Application of Function Minimization Techniques to Determination of Filter Model Parameters

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Hybrid and electric vehicles (HV/EV) are better options than regular cars with traditional engines because they produce less exhaust and air pollution. When HV/EV systems are working, they create strong, low-frequency electrical currents. To reduce the electromagnetic (EM) field produced by these currents, countermeasures like cables shielding and using filters are applied. A common test is done at the component level to check how well the system performs in terms of electromagnetic compatibility (EMC) and how effective the countermeasures are. However, the system's EMC performance can change when it's tested in the car, so it's important to also do tests at the system level.

Computers simulations could be a good alternative to measurements and could give a big advantage in solving EMC-problems in the early stages of the vehicle electronic systems design. However generation of accurate model is a laborious process, is often restricted with limited information on device design and used elements, and thus requires reverse engineering. Another option can be using of equivalent model produced with general information on device type and knowledge on system behavior obtained from component tests. Device filter being first cascade on cable/component connection has big impact on system EMC performance and should be modeled appropriately. Filter characteristics depend on selected model type and also on parasitics introduced by packaging and used circuit elements. While model type selection is strictly linked to general requirements to filter performance within used device under test, values of internal circuit parameters can differ from expected values.

In current work we present procedure for determination of unknown exact values of circuit elements based on known filter characteristics. Multiple parameter function minimization techniques are applied: Nelder-Mead and Differential Evolution. With both approaches filter characteristics were reconstructed with graphical accuracy. Efficiency of performed procedure is analyzed.