EDA Tools Improve Through Programming Advances and User Feedback

There is no question that EDA tools are among the most important design aids for today's engineers. Since the introduction of the earliest practical RF/microwave software in the 1980s, developers have been striving to make their products more accurate, easier to use, faster in their computation, and as comprehensive as possible.

In the era before the personal computer, EDA tools—whether for high frequency design or general electronics—were limited in scope and speed, not to mention the limits on access due to the batch processes used for mainframe computers. Most of today's senior engineers remember the time it took to create a deck of punch cards, wait for the results, and hope that there weren't too many typing mistakes that required another delivery of cards to the computer center and another wait for the results.

Fortunately, the mainframe computer and batch processing have gone the way of the slide rule. Early personal computers became popular almost instantly, despite their apparent deficiencies in power compared to mainframes or even so-called minicomputers that only took up part of an equipment rack instead of a whole room. Engineers have always appreciated the best math tools, and the PC was the next big step. Not only could the computations be performed like a programmable calculator, but the data input and output could be pre-formatted in a usable manner, and the numerical results printed—and eventually plotted—for a permanent record and for sharing with colleagues. This is where we will start our look at the things that make today's EDA tools better than just a few years ago.

Documentation and Data Sharing

One of the most dramatic impacts of growing EDA tool usage is in record-keeping and the sharing of the data—not only among engineering staff, but from one piece of software to another, and from the software to hardware. The last issue of this magazine featured a new release from Applied Wave Research (AWR) that emphasized its new capabilities for easy interaction with multiple tools. In particular, all EDA vendors are making sure that the electronic design portion of their tools can be seamlessly integrated with physical p.c. board and IC layout tools, and with the electromagnetic (EM) analysis engine preferred by the user, which may be a third-party product.

Engineers, especially project managers, appreciate the ability of software to save simulation setups (including industry standards) and design iterations, then record and track the results of each version. While this capability has been included in EDA tools for some time, its importance has grown along with the reliance on simulation versus workbench experimentation. In particular, the inclusion of setups based on specific telecommunication standards is more important than ever, and therefore a high priority for product vendors.

As noted previously, the interconnection of multiple types of design software, test equipment hardware, and fabrication support tools is a current trend in EDA tools, and is based on customer requirements for end-to-end simulation, testing and manufacturing—and the easiest possible means of iteration when needed. First pass success is every designer's goal, but it doesn't always happen. However, getting the *second* pass right is essential, which is one place where a complete record of the earlier work is indispensible.

Software Development and the PC Platform

Programming techniques, mathematical algorithm development and support from Microsoft and other providers of tools for programmers have played a big role in the ability of EDA tool vendors to continually improve their products. Software developers don't always appreciate the importance of the application of their craft. After all, it's their everyday job to use the latest programming techniques. New features are essential, but they can only work properly if the program is well-structured and operates trouble-free on all the different PC hardware that is on the market.

In the past few years, Agilent EEsof EDA notes that they have made a significant commitment to improve the robustness of their EDA tools. As their spokesperson put it, "We have matured from 'testing quality in' to 'designing quality in' and made how we do our work a competitive advantage."

Agilent feels that the biggest impact was made when they held formal, cross-functional Requirement and Design Reviews before implementation. This has been broadly adopted across R&D—they held more than 50 design reviews during the last main release of ADS and RFDE. "These cross-functional reviews allow us to draw on the collective experience of people who have been in the EDA business for many years and it improves the overall quality of the product."

Robust operation is a greater challenge than ever, given the size and complexity of today's EDA packages. Talented and disciplined programmers must manage a program structure that accommodates such current practices as multi-user environments, multiprocessing and internal data sharing among numerous program elements, sub-programs and external programs.

Fortunately, PC hardware has been able to keep pace with programming advances, offering a level of desktop computing power that was hard to imagine as little as 10 or 15 years ago, at prices that no one would ever have guessed that long ago. The speed, memory and display capability of today's computers have, to a large degree, allowed EDA tool developers to implement complex software and simultaneously increase its operating speed.

