INTEGRATED
ENGINEERING SOFTWARE

TRANSFORMERS, INSULATORS AND BUSHINGS ANALYSIS SOFTWARE

Hybrid simulation tools for electromagnetic and thermal analysis of Power Systems Components

SOFTWARE THAT
LIVES UP TO THE
POWER
OF YOUR
IDEAS

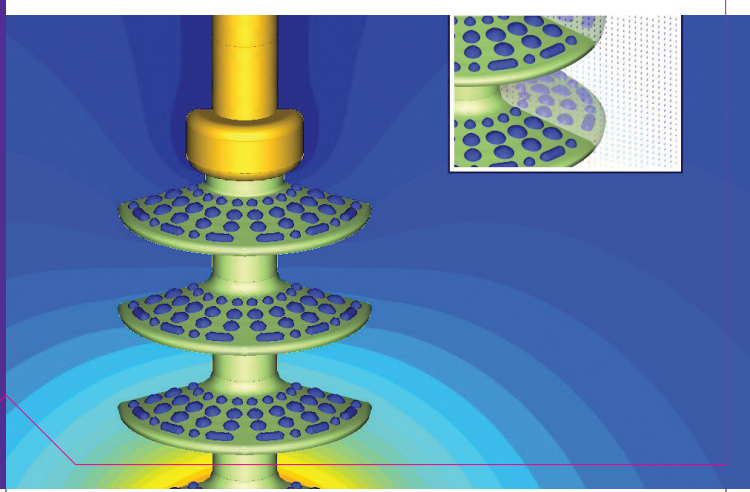
Electric Field Solvers

Designing high voltage equipment requires accurate electric field analysis. In practice, this can lead to numerically challenging problems complicated by diverse factors ranging from large open regions to thin layers of contaminates.

Static (DC), phasor (AC) or completely general transient electric fields can be simulated using **ELECTRO** (if 2D or Rotationally Symmetric) or **COULOMB** (where full 3D analysis is required). Both programs can perform electric field simulations using Self-Adaptive **Boundary Element Method (BEM)** or **Finite Element Method (FEM)** solvers. **BEM** is particularly well suited to open region problems (encountered in studies of insulators on transmission towers) and thin layer problems (encountered in studies of insulators contaminated by pollution or water/ice films).

In addition to providing outstanding visualization of voltage gradients and field components, both programs also contain advanced analysis features for calculation of streamlines and partial discharge inception in insulating oils.

Analysis of insulator covered with water droplets



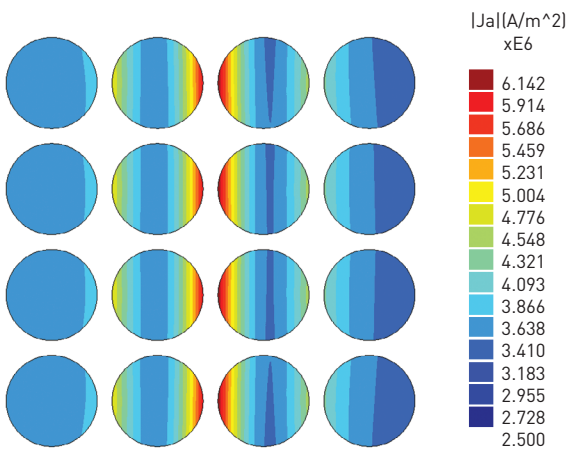
Magnetic/Eddy Current Field Solvers

Magnetic/Eddy Current field analysis software enables the determination of flux densities, impedances, losses and mechanical forces under both normal operating and fault conditions.

Static (DC), phasor (AC) or completely general transient magnetic fields can be simulated using **OERSTED** (if 2D or Rotationally Symmetric) or **FARADAY** (where full 3D analysis is required). Both programs can perform field simulations using Self-Adaptive **Boundary Element Method (BEM)** or **Finite Element Method (FEM)** solvers. **BEM** is particularly well suited to open region problems (encountered in air core reactor and transmission line analysis) while **FEM** can easily accommodate transient problems.

