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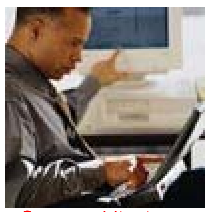
Integration allows designers to use best-in-class software

Circuit designers are using an increasingly diverse set of simulation tools. Martin Timm argues that the industry must develop open architectures that allow users to combine programs from various vendors.

Simulation tools are an indispensable part of the radio frequency (RF) and microwave systems design process. The optimization of virtual design prototypes reduces the number of "cut and try" iterations - in which real prototype devices are built and tested - thereby saving time and money.


Open architectures

Today's wireless equipment designers need a range of simulation software that offers maximum versatility and accuracy. Although some software vendors have responded by developing all-in-one packages, in practice designers rely on the combined expertise of several companies.

Most software vendors have a particular area of expertise. This creates a pool of unprecedented diversity in solution methods and approaches from which the engineer may select the most appropriate solution to a given problem. Although this flexibility of choice can confer great technological advantage, it is still a challenge to achieve the easy exchange of data between software from different suppliers. A number of software vendors, including Germany's Computer Simulation Technology (CST) and US-based Agilent Technologies, are addressing the challenge by creating design environments that use modern communication mechanisms to ease the exchange of data.

Simulation techniques

Integration can be very hard because designers must use a broader range of software types as designs become more complex and operating frequencies rise. These types can be divided into three major classes according to the level of abstraction or the underlying numerical method used in the simulation. These main classes are the system, circuit and electromagnetic-field simulation tools.

Each class of tool has a specific range of uses, capabilities, advantages and disadvantages. In addition, each class has a distinct group of users, which may use very different technical vocabularies to describe design parameters and processes. For example, the needs of an engineer involved in signal integrity differ drastically from those of an engineer designing waveguide filters or antennas.

The traditional boundaries between these modelling classes are beginning to blur, however, thanks to the higher operating frequencies and increasingly complex designs of today's circuits. For example, an engineer that traditionally made primary use of a circuit simulator now has to consider 3D electromagnetic effects. As a result, specialist knowledge of 3D field simulation is now needed to produce an accurate design - and obtaining this could entail considerable additional effort by the circuit designer.

The same also applies to software vendors that choose to offer a range of simulation products. To achieve this diversity vendors must push the traditional boundaries of their application range, often taking the company beyond the limits of its main simulation method. At this point the vendor must decide whether the new development work will be done in-house or through collaboration with another firm that specializes in that area.

In-house development usually involves acquiring new staff to achieve the appropriate level of expertise. Then the company must endure a lengthy initial learning period. Finally, the vendor may be able to produce a software package that seems attractive on the surface but is not nearly advanced enough for the needs of engineers working within research and development departments. Indeed, the in-house approach is often not in the best interests of the software vendor or its customers. Instead, vendors should concentrate valuable resources on their area of expertise to maintain key technological advantages and consider other options for providing customers with access to a range of simulation techniques.

One option is to acquire specialist knowledge by buying computer code or even an entire company. However, this strategy will not necessarily increase the usability of the new code because the integration of historically independent programs will remain a key challenge. Indeed, persistent integration problems can effectively nullify any apparent advantages of a single-vendor solution developed in this way.

Collaborative approach

A much better approach is to work with other vendors to ensure a high degree of connectivity between simulation products - thereby giving customers access to a range of simulation systems. Various collaborative approaches can be taken, ranging from the establishment of a loose link between two vendors' development programs to the complete integration of the vendors' software codes.

The collaboration involving Agilent and CST has created a link between the CST Microwave Studio (CST MWS) and Agilent's Advanced Design System (ADS) simulation products. CST MWS is a 3D electromagnetic-field simulator that provides fast and accurate solutions to broadband RF simulation problems and ADS is the industry-standard circuit simulator.

Design Studio

Although Agilent provides an electromagnetic-field simulator for 2D planar structures, it has decided to concentrate on its core competence of circuit simulation. By developing a link to CST MWS, Agilent can provide its users with the precision of a 3D simulator without investing heavily to develop this technology in-house.

Many modern simulation programs are Windows-based and creating links between them can be done with a high degree of automation using Microsoft's distributed component-object model and component object model (COM) technologies. CST has taken advantage of this in its Studio software family, which combines various simulation technologies. It has also implemented a macro language, which is compatible with Visual Basic for Applications, to enhance connectivity. Thanks to these technologies the software can serve as either a client or a server in the Windows environment. This means that the program can control or be controlled by common software, such as MS Word and Excel, or even by specialist software, such as the Matlab mathematics package. This allows the user to create customized interfaces between software tools.

For example, CST Design Studio (DS) is a significant step towards a truly open architecture, which can connect to the generalized S-matrices of blocks. The origin of these blocks is of secondary importance - they can be analytic descriptions of circuit or waveguide elements, Touchstone files, or results from CST MWS or third-party simulators.

The accuracy of the interface between blocks can be improved by considering higher-order mode coupling. Standard links between programs can also support the automatic selection of the most suitable simulation model. For example, if CST DS is assuming the role of simulation manager it can decide whether a 3D model should be selected as an alternative to an analytical approach - and if the frequency range of the analytical model is exceeded it will automatically switch to the 3D representation.

CST MWS and CST DS are so tightly integrated that the full functionality of MWS can be accessed through the interface. This allows 3D modelling to be performed without switching programs or implementing data-update mechanisms. A built-in library facility allows CST DS to handle parameterized elements. Results are stored and if a parameter is changed CST DS checks the stored results to see if a solution is already available before embarking on a new simulation. Although the specialist knowledge is needed to set up these library elements, when in use they do not differ from any other block in the schematic.

The combination of library elements with built-in parameter study and optimization facilities allows the CST DS user to perform design calculations that traverse automatically between vendors and numerical methods. The degree of automation depends on the communication mechanisms implemented within the linked software. In the Windows world, COM and COM-based ActiveX controls are without question the easiest method of enabling comprehensive access to in-code functionality. These technologies also provide straightforward access to parameterization, and allow software vendors to provide stable geometry and simulation set-up mechanisms to keep any additional work by the end-user to an absolute minimum.

The development of an open architecture for wireless design simulations will offer users higher levels of accuracy, efficiency, flexibility and functionality. By taking on the challenges of providing an open architecture suitable for combining best-in-class simulation, vendors will help their customers reduce the time-to-market associated with designing complex circuits.

About the author

Martin Timm is senior application engineer at Germany's CST.

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