As the newest member of the Flomerics suite of products, FLO/PCB provides users with the opportunity to benefit from over 15 years of experience in commercial software applications dedicated to the physical design of electronics. Whether you're an experienced thermal practitioner looking to optimize a design, or a system's architect, looking to carry out 1st order feasibility studies, FLO/PCB's embedded technology will guide you through your board-level thermal investigations.

Functional Block Diagramming

One of FLO/PCB's primary objectives is to improve the communication between thermal engineers and system architects or board designers. In order to do that, FLO/PCB includes a functional block diagramming capability that allows one to generate a logical representation of functional partitions and interconnections for the board, prior to defining the physical layout. All of the critical aspects of a functional block diagram are available including the ability to create functional groups, discrete components, and connectors that are assigned a directionality, number of interconnects, speed, and technology. While a number of software packages are used for functional block diagramming, FLO/PCB is the only one that provides for bi-directional communication between the functional block diagram and the physical board layout.

SmartParts

One of FLO/PCB's most prevalent examples of embedded technology exists in the wide variety of Smartparts available for creating models. SmartParts are parametric representations of all the most common geometry found on your board, driven by simple user inputs. FLO/PCB currently has SmartParts available for the PCB itself, signal and power/ground layers, IC's, resistors, capacitors, vias, daughter boards, and heat sinks. SmartParts enable the user to type in simple information about a particular part, and then FLO/PCB makes the appropriate modeling assumptions. As an example, the user input layer information about the board, and FLO/PCB calculates the appropriate orthotropic conductivities in the in-plane and normal directions. While it's very simple to create these within FLO/PCB, many are already available in vendor libraries within the software or online at www.smartparts3d.com[1]. FLO/PCB also has the ability to import/export board geometry and component placement in the form of IDF files, which are supported by most major board-layout tools such as Allegro and Mentor Graphics.

Package Thermal Performance

Another critical aspect of any board-level analysis is the accurate representation of package thermal performance. FLO/PCB integrates directly with the online package tool, FLOPACK. FLOPACK provides users with a simple worksheet interface to quickly develop accurate thermal representations of their models. One can choose between detailed package models for very accurate predictions of component junction temperatures; or, they can opt for a compact thermal representation in the form of a two-resistor or multi-resistor network, such as a DELPHI model. This technology is a direct result of Flomerics' participation in Project DELPHI, a 3-year EU-funded research project undertaken by a consortium of electronics companies that concluded in 1996. Its contributions and conclusions have been documented in a number of publications available in the public domain[2]. The key goals of the project were as follows:

- Define the areas of responsibility that belong to the suppliers (i.e., IC part manufacturers) and end-users (i.e., system designers) that enable the supply-chain.
- Enhance our understanding for constructing detailed models of IC packages
- Propose a validated methodology for the creation of boundary condition independent (BCI) compact models of IC packages

FLOPACK currently supports the generation of DELPHI compact models for the QFN, SOIC/SOP, TSOP, TSSOP, and SSOP package families. This is in addition to the PQFP, PLCC, Wire-bond PBGA, Cavity-down PBGA, TBGA, ChipArray®, µBGA®, Flip-Chip PBGA, and Flip-Chip CBGA package SmartParts that already allow the generation of DELPHI models.

Typical Environments

FLO/PCB contains several standard predefined environments to evaluate your board within. Among the environments are standard still-air, standard forced-air, and a simple card slot. In the case of the standard still-air environment, the user specifies nothing more than the ambient temperature. In the case of the forced-air and card slot environments, the user has the additional input of velocity and board pitch. A final option for specifying the environment is a direct link to FLOTHERM that allows the FLO/PCB user to select and apply the boundary conditions associated with a region of the FLOTHERM model to their board of interest within FLO/PCB. FLO/PCB will automatically extract gauge pressure, angled velocities, and air temperatures in the form of transportable boundary conditions that can be used repeatedly for multiple studies.

Computational Grid

FLO/PCB uses the same Cartesian gridding topology successfully employed by FLOTHERM for over 15 years. The inherent orthogonality of Cartesian grids provides for extremely robust numerical convergence, which is not always the case with some general-purpose commercial CFD codes available on today's market. While other gridding topologies require substantial computational effort just to generate the grid, Cartesian grids have the additional advantage of virtually instantaneous generation. FLO/PCB also employs a Localized Grid methodology that places a high-resolution mesh into areas of critical interest, and coarse mesh into far-field areas or those of little concern. Finally, the most critical aspect of gridding within FLO/PCB is that it is all done automatically, requiring no user intervention. Automatic Gridding allows the user to focus on their design intent, confident in FLO/PCB's ability to accurately implement all of the secondary modeling effects.

Numerical Modeling

Like many other aspects of the tool, FLO/PCB takes the best numerical modeling algorithms from FLOTHERM and improves upon them. FLO/PCB solves the fully 3D Navier-Stokes equations taking into account conduction, convection, and radiation when necessary. Assignment of all thermal characteristics and material properties is tailored specifically for board-level studies, as are the turbulence models and other solver settings. FLO/PCB has even been equipped with an automated termination criterion that halts the solution once the components reach their steady state value.

1. www.SmartParts3D.com is an online, searchable database of ready-to-run thermal models for many common IC packages and other parts. These models can be used directly in FLO/PCB
2. Rosten, H, "DELPHI - A Status Report on the European funded Project for the Development of Libraries and Physical Models for an Integrated Design Environment", 46th Electronic Components & Technology Conference, Orlando, 1996.

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