Analysis results from **OERSTED** and **FARADAY** can also be directly coupled to **INTEGRATED's** thermal programs **KELVIN** (2D/RS) and **CELSIUS** (3D) to calculate temperature rise due to power losses.

Current density contour plots in winding conductors showing skin and proximity effects

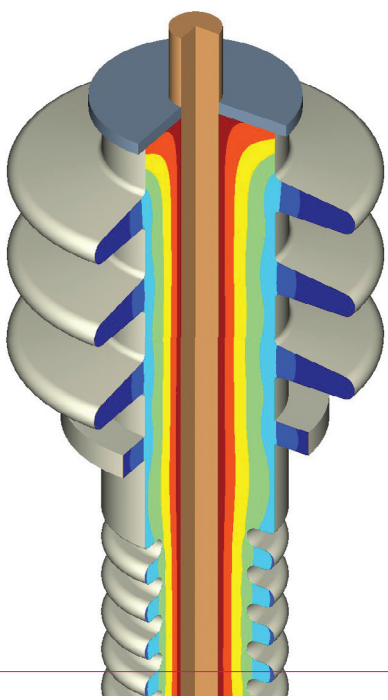


Thermal Analysis Software

Temperature limitations of insulating materials often dictate the maximum normal operating ratings of power system components. Similarly, maximum allowable temperature rise under fault conditions can determine the required time settings of protective relays and circuit breakers.

Steady state or transient thermal analysis can be performed by **KELVIN** (if 2D or Rotationally Symmetric) or **CELSIUS** (where full 3D analysis is required). Both programs can be coupled to **INTEGRATED's** other field solvers to include heat sources produced by ohmic and dielectric heating, as well as core loss curve calculations.

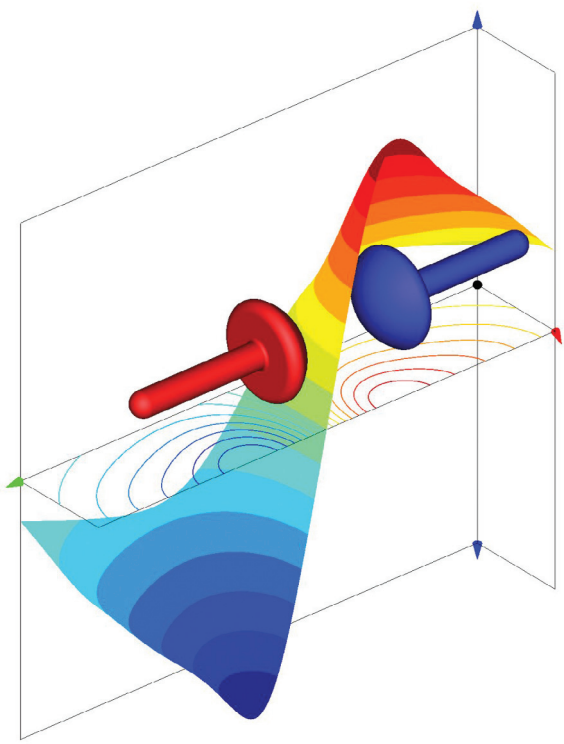
Thermal Analysis of High Voltage Bushing



Superior Visualization of Results

INTEGRATED's CAE tools include a wide variety of display options for superior visualization of analysis results. Display formats include arrow, contour, isosurface, profile and scatter plots as well as conventional graphs. Parametric results can also be viewed in animation files.

E Field Profile Plot Analysis of Mushroom Electrodes

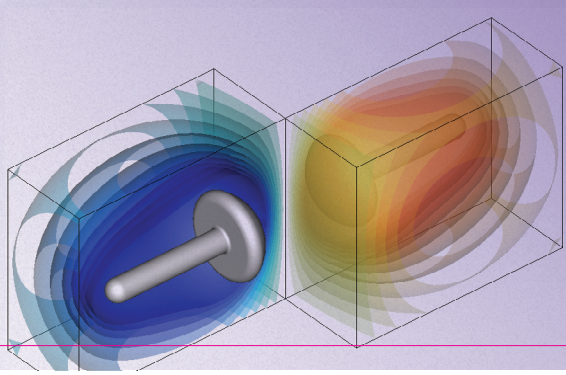


HOW CAN INTEGRATED'S SIMULATION TOOLS HELP YOU?

