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Fractals ease integration **Acquisition boosts RFIC design** **Quality RF drives ULCHs**

Simulation minimizes RF failure

These defects may occur for various reasons. Handsets are produced in large volumes and manufacturers will often use more than one supplier for a specific component. This can result in variations in the size, structure and composition of components and these differences can lead to defects. Other defects such as poor contacts, short circuits or grounding problems can be introduced during the manufacturing process. Some faults are related to the use of new materials such as metal coatings, which are used for shielding components, or composite dielectric–metal materials that are used to give handsets a metallic look and feel.

Three-step process

The handset-simulation process involves three steps. The first step is to import CAD data into the EM tool's modelling environment. Based on OpenGL, SPEAG's QTech rendering engine allows the rapid processing of more than 10 000 CAD parts. This eliminates the need for the time-consuming simplification of large CAD models.

The generation and verification of the EM model is the second step. Creating the correct EM model – in terms of structure, material parameters, grid resolutions etc – is especially challenging when dealing with many CAD parts. SEMCAD X employs an automated grid generator and voxel creator for obtaining reliable and effective grids for the most complex of models.

To be meaningful, virtual failure analysis must be based on a numerical model that is an accurate representation of the physical model. It is therefore imperative that the numerical model is validated using the appropriate performance parameters. These include impedance bandwidth, radiation performance, near-field scans and far-field radiation patterns, and data from SAR measurements.

The third and final step involves failure synthesis and begins after the numerical model has been validated. One approach is to define a failure synthesis matrix that contains a range of different scenarios to be simulated and certain significant parameters to be recorded. A failure synthesis matrix is used for assessing the effects of potential manufacturing defects and variations. These include the effects of different materials, ground connections, shields and mounting tolerances. A scripting engine based on the Python programming language was used to create a semi-automatic system for simulating the effect of these parameters on handset performance behaviour. This type of virtual testing offers a much more cost-attractive way of performing failure analysis than physical testing and can be conducted much earlier in the handset development process.

The next-generation CAD environment is designed to interact with the manufacturing process by allowing virtual prototyping of new technology efficiently. SEMCAD X offers the most advanced, reliable and fastest interactive design environment for assessing virtual failure analysis by integrating optimal performance features such as hardware acceleration for high computation speeds, special dedicated 3D rendering techniques and the Python-based automation/scripting engine. Upcoming new features such as an effective genetic algorithm based on automated optimization algorithms will offer even more reliable, cost and time-efficient solutions in virtual prototyping. The next version of SEMCAD X, V11.0 Edition Moench, scheduled to be released later this year, will provide a special feature that will further simplify the virtual failure analysis process.

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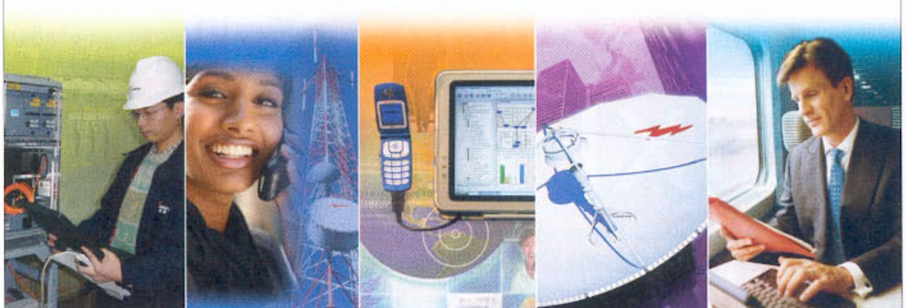

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Simulation tools minimize RF failure in handsets

By Peter Futter of SPEAG

The design, development and testing of complex RF devices such as mobile phones can be a costly and time-consuming process. Traditionally, design engineers and device manufacturers performed antenna design and RF integration separately. The introduction of RF and specific absorption rate (SAR) standards in the mid 90s by the CTIA, ISO and other groups, has imposed significant new restrictions on mobile-phone performance. This has led to an ongoing drive to increase the synergy between the design and RF integration phases.

Many modern handsets operate in multiple bands and have multiple antennas, which must be accommodated within ever-shrinking space allocations. The resulting RF challenges have reinforced the need for closer synergy between the development and production phases. In particular, it is essential to assess and predict potential device failures at an early stage prior to the production phase.

Most antenna optimization software cannot address transmitter design, integration and compliance issues on its own. This is because traditional software suffers from two important limitations: insufficient computational performance and the poor handling of complex computer-aided design (CAD) models.

The electromagnetic (EM) simulation of a detailed mobile-phone structure covering all the relevant operational frequency bands can involve many computational unknowns. Simulation times on the order of hours and days are also required, depending on the level of spatial detail to be resolved.

GUI restrictions

The graphical user interface (GUI) and modelling engines of some simulation tools experience a significant slowdown as the complexity and number of parts in the CAD model increases. This can make it impossible to handle models that contain more than about 100 CAD parts.

