# APPLICATION OF ELECTRONIC DESIGN AUTOMATION IN ELECTRONIC DESIGN

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**Abstract:** The emergence of electronic design automation (EDA) brings a whole new concept to the field of electronic design. The manufacturing process of electronic equipment is also becoming more and more complex, and it is inseparable from the various stages of the development of various electronic devices from R & D to factory processing Electronic circuit electronic design automation, it is the inevitable trend of the development of electronic design. This paper briefly introduces the development and characteristics of EDA technology, discusses the general method of electronic design using EDA, the basic process and project-related analysis, points out the existing problems of electronic design automation, and prospects for the future of electronic design automation technology. The trend of development.
**Keywords:** Electronic design automation EDA electronic design electronic circuit development.

**Introduction**

With the development of the electronics industry and the advent of large-scale and very large-scale integrated circuits, circuit design and analysis have become more and more complex, and the requirements for circuit design reliability and design cycle are getting higher and higher. Artificial design and analysis circuits Approach has been unable to meet the general requirements, therefore, with the help of computer simulation and analysis of the circuit has become very important. On the other hand, with the rapid development of computer industry, its characteristics such as high speed, large capacity, high precision and convenient operation make the computer become an excellent technical condition for circuit simulation and thus promote the development of circuit simulation technology.

At the same time, with the continuous development of semiconductor technology, the integration of integrated circuits is getting higher and higher, the number of gate circuits per unit area is more and more. In order to solve the design and development problems of large scale integrated circuits, Electronic Design Automation (EDA) Technology came into being, EDA technology is based on CAD (Computer Aided Design) gradually evolved from the main

programmable logic circuit for the design and development of objects, the use of software tools to complete the input from the circuit, logic synthesis, process mapping, layout Wiring, bit stream download the whole process of a comprehensive technology.

The emergence of EDA technology to develop designers from the complicated work to liberate, greatly reducing the designer's work tasks, designers can spend more time on the functional design of the circuit, and the specific realization of the work by the computer Automated, greatly improving the efficiency and quality of circuit design. EDA technology has thus become an integral part of modern electronic circuit design.

## 1. The advantages of electronic design automation in electronic design

Electronic Design Automation (EDA) is a computer-aided design (CAD) universal software package that is based on the computer as the working platform and integrates the latest technological achievements in application of electronic technology, computer technology and intelligent technology. As an emerging technology, EDA Widely used in machinery, electronics, communications, aerospace, chemical, mineral, biological, medical, military and other fields. EDA is a rapidly developing new technology, covering a wide range of content-rich, mainly refers to the large-scale programmable logic device as the design carrier, the hardware description language (HDL) as the system logic describes the main expression, with computer, development Software and experimental development system as a design tool to automatically complete the logical compilation, simplification, segmentation, synthesis, optimization, layout, routing and simulation of electronic systems and hardware systems by software development through software development until the appropriate target chip With compiled, logical mapping and programming downloads, etc., eventually forming integrated electronic systems or ASICS. Among them, the main advantages of using EDA technology in the field of electronics are as follows:

First, shorten the design cycle. The use of EDA technology, computer simulation instead of manually set up the test circuit, greatly reducing the design verification stage of the workload, speeding up the design process and shorten the design cycle. For complex communication protocols, FPGA programming using VHDL is efficient, flexible and can quickly adapt to standard upgrades. In fact, the development trend of high capacity, high speed and high

performance of FPGAS is precisely to meet the needs of applications in the communications field . FPGA products are increasingly using advanced IEEE 1149.1 Boundary Scan Test (BST) technology and ISP (in system configuration programming). The FPGA on the working system can be programmed in whole or in part at any time in the system and can perform so-called daisy-chain multi-chip serial programming with almost unlimited number of download programming times for SRAM-based FPGAS. This type of programming makes it easy to program infrared, ultrasonic or wireless programming, or remotely online over a telephone line.

Second, improve the design quality. Compared with the traditional mathematical method, the EDA circuit used in the component model is more complex and accurate. Not only that, EDA tools can also simulate the effects of various parasitic parameters. At the same time also overcome the traditional design methods due to the instrumentation access caused by a variety of errors. FPGA / CPLD programming easier to achieve wireless programming, infrared programming, ultrasonic programming or remote online programming via telephone line, and has good encryption. In the field of high reliability applications, MCU's shortcomings leave a lot of use for FPGA applications. In addition to the inherent defect of unreliable MCU reset and PC runaway, the high reliability of FPGAS is reflected in the fact that the entire system can be downloaded on the same chip, which greatly reduces the size, and is easy to manage and shield.