Changes in User Needs and Attitudes

All EDA companies maintain close contact with their customers. For example, Ansoft Corporation's user group meetings are well-known for demonstrating the wide range of problems that users are called on to solve. Some users are primarily design oriented, others are concerned with analysis, while still others emphasize the manufacturing end of the engineering development process.

Sorting out all the feedback is not an easy task. A single focus group of a dozen users—a common practice in the 1980s and '90s—just won't accomplish much. Such limited attention may be good for a specific program feature, but can only be considered one small input concerning the entire EDA package.

User feedback is a continual process that must be managed as closely as the structure of a complex program. This puts business management at a higher level of importance than at any time in the past in this industry segment. Sales and applications support personnel must collect data completely and accurately, the programming staff must be able to identify trends in the technical issues, and management must be able to see both immediate and long-range implications of the things that users tell the company about their product.

One recent development among users is an increased reliance on their EDA tools. As Agilent puts it, "The mentality towards software development is becoming more mature. Engineers are taking a more methodical approach to design, where it is viewed as more of a science than an art. In general, having a quality product is a requirement for survival in the competitive EDA landscape. Designers rely on these tools and have to trust the accuracy of the data."

The key statement that design is viewed as more of a science than an art is confirmed by all EDA companies. In the early days of computer tools, they were viewed by the users as design aids, like a reference book or a fast calculator. The design process took place completely in the heads of the engineers working the project. While this is, in general, still the right approach, there is no longer a need to keep designers and their tools separated. In present use, EDA tools are literally an extension of the mind of the engineer, and the connection among many different engineers' minds.

A Design Process Example

Let's suppose that a company has decided to develop a new wireless product that will network all the voice, data and entertainment devices in a private home. Here are some of the major design issues that the team will face, and how EDA tools can help:

- Will the product use an available chipset, a collection of "building block" devices, or a semi-custom RFIC?

Models will be available for existing parts, which should speed design and performance evaluation. If a custom IC is needed, design setups for the selected foundry make it possible for the designers to do their work without needing to become IC design experts.

- Is the modulation and data protocol proprietary or will it conform to an existing (or proposed) standard?

Today's EDA tools have data for major standards included or available, but are flexible enough to build a new setup that can be saved and shared among the members of the design group (present and future).

- Is the intended frequency range populated with other users—with potential interference that impairs transmission reliability?

End-to-end signal integrity, including circuit, propagation and interference effects can be simulated to assure robust performance in the anticipated operating environment.

- Will the antennas be internal or external, and how will they be mounted?

Electromagnetic analysis of the enclosure can be used to select an appropriate antenna mounting location, or at least verify the efficiency and show the radiation pattern.

- What are the required parameters for transmit power and receive sensitivity.

With impairments and antenna patterns identified, the link can be analyzed for the required signal-to-noise levels. Circuit designers can make design tradeoffs for size, cost and power consumption that include the effects of the entire link.

- Will the completed devices comply with FCC and CE mark regulations for electromagnetic compatibility?

EDA tools are available that can analyze the entire circuit and packaging assembly, to predict the radiation and susceptibility characteristics of the unit. The simulation can then be used for troubleshooting and evaluation of methods for correcting any deficiencies.

- Can we save money and maintain performance by using a cheaper p.c. board material that is preferred by the contract manufacturer?

Comparisons among various substrate materials is easy and reliable if substrate-scalable component models are used, such as those offered by Modelithics. In addition, layout and component changes are easily implemented and evaluated with the ability of current EDA tools to apply those changes to all portions of the simulation environment—layout, EM analysis, circuit simulation, and full-system signal throughput.

Summary

Today's EDA tools are extremely powerful. They have achieved this level of performance through a combination of factors, from basic software coding to using the most accurate mathematical models. Then, the features incorporated have been developed according to extensive and thoughtful response to user feedback.

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