Electromagnetic Simulation Software Minimizes Design Timescales

A major new release of the well-known Opera electromagnetic design software from Cobham Technical Services greatly improves the speed and accuracy of simulation by extending the flexibility of finite element analysis meshing. The software also includes numerous further enhancements, including an integrated graphical circuit editor for defining associated electrical circuitry such as motor drive components.

Opera, from the Vector Fields Software family, provides a complete design-simulate-analyze-optimize toolchain. It is available in several variants with finite element analysis (FEA) solvers for static and time-varying electromagnetic fields, or with application-specific solvers for design work including rotating electrical machinery, superconducting magnets, particle beams, dielectric insulation, and magnetization/demagnetization processes.

Opera is renowned for its accuracy of simulation and speed of execution - allowing complex problems to be solved on standard office-grade PCs. The latest version 14 of the software extends this fundamental performance advantage substantially by increasing the range of FEA meshing shapes that may be employed to break down a three-dimensional (3D) model of a proposed equipment design into smaller connected elements to simplify numerical solution. In addition to tetrahedral finite element shapes, volumetric models may now be meshed using a 'mosaic' mixture of prism, hexahedral and pyramidal shapes to enhance the accuracy and speed of the simulation solution. This mosaic meshing also improves the speed of any subsequent coupled multi-physics simulations that might be employed.

The new meshing capabilities allow precision simulation to be carried out more quickly especially for challenging models, for example eddy currents flowing in conductor surfaces. This particular case is further aided by a new surface impedance boundary condition, which avoids the need to capture skin effects using the finite element mesh in some situations.

"Meshing improvements mean that Opera's toolchain can now find the ideal solution even faster, further reducing the time and costs compared with physical design iteration cycles, and with no compromise in accuracy. This release increases the extremely large amount of intellectual property already incorporated in this tool suite, to simplify the most challenging of projects," says Cobham Technical Services' Alex Michaelides.

Numerous additional enhancements are incorporated in the new release of Opera. One of the most widely applicable is the integration of a graphical circuit editor for either two-dimensional or three-dimensional versions of the software. This makes it both simpler and quicker to define electrical circuits driving the electromagnetic

equipment being designed - compared with the previous standalone utility that was available. The tool will also interactively interrogate circuit results following simulation - dragging the cursor over a component displays the current and voltage levels for instance. This feature will be particularly beneficial for developers of equipment such as electrical machines and actuators. In addition to the new circuit editor, Opera models may also be co-simulated with other models via a Simulink interface.

The latest release of Opera also extends the performance of many of the solvers to enhance simulation fidelity and speed. One major new option has been added to the generic solvers for two-dimensional electromagnetic simulation. It allows users to choose to simulate the performance of a design idea using either Cobham's established iterative solver for the problem in question, or a new direct calculation solver - which can speed execution by as much as ten times. This option will help developers with large and complex design models, but also gives all users a useful tool for exploring the impact of a wide range of design ideas before homing in on a design space where the optimum solution is likely to exist.

To aid the final optimization of a design concept, Cobham's Opera software package can also be supplied with an advanced auto-optimization tool designed specifically to work with finite element methods and able to work out the best solution for one or multiple goals — even when they compete with each other. For users with demanding and computationally intensive problems, Opera v14 now allows the number of concurrent design simulations to be set to exploit the performance of PCs with multiple processors. New designs can be created before all the previous designs have been analyzed. These features can be used to maximize the use of a multi-processor computer or multiple computers serving a common batch folder: the power of this facility has been proven by Cobham Technical Services by executing over 25,000 simulations in a single session on a multi-computer configuration.

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