Again, reducing design costs. The use of EDA technology, the traditional design process can be designed, tested, commissioned by the computer work directly and easily carried out. Thus saving a lot of manpower and material resources. MCU does not exist inherent reset reset unreliable and PC defects, but also the entire system can be downloaded on the same chip to reduce the size, easy to manage and shield, which has high reliability.

Finally, shared design resources. In the EDA system, the mature module design and model parameters are stored in the database file, the user can directly share these design resources to the network for other designers to use. Device function blocks can work simultaneously, enabling instruction-level, bit-level, pipeline-level or task-level parallel execution, speed up the computing speed, the computing system implemented by the FPGA can reach the existing general-purpose processors of hundreds or even thousands Times

Computer-aided analysis (EDA) is the core of EDA technology, that is, the circuit structure and component parameters and other physical information input to the computer, the circuit components to establish the corresponding mathematical model, and to solve. The system of equations describing the circuit is determined by the model equations of the components and the circuit topology formed by the components. By solving the circuit equations under different conditions, the circuit design performance can be achieved.

## 2. The application of electronic design automation in electronic design status quo

2.1 The status of foreign research

In EDA tools software development, foreign research is relatively early and more in-depth research, foreign companies and universities and other research institutions more mature than the domestic research. More famous EDA companies and universities are: Cadence, Mentor, Synopsys, Xilinx, Altera and other companies, University of Toronto, University of California, Berkeley and other colleges and universities.

Cadence, the world's largest supplier of EDA support software, covers almost the entire electronic design process from system design and verification, digital system design and verification, custom IC design, analog and RF circuit design, IC package design and analysis to PCB design and analysis, in addition to a series of tool kits and resource libraries.

Mentor is one of the world's top three suppliers of EDA products. Its main products are electrical and wire harness design, electronic system level design, embedded software, FPGA functional verification, FPGA advanced synthesis, IC design, IC manufacturing, IP Intellectual Property, Particle Size Analysis, PCB Design Analysis and Packaging Integration, PCB Manufacturing Integration and Testing, RTL Low Power Design, Silicon Crystal Testing and Site Analysis, System Modeling and Design Management, Vehicle System Design. The table software has ModelSim, Mentor EE, Board Station, HDL Designer Series and so on.

Synopsys is another global supplier of three EDA products. Synopsys focuses on IC circuit design and SoCs design of complex system-on-chip. Its main product areas include TCAD (Technology Computer Aided Design) , Silicon crystal mask synthesis, silicon yield management and other silicon crystal products, Galaxy expandable language design platform, RTL synthesis, based on a comprehensive test platform and a series of design and development

platform, in addition to including a series of simulation verification tools, prototype Research and design platform, low-power electronic design system and user-customized solutions.

Xilinx is the world's largest supplier of programmable logic devices. Its design areas include the entire flow of programmable logic device design such as hardware platform, software platform and system design platform. Its main hardware products are FPGA, Mainstream models SPARTAN, VIRTEX, KINTEX, ARTIX, manufacturing process from 45 nm to 16 nm, the corresponding support software has an early Foundation and now mainstream ISE support software. In addition to FPGAS, Xilinx products include 3D ICS and system-on-chip SoCs.

Altera, the world's second largest supplier of programmable logic devices, designs and develops FPGAS, SoCs and CPLDS. Its mainstream FPGA chips include Stratix, Arria, Cyclone, MAX, The smallest process to 14 nm, the main development software Maxplus , Quartus , Nios and so on.

VPR (Versatile Place and Route), an open source tool software developed by the University of Toronto in Canada, is a common layout and routing tool in FPGA development and design. VPR is also the most widely used FPGA layout and routing tool because of its good Placement and routing performance [1-3], so widely respected, a lot of placement and routing algorithms are based on the VPR to improve and optimize it, because of its good performance, it was acquired by the Transcend semiconductor company, and This greatly enhances the company's products in the layout of the extension of the advantages.

