theory and design of computational systems using VLSI. Until very recently, integrated-circuit research and development were concentrated in the device physics and fabrication design disciplines and in the integrated-circuit industry itself. Within the last few years, a community of

researchers is growing to address issues closer to computer science: the relationship between computing structures and the physical structures that implement them; the specification and verification of computational processes implemented in VLSI; the use of massively parallel computing made possible by VLSI; the design of special purpose computing architectures; and the changes in general-purpose computer architecture that VLSI makes possible. It is likely that the future exploitation of VLSI technology depends as much on structural and design innovations as on advances in fabrication technology. The book is divided into nine sections: - Invited Papers. Six distinguished researchers from industry and academia presented invited papers. - Models of Computation. The papers in this section deal with abstracting the properties of VLSI circuits into models that can be used to analyze the chip area, time or energy required for a particular computation.

A Framework for Simultaneous Placement and Routing of Radio Frequency Circuits Springer Science & Business Media

Multithreaded computer architecture has emerged as one of the most promising and exciting avenues for the exploitation of parallelism. This new field represents the confluence of several independent research directions which have united over a common set of issues and techniques. Multithreading draws on recent advances in dataflow, RISC, compiling for fine-grained parallel execution, and dynamic resource management. It offers the hope of dramatic performance increases through parallel execution for a broad spectrum of significant applications based on extensions to 'traditional' approaches. Multithreaded Computer Architecture is divided into four parts, reflecting four major perspectives on the topic. Part I provides the reader with basic background information, definitions, and surveys of work which have in one way or another been pivotal in defining and shaping multithreading as an architectural discipline. Part II examines key elements of multithreading, highlighting the fundamental nature of latency and synchronization. This section presents clever techniques for hiding latency and supporting large synchronization name spaces. Part III looks at three major multithreaded systems, considering issues of machine organization and compilation strategy. Part IV concludes the volume with an analysis of multithreaded architectures, showcasing methodologies and actual measurements. Multithreaded Computer Architecture: A Summary of the State of the Art is an excellent reference source and may be used as a text for advanced courses on the subject.

New York Review of the Telegraph and Telephone and Electrical Journal Springer Science & Business Media

This thesis presents four new algorithms to route noncrossing power and ground trees in one metal layer of a VLSI chip. The implementation of the best algorithm forms MIT's Placement-Interconnect (PI) Projects power-ground routing phase. The input of this power-ground algorithm is a set of rectangular modules on a rectangular chip. Because of bonding limitations, the pads are placed along the chip's perimeter, while the logic modules are placed in the interior. In constructing the power-ground layout, the algorithm first lays a ground ring between the pads and the chip's perimeter, then a power ring between the logic modules and the pads. Next, a tree of wires connects the ground pad with the logic modules' ground connection points. Then, starting at various points on the power ring, several branches of wires connect the power ring to the logic modules' power connection points. A tree-traversal algorithm then uses the modules' current requirements to determine how much current will flow through each power-ground wire during the chip's operation. An algorithm then widens each wire to the width appropriate for carrying that current. (Author).

Memory, Microprocessor, and ASIC Springer Science & Business Media

A number of interconnection algorithms exist and have been used quite successfully. However, most of them, though differing in detail, appear to subscribe to the same underlying philosophy which has developed from that for single layer boards. Arguments are advanced which question the validity of this philosophy in this environment of multilayer board technology. A new philosophy is developed in this report, which, it is

hoped, will be more suited for use with multilayer boards. Based on this philosophy, an interconnection algorithm is then developed in a step by step fashion.

Disruptive Logic Architectures and Technologies Springer Science & Business Media

This volume gives the proceedings of the ninth Symposium on Theoretical Aspects of Computer Science (STACS). This annual symposium is held alternately in France and Germany and is organized jointly by the Special Interest Group for Fundamental Computer Science of the Association Francaise des Sciences et Technologies de l'Information et des Syst mes (AF CET) and the Special Interest Group for Theoretical Computer Science of the Gesellschaft für Informatik (GI). The volume includes three invited lectures and sections on parallel algorithms, logic and semantics, computational geometry, automata and languages, structural complexity, computational geometry and learning theory, complexity and communication, distributed systems, complexity, algorithms, cryptography, VLSI, words and rewriting, and systems.

