ENGINEER'S SOFTWARE TOOLBOX

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We examine the flexibility afforded in this field by CAE software.

Electromechanical designs based on electromagnetic principles are found in a wide variety of industrial and R&D applications: electric, motors, sensors, transmission lines, high voltage systems, actuators, printed circuits boards, and other systems. Engineers need to understand the electromagnetic behaviors (such as torques, forces, eddy currents, fields or voltages) of these designs so that costs and performance can be managed effectively. In the past, engineers were limited to costly prototyping or restrictive analytic models. Today, engineers use electromagnetic Computer-Aided Engineering (EM-CAE) software tools that provide cost effective design solutions (Figure 1 and Figure 2).

Two distinct numerical approaches exist for EM-CAE software tools: the finite element method (FEM) and the boundary element method (BEM). While the FEM approach is more familiar to engineers, the BEM technique offers some unique advantages over FEM. BEM requires only the system's surface to be modelled with boundary elements in contrast to the FEM approach which requires the entire system's domain to be modelled with a finite element mesh.

Integrated Engineering Software (Integrated), a Canadian research and development company, provides the international engineering community with BEM-based electromagnetic CAE software tools. Integrated's 2-Dimensional (2D) and 3-dimensional (3D) electromagnetic software enables engineers to understand their designs prior to prototyping. The BEM-based software allows the engineer to test various physical and material configurations, examine new design concepts, and optimize designs for a wide variety of electromagnetic applications.

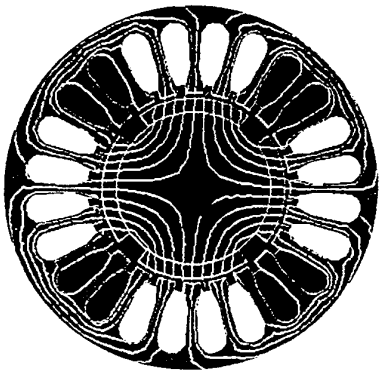

Figure 1: Permanent magnet motor flux lines.

At Moving Magnet Technologies SA (MMT), a French engineering company, we conceive and develop new high energy permanent magnet designs for electromagnetic actuators and sensors (patents pending). The EM-CAE simulation is critical to reducing our development time, controlling material costs and allowing us to offer our customers optimal designs. Indeed, after theoretical calculations and before prototype measurements, Integrated's software provides important information on the physics of the electromagnetic design which complements our electromagnetic experience.

Thus, as a matter of illustrations, the inertia of an actuator's moving part was decreased by simulation the moving part's flux density magnitude distribution. Based on the simulated results, all non-essential magnetic flux flow regions were removed and the actuator's performance was improved. Without an electromagnetic simulation tool, costly prototypes would have had to be designed and modified until acceptable results occurred. Electromagnetic simulation tools save us time and money –two commodities always in short supply.

EUROMOLD, a Belgium -based manufacturer of pre-molded medium and high voltage cable accessories, has more than 25 years experience in supplying the electrical industry. Since 1988, our product development group has relied on Integrated's software for the design of stress-control elements and, more recently, high voltage cable joints and stress-cones for system voltages up to 420kV. This reliance is due, in part, to the software's short learning curve and the continuous improvements made to the software's electromagnetic analysis capabilities.

Typically, we create the design geometry on a CAD system and then import the design into Integrated's software through their IGES interface, allowing us to exploit the strengths of both the CAD and the electromagnetic CAE tools. The graphical representation of the results enhances our field control understanding and enables optimization. The end result is a reduced product design cycle.

At Mannesmann Demag, a German-based electric arc furnace manufacturer, we needed to conduct 3-dimensional magnetic field design and analysis of our electric arc furnaces used in the iron and steel industries. The lack of rotational symmetry in the design's geometry meant that 2-dimensional software could not be used (Figure 3).

After several unsuccessful attempts with various 3D FEM-based software programs, due to the excessive effort required to generate the finite element mesh, we decided to select the BEM-Based software from Integrated. The software allows us to successfully carry out our 3D magnetic field analysis within a relatively short period of time.

Electromagnetic computer-aided engineering software is becoming a standard tool in the engineering design process. In particular, BEM-based electromagnetic software tools offer engineers a proven and effective method for reducing design costs and optimizing designs based on electromagnetic principles.

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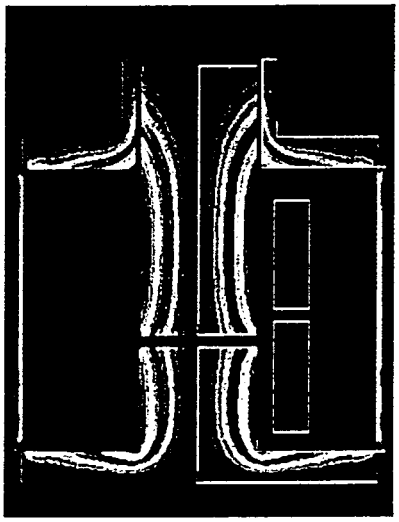

Figure 2:
Current density
Distribution
For an electro-
Magnetic
solenoid

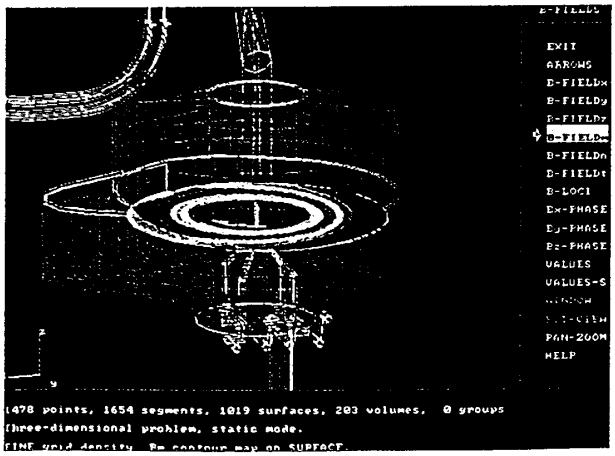

Figure 3:
Magnetic
inside
a D Field. C.
arc
furnace