INTEGRATED's suite of CAE software products provides a complete toolbox for designers of power system components.

- Programs that cover the range of physical systems including magnetic, electric, eddy current, transient, thermal, particle trajectory and high frequency field solvers.
- Mathematical Solver methods optimized for each particular application.
- **Self-Adaptive** meshing plus optional user defined **Element Weighting** for maximum accuracy of field solutions.
- Direct import of models from CAD partners including: **Autodesk**, **PTC**, **Solid Edge** and **SolidWorks**. (Also **STEP**, **SAT** and **openNURBS (.3DM)** import from general 3D CAD programs.)
- Complete range of **analysis results** and **visualization/export** tools.
- **Parametric** utility for prototype testing and optimization.
- **API** and **Scripting** for fast automated custom designs.

Voltage isosurfaces around mushroom electrodes



OPTIMIZE YOUR DESIGNS

USING INTEGRATED API, PARAMETRIC AND/OR SCRIPTING CAPABILITIES

All **INTEGRATED** programs include **API**, **Parametric** and **Scripting** capabilities.

Parametrics provides an easy to learn GUI based method of testing devices through their range of operating conditions, as well as modifying basic designs to obtain optimum performance.

The **INTEGRATED API** enables the direct control of program functions by utility scripts or macros created in tools such as Excel, MATLAB® and VisualStudio. **Scripting** can control the entire process of model creation and testing.

MathWorks Partner

Find the best solver for your particular application

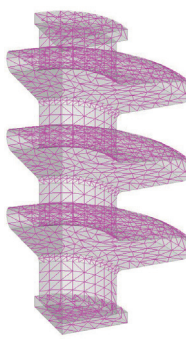
INTEGRATED provides power system designers with the best solver for their particular applications.

The most common power system applications can be analyzed with either the **Boundary Element Method (BEM)** or the **Finite Element Method (FEM)**.

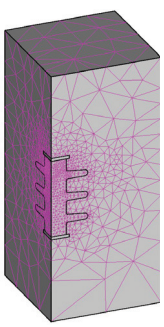
BEM is often the preferred method since many power system applications involve large regions of open space. **BEM** requires neither artificial boundaries to limit the model space, nor meshing of empty space regions.

FEM is particularly well suited to transient simulations which involve the field solution at a large number of time steps.

An additional advantage to having both solution methods is the ability to confirm the validity of models using two independent solvers based on entirely different mathematical formulations.



*Periodic section of an insulator modeled using **BEM**. No artificial boundary box or meshing of open regions is required.*



*Periodic section of an insulator modeled using **FEM**. A boundary box to limit the model space is required, as is meshing of the entire simulation space.*

Why should I use CAE software in the design of Power Systems Components?

Power Systems Components (such as transformers, insulators and bushings) are subjected to extreme operating and often extreme environmental conditions. In addition, they must also be designed with safety margins to enable them to withstand occasional fault or surge conditions.

Prototype testing of power systems components is most often extremely expensive because of the high voltage and/or high current levels required. Prototypes that fail during testing may not necessarily provide clear indications of what design modifications are required.

CAE software can be an invaluable design tool providing insights into problem areas and allowing simulation of multiple model variations. Though final testing should always be done with an actual physical prototype, the use of CAE software can dramatically reduce time and expense involved in reaching design requirements.

Without the insights that only CAE software can provide, the design process will almost always revert to inefficient and expensive trial and error prototyping.

PUT OUR SOFTWARE TO THE TEST

Send us your model, whatever the level of complexity. **We will show you how to get results from your exact design** – no packaged demos.

Contact us for an evaluation and start improving productivity today. A live demo is also available.

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