VLSI Systems and Computations Springer Science & Business Media

VLSI Design Environments investigates design alternatives such as object oriented data modelling. The difficulty of automating chip architecture designs is caused by the complexity of the problem. The explosion of design decisions make a heuristic approach necessary. PLAYOUT aims at the solution of system problems based on hierarchy, top-down planning, silicon compiler presentations, advances in encoding logic synthesis and a microarchitectre and logic optimization system. PLAYOUT supports the physical design from entering the structure of digital systems to the generation of the mask. The concept for autonomous tools with a clear interface to the network description and the simple interface to the graphics is presented. This enables the designer to have a great influence on the configuration of the placement of the schematic diagram. Substantial progress is being made in behavioural and logic synthesis, both of which depend upon specifications.

Algorithms for VLSI Physical Design Automation Single-layer Wire Routing This dissertation concerns the problem of routing wires on a single layer of an integrated circuit or printed circuit board, starting from a sketch of the layer. A sketch specifies the positions of layout features and the topology of the interconnecting wires. Efficient algorithms are presented that (1) determine whether a sketch is routable, and (2) produce for a routable sketch a proper routing that minimizes both individual and total wire length. Both algorithms run in time $O(sq n \log n)$ on input of size n , and both are simple to implement. They can be adapted to a variety of wiring models, and they subsume most of the polynomial-time algorithms in the literature for single-layer routing and routability testing. The algorithms are based on two theorems concerning the routings of a sketch. One states that a sketch is routable if and only if for each cut between fixed features, the total amount of wiring forced to cross the cut is no greater than the length of the cut. The second theorem states that every routable sketch has a routing that simultaneously minimizes the length of every wire, and that it characterizes the wires in this routing. To formalize and prove these theorems, a rich mathematical theory of single-layer wire routing is developed. Its central tool, which is new to the wire-routing literature, is the lifting of wires and cuts to a simply connected topological covering space of the routing region. An Experiment in Wire Routing A Priori Wire Length Estimates for Digital Design

This book discusses the opportunities offered by disruptive technologies to overcome the economical and physical limits currently faced by the electronics industry. It provides a new methodology for the fast evaluation of an emerging technology from an architectural prospective and discusses the implications from simple circuits to complex architectures. Several technologies are discussed, ranging from 3-D integration of devices (Phase Change Memories, Monolithic 3-D, Vertical NanoWires-based transistors) to dense 2-D arrangements (Double-Gate Carbon Nanotubes, Sublithographic Nanowires, Lithographic Crossbar arrangements). Novel architectural organizations, as well as the associated tools, are presented in order to explore this freshly opened design space.

1795-1895: One Hundred Years of American Commerce ... Springer Science & Business Media

This book explores fundamental aspects of geometric network optimisation with applications to a variety of real world problems. It presents, for the first time in the literature, a cohesive mathematical framework within which the properties of such optimal interconnection networks can be understood across a wide range of metrics and cost

functions. The book makes use of this mathematical theory to develop efficient algorithms for constructing such networks, with an emphasis on exact solutions. Marcus Brazil and Martin Zachariassen focus principally on the geometric structure of optimal interconnection networks, also known as Steiner trees, in the plane. They show readers how an understanding of this structure can lead to practical exact algorithms for constructing such trees. The book also details numerous breakthroughs in this area over the past 20 years, features clearly written proofs, and is supported by 135 colour and 15 black and white figures. It will help graduate students, working mathematicians, engineers and computer scientists to understand the principles required for designing interconnection networks in the plane that are as cost efficient as possible.

The Aeroplane Springer Science & Business Media

This book constitutes the refereed proceedings of the 8th International Symposium on Reconfigurable Computing: Architectures, Tools and Applications, ARC 2012, held in Hongkong, China, in March 2012. The 35 revised papers presented, consisting of 25 full papers and 10 poster papers were carefully reviewed and selected from 44 submissions. The topics covered are applied RC design methods and tools, applied RC architectures, applied RC applications and critical issues in applied RC.

IEEE International Conference on Computer Aided Design IEEE Computer Society

Programmable Logic Devices (PLDs) have become the key implementation medium for the vast majority of digital circuits designed today. While the highest-volume devices are still built with full-fabrication rather than field programmability, the trend towards ever fewer ASICs and more FPGAs is clear. This makes the field of PLD architecture ever more important, as there is stronger demand for faster, smaller, cheaper and lower-power programmable logic. PLDs are 90% routing and 10% logic. This book focuses on that 90% that is the programmable routing: the manner in which the programmable wires are connected and the circuit design of the programmable switches themselves. Anyone seeking to understand the design of an FPGA needs to become literate in the complexities of programmable routing architecture. This book builds on the state-of-the-art of programmable interconnect by providing new methods of investigating and measuring interconnect structures, as well as new programmable switch basic circuits. The early portion of this book provides an excellent survey of interconnection structures and circuits as they exist today. Lemieux and Lewis then provide a new way to design sparse crossbars as they are used in PLDs, and show that the method works with an empirical validation. This is one of a few routing architecture works that employ analytical methods to deal with the routing architecture design. The analysis permits interesting insights not typically possible with the standard empirical approach.

