Simulation of RF Effects on Electronics

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Electronic systems are often exposed to electromagnetic fields from natural and man-made sources. Lightning, electromagnetic intereference (EMI) and intentional electromagnetic interference (IEMI) are frequent sources of high-power electromagnetic fields and currents. While the community has made a large investment in simulating coupling to complex geometries, there are severe limitations in applying these methods to real systems. Further, little investment has been made in RF effects simulation.

These disadvantages include difficulty scaling the methods to the detailed geometries present in real systems, sensitivity to the small changes inherent in real system manufacture and evolution and extreme differences among types of systems. To solve these problems, the analyst must use a higher level of abstraction to perform a functional simulation of frequently used types of systems and subsystems.

What is a functional simulation? A SPICE model of a transistor is a functional simulation of a frequently used type of subsystem. The class describing the transistor is made up of parameters and fit equations that predict the currents and voltages out of the transistor. CRIPTE and other BLT equation solutions are similar higher level of abstraction simulations that combine parameters, measurements and fit equations to simulate the field penetration into the system.

We will outline a multi-domain, higher level of abstraction simulation workflow based on the Modelica® language. The initial external interaction and penetration follows the usual topological decomposition and the cable coupling follows the graphs similar to the BLT simulations. However, in this workflow, the tubes and scattering matrices carry much more in their tensor (supermatrix) formulation. The tubes carry electromagnetic variables, as usual, but also structural, orientation and thermal stresses. The scattering matrices carry orientation, amplification, subsystem, circuit failureand actuator failure information, as well. The result is a workflow that will predict system failure from the described field illuminating the target.