Modeling of Electronic Devices using Near Field Sources

Miniaturization of electronic devices, rising of operating frequencies, rising of complexity and reductions in the levels of operating voltages increase the risk of malfunctions due to the interaction between subcomponents. Consequently, there is a great demand for the detailed analysis of electromagnetic interference (EMI) sources, which is necessary for the design of reliable systems.

In EMI applications, the main focus is on localization of EMI sources. One of the common approaches is measurement of electromagnetic fields around active devices. The near field scanner system is able to measure the vector electromagnetic field as a function of spatial coordinates and frequency. The measured data might be used to determine field distribution outside scanning volume as well as for reconstruction of electric currents and charges inside device under test (DUT).

Voltage coupled from the ECU in the car represented as Near Field Source is calculated and compared with results of fullwave MoM solution.

Problem Definition

Consider the problem, where coupling of fields from electronic control unit (ECU) to cable inside the car is investigated (see Fig.1).

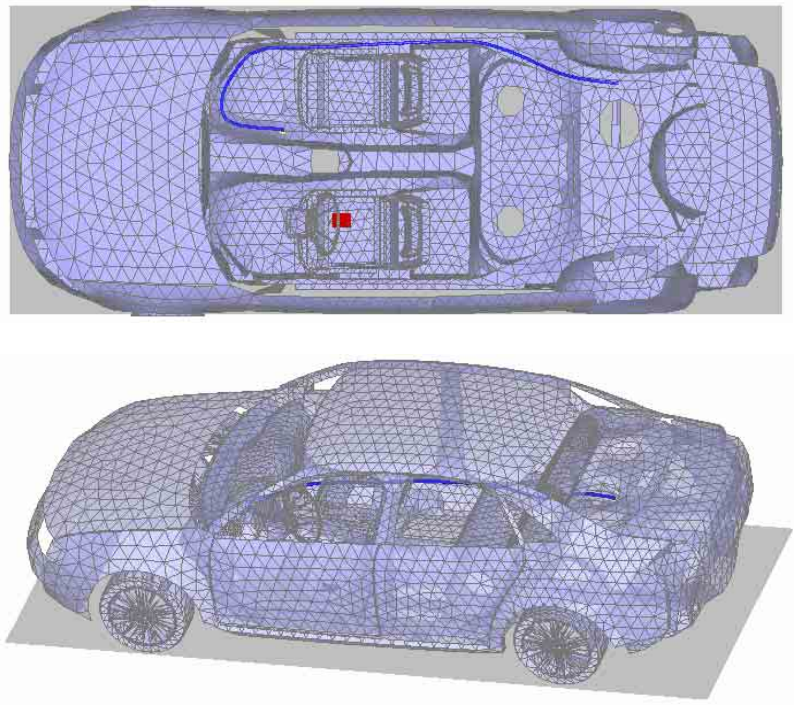

Fig. 1. Models of ECU and cable, located inside the car

Investigation of complex source radiation can be performed in the following way. Using near field scanner, ECU can be investigated in laboratory and fields on some surfaces above the ECU can be measured. Then, closed surface around ECU is chosen and equivalent electric and magnetic currents, producing the same fields as detected by scanner should be calculated. These equivalent currents must be used as surface near fields in EMC Studio, which will give possibility to investigate coupling into surrounding cables. It should be noted, that Near Field Source calculation does not take into account backward interaction between source and passive system.

Let's consider details of the example, shown in Fig.1.

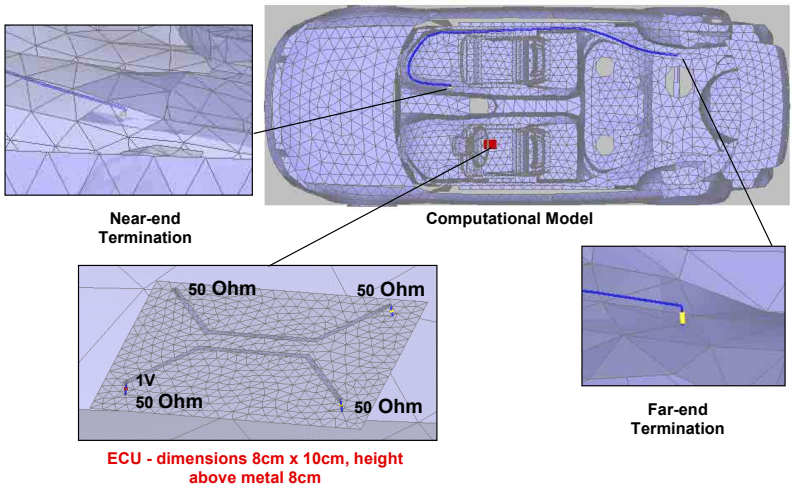

Fig. 2. Details of Models

In order to perform investigation we can simulate process of obtaining of fields on the surface, surrounding ECU. Lets calculate these fields in the absence of surrounding 3D car body. Model of ECU as simplified PCB shown in the Fig. 2 is placed above the PEC ground and fields are calculated on some surrounding surface (Fig.3).