Computer Minimization of Wire Routing for Single Family Dwellings Springer Science & Business Media

Introduced in 1997, the GM LS engine has become the dominant V-8 engine in GM vehicles and a top-selling high-performance crate engine. GM has released a wide range of Gen III and IV LS engines that deliver spectacular efficiency and performance. These compact, lightweight, cutting-edge pushrod V-8 engines have become affordable and readily obtainable from a variety of sources. In the process, the LS engine has become the most popular V-8 engine to swap into many American and foreign muscle cars, sports cars, trucks, and passenger cars. To select the best engine for an LS engine swap, you need to carefully consider the application. Veteran author and LS engine swap master Jefferson Bryant reveals all the criteria to consider when choosing an LS engine for a swap project. You are guided through selecting or fabricating motor mounts for the project. Positioning the LS engine in the engine compartment and packaging its equipment is a crucial part of the swap process, which is comprehensively covered. As part of the installation, you need to choose a

transmission crossmember that fits the engine and vehicle as well as selecting an oil pan that has the correct profile for the crossmember with adequate ground clearance. Often the brake booster, steering shaft, accessory pulleys, and the exhaust system present clearance challenges, so this book offers you the best options and solutions. In addition, adapting the computer-control system to the wiring harness and vehicle is a crucial aspect for completing the installation, which is thoroughly detailed. As an all-new edition of the original top-selling title, *LS Swaps: How to Swap GM LS Engines into Almost Anything* covers the right way to do a spectrum of swaps. So, pick up this guide, select your ride, and get started on your next exciting project.

Regular Fabrics in Deep Sub-Micron Integrated-Circuit Design Information Gatekeepers Inc

Timing, memory, power dissipation, testing, and testability are all crucial elements of VLSI circuit design. In this volume culled from the popular *VLSI Handbook*, experts from around the world provide in-depth discussions on these and related topics. Stacked gate, embedded, and flash memory all receive detailed treatment, including their power cons

The Electrical Review Springer Nature

Abstract: "This work aims to address the lack of fundamental layout tools for Radio Frequency circuits, which are inherently different from other circuit families like digital CMOS for which we have mature automation tools. We introduce a subtree-driven slicing tree-based floorplanner that places objects down to individual devices. We also present a gridless, detailed, dynamically resized maze router that optimizes planarity, crosstalk and number of bends for each wire along with routing length. A genetic algorithm optimizer combines the floorplanner and router by routing every floorplan generated to assess the quality of the overall design. This strategy achieves simultaneous evolution of the placement and routing. Length constraints on wires are satisfied by meandering next to one of the two modules being connected. This further integrates routing and placement to allow better overall area optimization. The layout framework introduced in this thesis will be the basis for a more advanced tool suite that can handle subtle electromagnetic interactions to aid the designer in rapid prototype production. The current implementation can successfully optimize planarity, realize multiple constraints on nets, and achieve reasonable area utilization in acceptable computational time."

Multithreaded Computer Architecture: A Summary of the State of the ART This pioneering study of two-dimensional wiring patterns develops powerful algorithms for the physical design of VLSI circuits. Its homotopic approach to circuit layout advances the state of the art in wire routing and layout compaction, and will inspire future research. By viewing wires as flexible connections with fixed topology, the author obtains simple and efficient algorithms for CAD problems whose previous solutions employed, unreliable or inefficient heuristics. *Single-Layer Wire Routing and Compaction* is the first rigorous treatment of homotopic layouts and the techniques for optimizing them. In a novel application of classical mathematics to computer science, Maley characterizes the ideal routing of a layout in terms of simple topological invariants. He derives practical algorithms from this theoretical insight. The algorithms and their underlying ideas are intuitive, widely applicable, and presented in a highly readable style. F. Miller Maley is a Research Associate in the Computer Science Department at Princeton University. *Single-Layer Wire Routing and Compaction* is included in the series *Foundations of Computing*, edited by Michael Garey and Albert Meyer.