Opera-3d Thermal Analysis Module

The most important thing we build is trust

Opera Simulation Software

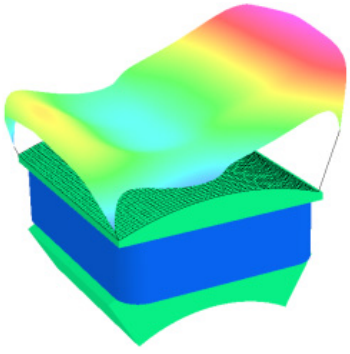
COBHAM

Opera-3d is a finite element (FE) software suite with capabilities for electromagnetic (EM), thermal and structural simulations. The suite includes a range of solver modules, including the 3d Thermal Analysis Module in which users can calculate temperature, heat-flux, and thermal-gradient fields due to electromagnetic heating or external heat sources. This solver was formerly called TEMPO.

3d Thermal Analysis Module

With the 3d Thermal Analysis Module (thermal module), users can compute the steady state or transient temperature, heat-flux, and thermal-gradient fields due to electromagnetic heating or external heat sources. Users can specify thermal properties, such as the conductivity tensor or specific heat, and heat source density as a function of position, and can be temperature dependant (leading to a non-linear analysis).

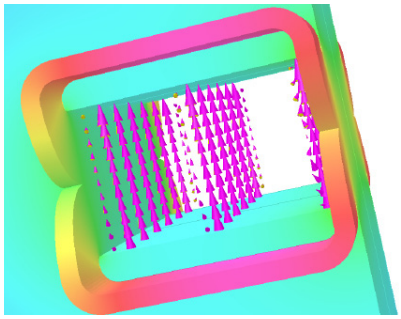
While primarily used to specify the coupling of the thermal system to its surroundings, boundary conditions can also be used to setup symmetry planes to reduce the size of a calculation for appropriate models. The boundary conditions implemented in the thermal module are:



Pole face temperature distribution in a 6-pole synchronous generator rotor

- perfect insulator;
- fixed temperature;
- heat flux;
- heat transfer;
- radiation;
- combination of the above

Users can choose to deploy the thermal module in stand-alone mode, with the user defining the distribution of heat



Temperature distribution and gap magnetic field in an AC septum magnet

input, or in a multi-physics simulation with other OPERA-3d modules providing the distribution of heat. It is possible to include multiple heat sources (for example eddy current heating and iron losses in a motor) in a single calculation, and the thermal module will calculate the temperature distribution in the model, which may modify the electromagnetic solution (if material properties are temperature dependent). By using the 3d Stress Analysis Module, users can analyse the stress induced by thermal expansion. The deformation caused can be used in subsequent thermal and electromagnetic simulations.

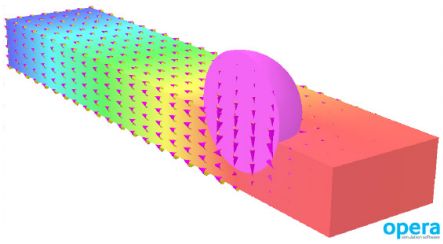
Modeller and Post Processor

Opera-3d includes a geometric modeller used for model data definition, and a geometric post-processor offering results analysis. The Graphical User Interface (GUI) gives access to features specifically tailored for electromagnetics and multi-physics design. Users can program regularly performed actions into parameterized macro-files.

The Modeller allows users to create models, define material properties, set boundary conditions and excitations, define emitters, create the mesh and launch the calculation. Users can build models from primitive shapes using Boolean operations, or import geometry from other CAD programs for which a range of I/O filters is available. A library of characteristics offers the user the opportunity to select from material data or input from user data.

The Opera-3d mesh generator can create hexahedral, prism and tetrahedral meshes (with the mesh existing as a mixtures of types). Users can save themselves time and inconvenience by implementing automatic meshing, which requiring little or no user setting in many cases. The generator offers sophisticated facilities to finely control the mesh where required.

The Post Processor can be used to interrogate solutions, which are conveniently stored in a database.



Temperature and heat flow from a part embedded steel ball with thermal contact resistance

Opera-3d will run on Windows and Linux platforms A parallel option is available for shared memory computers.

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Applications

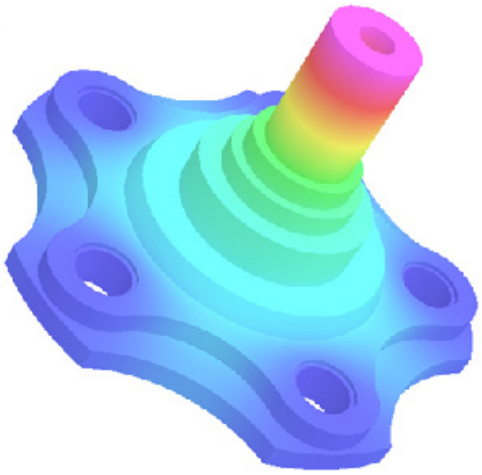
- Motors
- Generators
- Charged particle devices
- Electromagnetic brakes
- Actuators
- Transducers
- Induction heating
- Induction welding
- Cool down of superconducting magnets

Tools

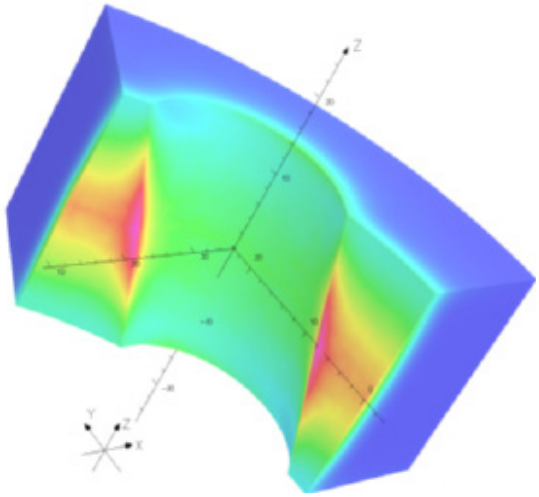
- Full 3d modelling
- Transient and steady state thermal analysis
- Linear and non-linear materials
- Isotropic and anisotropic materials
- Interfaces to CAD/CAM
- Extendible Post-Processing

Results processing

- 3D model views from any angle
- Graphs, histograms and contour maps of the solution
- Contours of the results on any surface
- Temperature
- Thermal gradients
- Heat flux
- User defined functions
- Surface and volume integrals



Thermal automotive axle annealing temperature



Thermal induction hardening temperature rise

Customer Support

We provide support to Opera users from our offices in the UK and the USA, and through a worldwide network of local representatives. Our support engineers have an extensive knowledge of multi-physics analysis of electromagnetic devices and applications, and are available to assist both existing and prospective customers with their design requirements.

For more information about Opera and multi-physics simulation for EM devices and systems, please refer to our website operaFEA.com. This website includes links to application specific websites that contain information, including a range of technical publications, videos and webinars, of interest to engineers and scientists involved in electromagnetic design and analysis.

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