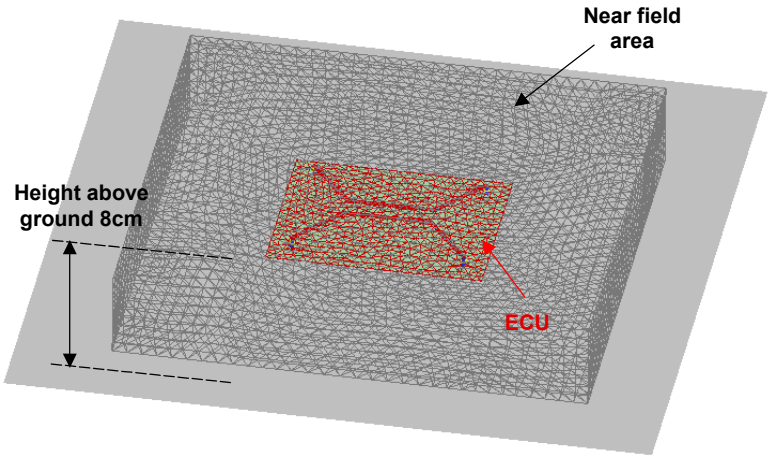

Fig. 3. ECU model

The ECU model detailed parameters:

- Dimensions of near field area: 4cm x 20cm x 22cm
- PCB is located at 8-cm height above ground. This corresponds to location in car
- Field observation area must be closed and all triangles should be oriented in one direction for correct power balance

Field values are demonstrated in the Fig. 4. Magnetic field distribution is shown in the Fig.5.