The Berkeley Collaborative Research Center at the University of California, Berkeley, has developed an open source tool, ABC, which is a synthesis and verification tool for binary logic circuits [4-6] that synthesizes files written in hardware description language into A netlist file consisting of look-up table LUT (Look Up Table) and flip-flop FF (Flip Flop) provides an input file for logic cell package after FPGA logic synthesis. ABC is an integrated tool with excellent performance in logic synthesis in FPGA development and design.

2.2 Domestic research status

The EDA market in China is huge, but compared with the European and American countries in research and development started relatively late, the corresponding research and development companies are relatively small, more famous R & D companies and research institutes have

Beijing Huada nine days Software Co., Ltd., Fudan University, Xi'an Electronics University of Science and Technology, University of Electronic Science and Technology. In addition, there are some colleges and universities on the electronic circuit EDA part of the design were studied, such as the Chinese Academy of Sciences, Tsinghua University, Beijing Jiaotong University, Huazhong University of Science and Technology, Zhejiang University, Wuhan University of Technology.

Beijing Huada nine days Software Co., Ltd. (Huada nine days) is the largest EDA suppliers, the main EDA solutions include: mixed digital design software, custom IC design software, SOC digital backend optimization software, digital-analog hybrid IP core, etc. The mainstream application software includes the early Panda system, Zeni system after nine days of upgrade, and ClockExplorer, SOC clock analysis and optimization tool. After nearly 20 years of development, its products have gradually matured and its market share has steadily risen.

Wang Lingli, Lai Jinmei, Tang Pushan, Zeng Xuan and Peng Chenglian from State Key Laboratory of ASIC and Systems, Fudan University conducted extensive and in-depth studies on electronic circuits, especially integrated circuits and programmable logic circuits. Has made a wealth of research results. Hu Xin introduced the first domestic programmable logic chip FDP100K chip structure, developed a corresponding software development environment FDE, and gives a detailed design process, module design and test results [7]. Xie Ding and other detailed Fudan University, a new generation of self-developed programmable logic device FDP2008, the hardware structure of an exhaustive description of the development and design of the corresponding development software FDE2009, and software design, design process, module settings and The test results are described, illustrating the feasibility and applicability of the developed software and hardware [8]. Hong Shengyan proposed a FPGA structure with bus layout software, and verify the feasibility of the proposed software [9]. Ni Gang and other development and design of a suitable FPGA logic cell structure of different process mapping software FDUMap, and the use of test circuit to verify the versatility of the software [10]. Wang Yu and other proposed a new FPGA logic cell structure, developed for this new structure packing tool FPack, to achieve the purpose of reducing the number of logical units to optimize [11]. In addition, researchers at Fudan University's State Key Laboratory of ASICs and

Systems also conducted in-depth and detailed studies on various subsystems of EDA in FPGA design and development, including process mapping, packing algorithm, logic synthesis, Layout and routing, bit stream download, etc. [10,12-17]. At the same time, the corresponding hardware structure was designed [18-19], and the digital module was designed by using the developed software and hardware platform. The excellent performance of the software and hardware platforms designed and developed, in addition to programmable logic devices, has extended the area of research to 3D IC space.

Xi'an University of Electronic Science and Technology Professor Duan Zhenhua and other research projects supported by the FPGA software technology research, and the National Natural Science Foundation of China to support FPGA EDA software research and development of FPGA EDA designed in-depth and extensive research. Zhao Zheng and other assembly language used to describe the structure of the FPGA, FPGA assembly tools to achieve the development [20]. Zhang Lihong et al. Introduced XDFpgaEDA, an FPGA supporting software independently developed by Xidian University, and designed and researched the man-machine interface of the software [21-22]. Wang Pei and other FPGA support software for the bottom of the library design process, that is, the FPGA system modeling to support software to adapt to changes in FPGA architecture [23]. In addition to developing and researching FPGA support software, Xidian University has also conducted in-depth studies on the details of EDA design such as technology mapping, process mapping, timing analysis, behavior synthesis, packing algorithm, placement and routing algorithm Study [24-29]. In addition, Prof. Duan Zhenhua et al. Also studied the EDA design of very large scale integrated circuits.

