TOSCA

3D STATIC EM FIELD COMPUTATION

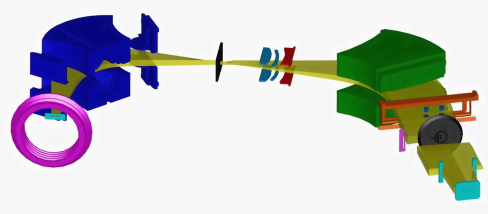
The TOSCA analysis package is a module of the OPERA-3d integrated suite of finite element software for 3D electromagnetic design analysis and simulation. TOSCA computes magnetostatic and electrostatic fields in three dimensions, and is well proven by over 20 years of industrial use. The package is renowned for its accuracy of computation which is the result of extensive research into advanced numerical methods.

TOSCA features the following:

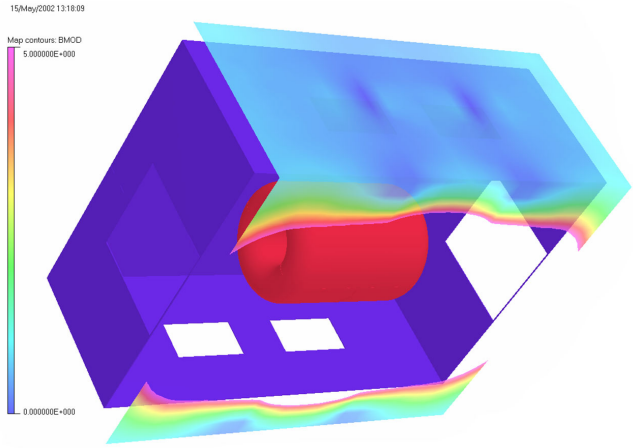
- Full 3D modeling
- Electrostatic field analysis
- Magnetostatic field analysis
- Non linear materials
- Anisotropic materials
- Permanent magnets
- Conductors independent of mesh
- Interfaces to CAD/CAM
- Extendible Post-Processing

Applications

TOSCA is a pioneer in the use of finite element electromagnetic analysis techniques in three dimensions for the design of electrical equipment. Consequently the package is used extensively world wide by leading manufacturers, research laboratories and universities for the design of a wide range of devices from the smallest micromotor to the largest accelerator.



A set of individual magnets can be modeled, and the flow of particles then be tracked through the complete system.



Field from an MRI magnet placed inside a shielded room, modeled using TOSCA. The 5 Gauss line is also visible.

The following list is a selection of some of the design applications for which TOSCA is being used:

- Motors
- Generators
- Recording Heads
- Electron Lenses
- MRI Systems
- Corrosion Protection
- Scientific Apparatus
- Electromagnetic Shielding
- Fusion Magnets
- Particle Accelerators

Optimal design of electrical equipment requires the use of analysis software dedicated to electromagnetics. By using TOSCA to simulate the fundamental electromagnetic performance of a design, the design engineer can evaluate alternative approaches easily and quickly with confidence at the concept stage. This reduces or can even eliminate the need for expensive and time consuming preproduction prototypes.

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Method

TOSCA uses a discrete finite element model in order to solve the partial differential equations governing the behavior of electromagnetic fields. The TOSCA method computes the total potential in the magnetic material and the reduced potential in the regions where source currents have been specified. The reduced potential represents only that portion of the field produced by magnetization, the remainder of the field being computed directly from source currents. By using this method TOSCA avoids the drawbacks of other methods which often produce cancellation errors. As a result, the accuracy of the TOSCA computation is far higher than alternative methods and is proven by over 20 years of comparison with measured results.

The magnetic material properties for TOSCA may be specified as non-linear, anisotropic or permanent magnet. The program uses an iterative solution technique for the matrix of linear simultaneous equations obtained for the potential at each node of the mesh, considerably reducing the memory requirements needed for a direct matrix solution algorithm. The TOSCA program employs a modified Newton-Raphson technique to successfully update the element permeabilities in order to obtain the fields with non-linear materials present.

The results from the program are created in a database for direct examination by the user. The analysis affords restart facilities which allows partially completed solutions to be restarted from the point at which they had previously stopped, additional results to be obtained without re-analyzing, and previous solutions to be exploited when solving a problem with the same geometry, but, for example, different material properties.

Modeler and Post-Processing

As a module of the OPERA-3d suite of software, TOSCA interfaces to the OPERA-3d Modeler and Post-Processor. This gives the user access to powerful pre and post-processing features specifically tailored for electromagnetic design including an advanced Graphical User Interface (GUI) for data input and display of analysis results. Interfaces to industry standard CAD packages are also available.

The OPERA-3d Modeler uses the industry standard ACIS™ kernel and allows the user to build models from primitive shapes using boolean operations. Material data can be selected from a library of characteristics or input from the user's own data. The resulting input is fed directly to the TOSCA analysis module.

The Post-Processor gives the user facilities to display the results of the analysis in a number of ways including:

- 3D model views for any angle
- Graphs, histograms and contour maps of the solution
- Contours of the results on any surface
- Calculation of fields, forces and energy
- Particle tracking
- User defined functions

Hardware

All Vector Fields software runs on PCs and Workstations. It is Vector Fields policy to always support the latest operating system on each hardware. A list of supported hardware, and suggested minimum configurations, is available on request.

Customer Support

Applications advice and "hot-line" support is an integral part of the Vector Fields service. Professional engineers with extensive electrical design experience are available to help users in their application of TOSCA. Your local Vector Fields office or distributor will be pleased to be of assistance at all times.

Comprehensive user documentation is provided with TOSCA enabling new users to quickly apply the software to their application. In addition, training courses are held regularly to give "hands-on" training in the use of TOSCA.

User group meetings are held annually giving users the opportunity to discuss their applications with Vector Fields experts and other users in a relaxed atmosphere.

Whatever your application and wherever you are located, you can be sure of Vector Fields interest and support.

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