These limitations have forced designers to use oversimplified handset models during the antenna optimization process. Models are usually restricted to the antenna and printed circuit board (PCB) only. More complex problems are usually not considered for simulation because of the additional computational resources needed to obtain models with the required accuracy.

Schmid and Partner Engineering (SPEAG) has addressed these challenges in its SEMCAD X, EM- and thermal simulation software platform. Based on the finite-difference time-domain (FDTD) computational technique, the software offers hardware-accelerated models for FDTD. SEMCAD can achieve simulation speeds around 300 000 FDTD cells computed per second (300 Mcells/s). This can be achieved using a standard PC with an aXware accelerator card. The aXware card allows the simulation to run faster than on the latest desktop PC. Thanks to the accelerator, SEMCAD X can run up to 20 times faster than other tools. In figure 1, data are shown for two competing software products and SEMCAD X EIGER, which is the most recent version of SEMCAD runing on a standard PC. Also shown are results for SEMCAD X running on a PC equipped with an aXware card and on a Cluster in a Box (CIB), which is a 64-bit PC with two accelerator cards connected in parallel.

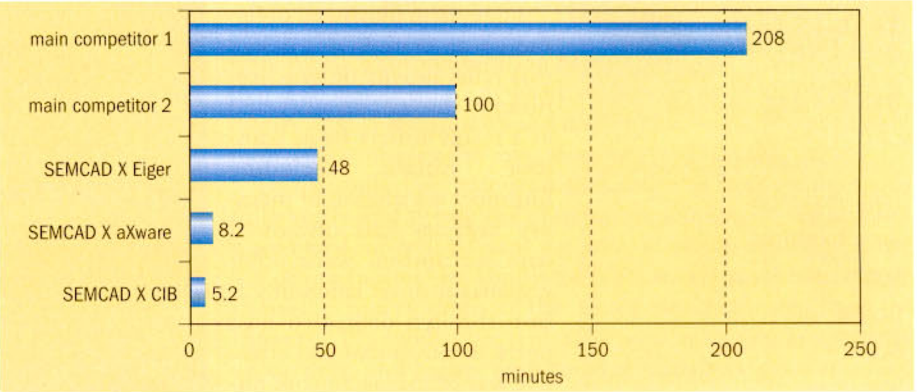

Fig. 1. Runtime comparison for a transmitter-absorber benchmark simulation demonstrating that hardware-accelerated FDTD SEMCAD X can achieve simulation speeds about 10 times faster than those possible on the latest desktop PCs.

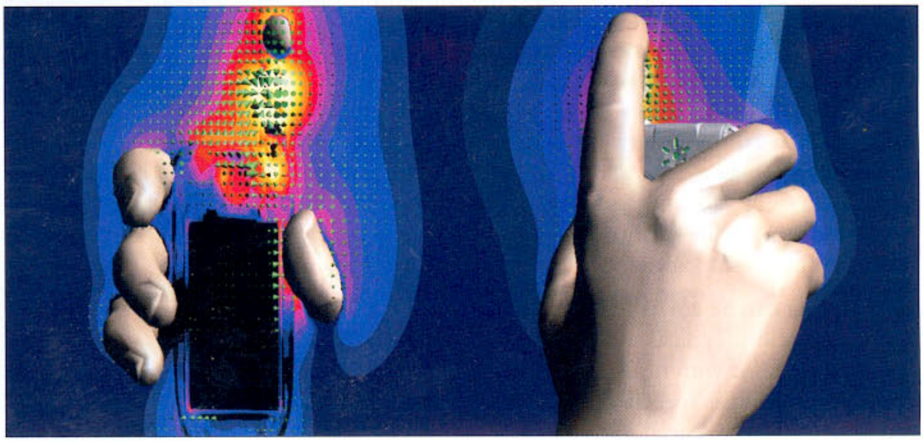

Fig. 2. Modelling the effects of hand positions on RF performance will soon be part of routine virtual RF failure synthesis.

SEMCAD X offers highly efficient routines for importing CAD models and SPEAG's QTech rendering system performs the quasi real-time processing and visualization of highly complex CAD derived models comprising 10 000 or more CAD parts. As a result, the system can simulate detailed mobile-phone structures within several minutes.

As handsets become ever more complex and diverse, SEMCAD X addresses these growing design complexities by bridging the capabilities of virtual prototyping, failure synthesis and whole multiphysics problems.

Failure synthesis involves the simulation of a range of different scenarios to assess potential shortcomings in the handset. For example, a user could hold a phone in several different ways, each having a different effect on performance. Figure 2 shows how SEMCAD X can be used to model the effects of different hand positions on RF performance. This exercise will soon become part of routine virtual RF failure synthesis

The ultimate aim of failure synthesis is to avoid potential problems – or even device failure – and ultimately to improve the overall design of the phone. These shortcomings can cause suboptimum RF performance of the device, failures in standards compliance, or even complete device failures.


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