University of Electronic Science and Technology of Electronic Thin Film and Integrated Device State Key Laboratory of Professor Li Ping, EDA design of programmable logic devices conducted in-depth study. Xie Xiaodong et al. Developed and designed two different FPGA chip architectures, MTP (Multi-Programmable) and OTP (One-Time Programmable), and on the basis of this, designed two kinds of supporting software development tools [30-31]. Wang Yin and other domestic use of China nine days of EDA software programmable memory designed to verify the function of the domestic EDA software [32]. In addition, Prof. Li Ping

also conducted research on layout and layout, process mapping and backend design in FPGA development [33-37], and expanded the research field from FPGA to other integrated circuits such as ASIC, VLSI and SoC.

In addition to the above universities and colleges, Chinese Academy of Sciences, Tsinghua University, Beijing Jiaotong University, Huazhong University of Science and Technology, Zhejiang University, Wuhan University of Technology and other electronic circuits and programmable logic devices EDA technology are also studied, the research focuses mainly on the layout Wiring, process mapping, low power design and some other parts, and has a good reference.

**3, the application of electronic design automation electronic design process**

Application of electronic design automation electronic design of the basic idea is that designers first use EDA tool text or graphic editor of the designer's design ideas expressed in text or graphics, and then compile the system for general syntax and circuit Troubleshooting and formatting for the following logic synthesis and optimization. In the logic synthesis design phase, linking the software design to the implementability of the hardware is a key step in turning the software into a hardware circuit. The combined result is hardware realizable, and the design will be optimized in synthesis to remove redundant logic, conserve resources and improve efficiency.

EDA is a high-level electronic design method, that is, system-level design method. High-level design is a "concept-driven" design that allows designers to focus on their creative Scenarios and Concepts As soon as these conceptual ideas are entered into the computer in high-level descriptive form, the EDA system can automate the entire design in a rule-driven manner. In this way, the new concept can be quickly and effectively become a product, greatly reducing the product development cycle. Not only that, high-level design is only to define the behavior of the system can not be involved in the realization of technology, integrated library vendor support, the use of integrated optimization tools can be transformed into a high-level description of a netlist for a process optimization, process conversion It's easy and easy Specific design process such as Figure 1 shows.

First, start the Foundation Project Manager, you can see the workflow include: Design Input, Logic Synthesis, functional Simulation, Design Implementation, Timing verification, Programming Download. In the design input stage, you can use the design input tools: HDL editor, Schematics Editor, state machine editor. Which HDL editor\supports Verilog, VHDL,ABEL. The most common input method in high-level design is HDL code input. Design start using the EDA tool text or graphic
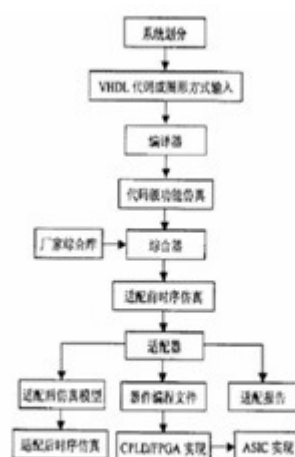


Figure 1 electronic design automation

editor designer's design intent The way or graphics (schematic, state diagram, etc.) expressed. VHDL generation after the code input is complete, we must first configure the environment, and then use the compiler to compile the design Project, automatically through the compiler error checking, netlist extraction, logic synthesis, the device Fit, eventually generating device programming files.

Second, after the completion of the design description can be compiled by the compiler debugging, into a specific text format, to prepare for the next comprehensive. Here, for most EDA software, which input format was used in the initial design is optional and can be mixed. General schematic diagram input method is easy to grasp, intuitive and convenient, the circuit diagram drawn by the traditional device connection exactly the same, it is easy to be accepted, but there are many ready-made editors in the device available, you can also according to Need to design the component (the function of the component can be expressed in HDL, but it can still be expressed in schematic). Of course, the most general, the most universal input method is the text of the HDL program. This method is the most common. If the compiled file is a standard VHDL file, you can simulate the described content before synthesis, which is called behavioral simulation. The design of the source code will be sent directly to simulate the VHDL simulator. Because the simulation at this time is only based on the semantics of VHDL, has nothing to do with the specific circuit. In the simulation, you can give full play to the VHDL for simulation control of the statement, for large-scale circuit design, the simulation

process is very necessary, but in general, you can skip this step. In the design simulation verification stage, the integrated netlist file can be used for function and timing simulation to verify the designed circuit.

