EMC Prototyping at Low and Middle Frequencies with CEDRAT Tools

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To respect the time-to-market requirements and to comply with product specifications, the virtual prototyping of EMC phenomena has nowadays to be performed from the early design stages by means of accurate, robust and well-adapted simulation tools, which must cooperate with each other to take benefit of their respective strengths. Therefore, the CEDRAT solution for EMC is oriented towards the integration and the synergy between three tools: Flux, InCa3D and Portunus.

The first one – Flux – is the well-known 2D and 3D solver based on the Finite Element Method and able to perform a wide range of low-frequency electric and magnetic analysis, whereas InCa3D – based on the PEEC method – is especially tailored for modeling the parasitic behaviour of 3D non-magnetic interconnections. On the other hand Portunus, our multi-domain system-simulator, can be applied for EMC studies as a very powerful circuit solver. In fact, besides the classical electric and electronic analysis based on well-provided libraries of components, Portunus is also able to include InCa3D equivalent macro-blocks and to drive transient Flux co-simulations. As illustrated in figure 2, these are the ways that the synergy between our EMC tools is achieved!

Thanks to these links between Flux, Portunus and InCa3D, the applicability range of the CEDRAT software suite to assess EMC phenomena is widely expanded. As an example, InCa3D by itself makes it possible to analyse the influence on an electronic module of the position of the decoupling capacitors or to minimize the current density flowing in the ground plane depending on the stack-up of the PCB layers. However in conjunction with Portunus, by modeling the parasitic behaviour (resistive and inductive) of the metallic panel-board bars in a high-power rectifier, the degradation of the current in the diodes can be successfully analyzed and reduced.

The complementary exchange between InCa3D and Portunus is being strengthened by the CEDRAT teams which are actively involved in the R&D project O2M (see page 3 for a detailed description). In particular, the computation of the radiated emissions of an electronic subsystem will be improved by the capability of Portunus to inject into InCa3D its time-domain simulation results, thus allowing the simulations to take into account the radiation effects of discrete components, in addition to the contribution of the 3D interconnections.

Another industrial case where the CEDRAT tools can be applied for EMC is represented by a low-voltage substation for the public distribution of electric energy: the AC steady-state magnetic application of Flux is able to compute efficiently the emissions generated by the cables, the distribution boards and the transformers, as shown in figure 1. The novel functionality of the Portunus-driven co-simulation widely extends the domain of applications of Flux, because the influence of the electronic part of the system (semiconductor components) is naturally included into the computation. A typical example is the automotive ignition system where an IGBT transistor creates, by means of a step-up transformer, the large peak voltages necessary for the ignition of the fuel mixture in the combustion chamber. Thanks to the accurate representation of the 3D non-linear magnetic core in Flux, the quality and the integrity of the signals are guaranteed.

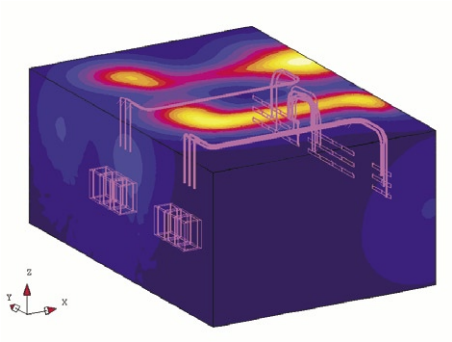

Figure 1: Radiated magnetic field on the walls of an electric substation simulated by Flux

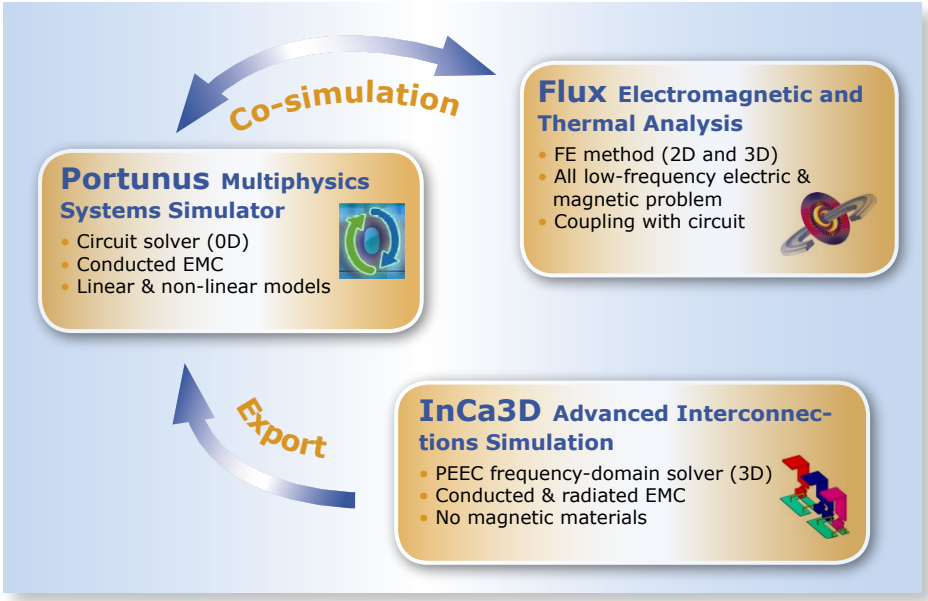

Figure 2: Graphical sketch illustrating the synergy between CEDRAT tools for EMC