INTEGRATED ENGINEERING SOFTWARE

NASA's Cryogenics branch benefits from new engineering software

Brent Warner, Aerospace Engineer at NASA, discusses the benefits of modeling in the design of cooling systems for satellites and spacecraft.

NASA satellites and spacecraft require standard temperature control for the electronic components to work properly due to their highly sensitive instruments. Cryogenic cooling systems involve liquid helium and a type of cooler called adiabatic demagnetization refrigerators (ADR). ADRs produce changing magnetic fields when running. The problem this poses is that the extremely sensitive systems within satellites and spacecraft are easily disturbed by any interference, including the magnetic fields emitted from the ADR cooling system. If the magnetic field leaks out of the cooling system and is seen by the instruments, this causes severe interference. When ADR cooling systems are designed at NASA, it is vital that there is no magnetic field leakage that is higher than the sensitive instruments optimum level.

NASA's Cryogenics branch has recently switched to using MAGNETO and AMPERES, 2D and 3D magnetic field solvers from INTEGRATED Engineering Software.. This software enables Aerospace Engineers to model the magnetic field and shielding requirements of cooling systems.

Brent commented, "One of the difficulties of magnetic design is that we often need to know the size of the field in areas where it would be difficult to measure directly. Because the basic physics of magnetic fields is well known, we're confident that we can get accurate values from the software in those areas."

NASA has been using INTEGRATED software since 1992, while the Cryogenics branch at NASA started to use it in 2001. Previously it used the Poisson group programmes. Brent continues, "These programs are free, but not as easy to use as INTEGRATED software. They use a text file for data input; whereas INTEGRATED's programs have a more contemporary graphical user interface for data input."

Brent continued, "In Poisson, to enter the details of the model, you have to type a text file, which lists all of the characteristics. You list the entire X, Y co-ordinates of all of the pieces that you are studying and include a list of the magnetic properties, such as iron or other magnetic materials that you are using. With MAGNETO, you just draw a picture on the screen, you can still type in all of the coordinates, but the picture is still visible."

MAGNETO and AMPERES calculate not only the magnetic fields from coils, called solenoids, but also the magnetic field caused by other materials such as iron, which is much more difficult to calculate.

Read more —>

220-1821 Wellington Ave
Winnipeg, Manitoba
R3H 0G4 Canada
204.632.5636
www.integratedsoft.com

INTEGRATED ENGINEERING SOFTWARE

NASA's Cryogenics branch benefits from new engineering software

Cont'd

It is possible to calculate the field of a coil using general mathematical software, assuming that you know the equations. However, that software will not calculate the field when you add magnetic material, such as iron, to the model. In that case, the solution depends on the magnetic properties of the iron (which are nonlinear) and on the shapes of the iron pieces and their positions in the field generated by the coil. This, of course, is precisely the job that specialised magnetic software is designed to perform.

Bruce Klimpke, Technical Director at INTEGRATED explained, "With MAGNETO and AMPERES, you can quickly fill in the details of the outline of the shape of the shield, and run the programme to see what the results are. This allows you to efficiently work out a complex calculation, and quickly change the details, such as one material to another material, or change the thickness or the shape."

The software enables the user to look at magnetic material, such as the iron being used to create a shield, and identify whether it has been saturated. If the field is so high that it can't provide any more shielding, this would indicate that the user might need to increase the thickness of the material. Bearing in mind that the shield needs to be as thin as possible, because apparatus that is being designed to go into space needs to be as light as allowed.

MAGNETO and AMPERES provide multiple options for the display of results. Brent comments; "This is an advantage because you can quickly switch between various types of displays and study various quantities once the programme has calculated the answer."

With Poisson, it calculates the magnetic field in a given area. If the user needs to find out the magnetic field outside of the given area, the user then has to input the data, set the problem up and run the programme over again. With MAGNETO and AMPERES, the user does not need to re-run the model to do this. The user needs only to increase the calculation area and the programme will give the field readings. This feature is called Boundary Element, and is incorporated into the software.

Brent commented, "To do the sort of job that we are doing, we have to have software like this. For many of the projects I have worked on for the Cryogenics branch, we used the 2D software, though for one project with complex geometry, we had to use the 3D software. Both 2D and 3D, software with a graphical user interface helps us get our job done quicker.

220-1821 Wellington Ave
Winnipeg, Manitoba
R3H 0G4 Canada
204.632.5636
www.integratedsoft.com