Third, the third step in the design is synthesis, linking the software design to the implementability of the hardware, which is a key step in turning software into hardware. Synthesizer source file synthesis is targeted at a FPGA / CPLD supplier product line, therefore, the combined result with hardware realizability. After synthesis, the HDL synthesizer can generally generate netlist files in formats such as EDIF, XNF or VHDL that describe the most basic gate structure from the gate level. Some EDA software, such as Synplify, has the ability to draw netlist files into different levels of schematics for designers. After synthesis, the resulting netlist file can be used for functional simulation to understand the consistency of the design description and design intent. Functional simulation is performed only on the logic functions described by the design.

Finally, the FPGA layout / routing adapter must be used to logically map the synthesized netlist file to a specific target device, including the underlying device configuration, logic partitioning, logic optimization, and placement and routing. Timing simulation is a simulation that approximates the operation of a real device. The hardware characteristics of the device have been taken into account during the simulation, so the simulation accuracy is much higher. Timing simulation netlist file contains more accurate delay information. If all of the above processes, including compilation, synthesis, wiring / adaptation and behavioral simulation, functional simulation, and timing simulation have found no problems, that is to meet the requirements of the original design, the configuration / download files generated by the adapter can be passed through the FPGA programmer Or download cable into the target chip FPGA or CPLD and then perform hardware emulation or testing to verify the design's operation in a more realistic environment. The so-called hardware simulation here is for ASIC design. In the ASIC design, the more commonly used method is to use the FPGA to design the system for functional testing, and then through the VHDL design to ASIC form; and hardware testing is for FPGA or CPLD directly for the detection of the circuit system of. In the programming download stage, after the simulation is confirmed that the design is correct, the design project

can be downloaded into the target device FPGA through the Multi LINX cable or the JTAG programmer to finish the design work.

**4, the existing problems and development trends**

After several decades of development, EDA technology has become an indispensable technology in the modern electronic design process. With the continuous improvement of microelectronic technology, EDA technology also evolves and develops, but there are still some problems , But also the future development of EDA technology trends.

First, normative, cross-platform. At present, the major EDA manufacturers out of business efficiency considerations, the development of EDA tools are often only applicable to their own hardware platform, so when the development platform changes, you need to switch between different EDA tools to complete the development work. The future trend of EDA technology is to have a better cross-platform, not just the hardware platform, but also the operating system changes, so that researchers can once developed and used everywhere, greatly improving the reusability of R & D results. In addition to better cross-platform, another trend of EDA technology is better normative, because EDA technology involves many aspects of the design process, requires a lot of software collaboration tools to complete the design process, so the need for better regulatory , In order to improve the compatibility of different tool components to improve system development efficiency.

Second, functional breakdown, the overall integration. Existing EDA vendors provide development software or tools, most of them consider the EDA design of the entire process, the whole system, to provide users with good compatibility, but also reduces the performance of all aspects, so the user during use , In order to optimize a certain part of the goal, often need to use third-party software to optimize the design results, so the future trend of EDA technology trend is more subdivided, it is impossible with a big tool to the entire Process optimization, functional subdivision in order to achieve the purpose of optimization, but also need a large framework to integrate various sub-tools, subsystems to complete the entire EDA

Life cycle design.

Third, independence and IP (Intellectu-al Property) nuclear. The emergence of EDA technology, making the independence between hardware and software more obvious, designers

or users can get rid of the dependence on a particular hardware well, because the traditional design of the electronic system is bottom-up design, once the system A component is damaged or faulty, in order to system reliability and stability, generally choose to replace the same parts to repair, and the emergence of EDA technology allows users to get rid of this dependence, as long as the development process and then re-download to the programmable logic device In the replacement of damaged or failed parts, without having to select the same parts, the future of EDA technology will be less dependent on the hardware platform, hardware and software independence will be more obvious. Another major trend of EDA technology is the further application and promotion of IP core. The emergence of IP core greatly improves the reusability of developers' work results. As a follow-up developer, the existing IP core can be used to achieve more powerful Function, which greatly improves development efficiency and shortens the development cycle.

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