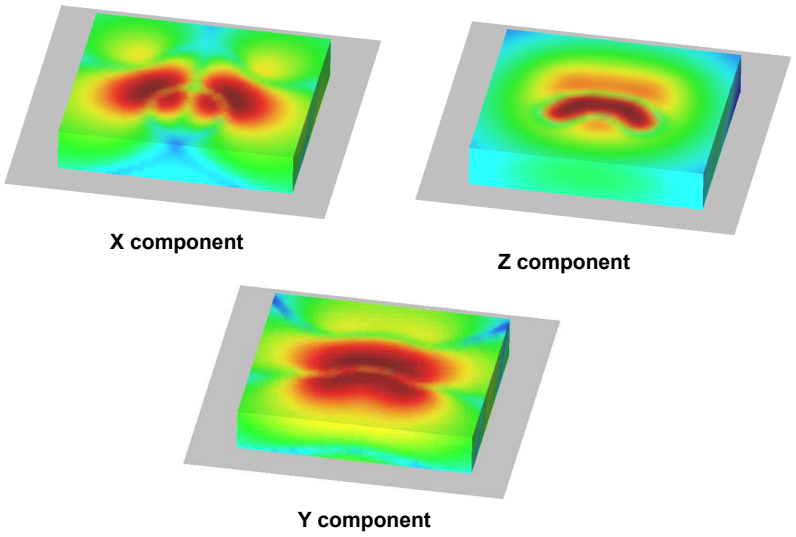

Fig. 4. Electric field distribution for 30 MHz

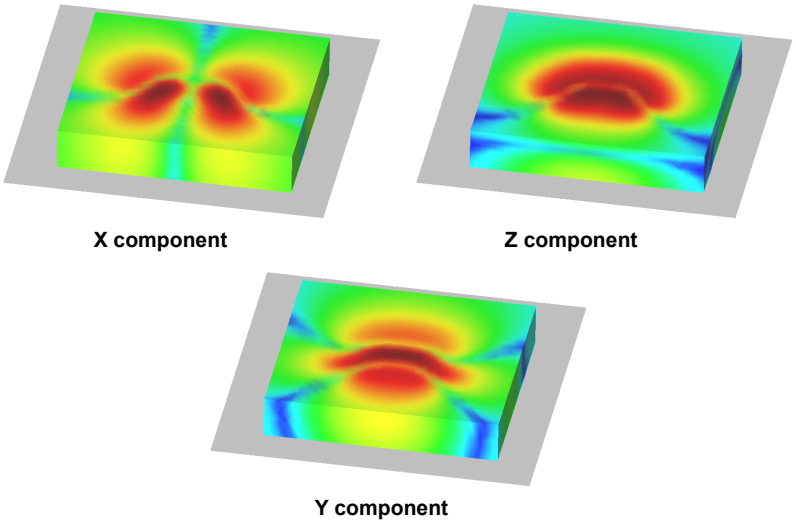

Fig. 5. Magnetic field distribution for 30 MHz

When calculated, near field source is placed inside the car (see Fig. 5).

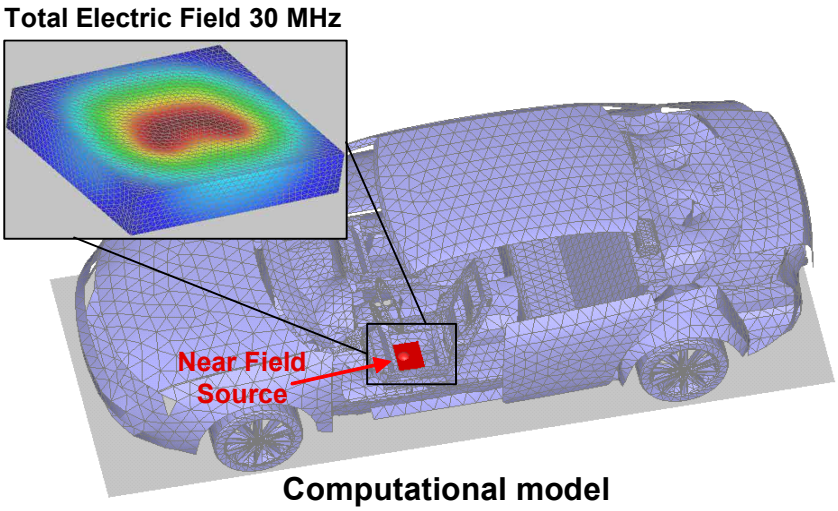

Fig. 6. Near field source placed in the car

Voltage coupled to Far-end termination is shown in Fig. 6. The numerical results were gather using direct solution and with usage of near field source.

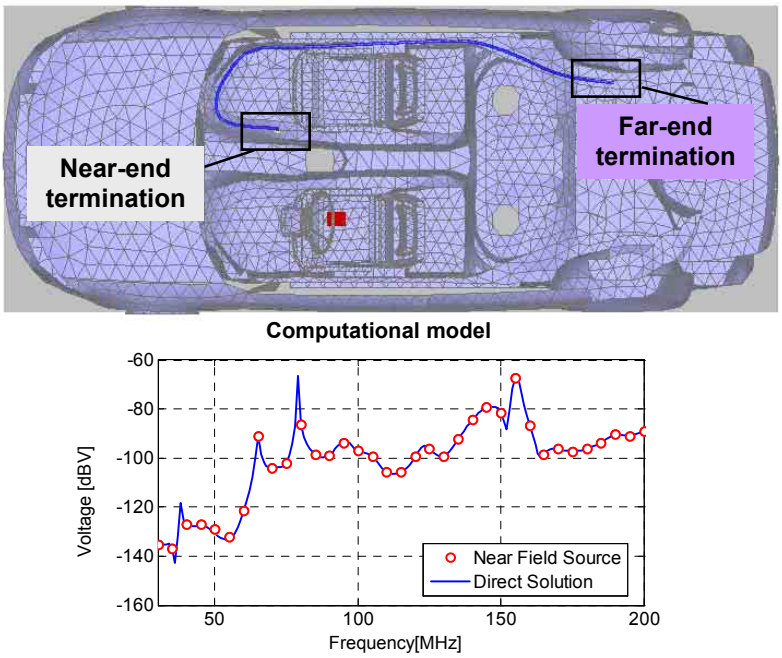

Fig. 7. Comparison of Near Field Source and direct solution

Conclusions

- Near Field Source solution based on *Equivalence Principle* is implemented in EMC Studio
- Results of application example show that Near Field Source solution is in very good agreement with fullwave solution
- Near Field Source in MoM solver can be effectively used for complex PCB emission modeling in complete car environment