Machine Learning for Efficient Electromagnetic Compatibility Engineering

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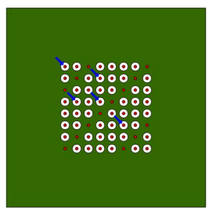
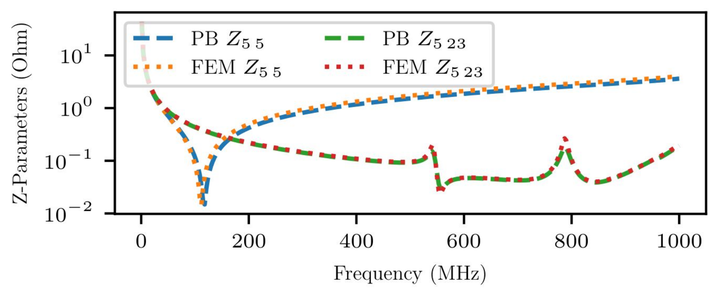
Physics-Based Simulation for the Exploration of PCB Design Spaces

Validation of Physics-based (PB) simulations using CONMLS, the institute's PB multilayer PCB simulation software



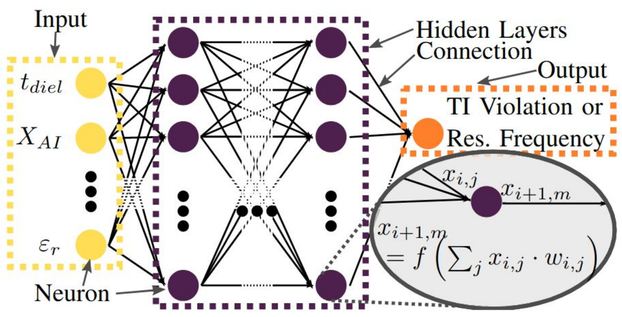
The CONMLS code is a modern Fortran implementation of PB models to simulate multilayer substrates enclosed by solid reference planes [1]. The simulation speed allows the exploration of large design spaces. The results are continuously validated by commercial full wave FEM solvers to ensure accuracy.

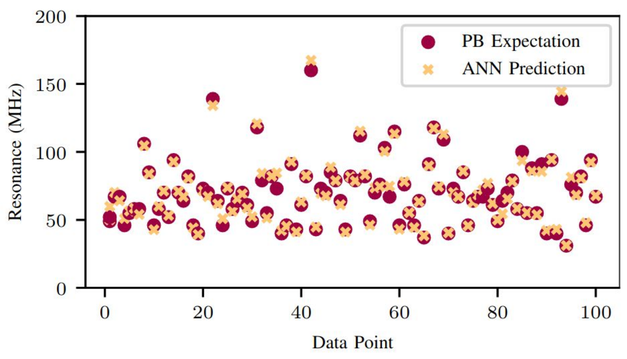


PCB based Power Delivery Network Design Using Machine Learning Tools

Artificial Neural Network (ANN) for the prediction of PCB resonances depending on board parameters

Using ANN techniques, the analysis and design of PCB based power delivery networks (PDN) is enhanced. The trained ANNs are applied to answer relevant PDN design questions such as PCB resonance frequency depending on material and geometry variations [4].

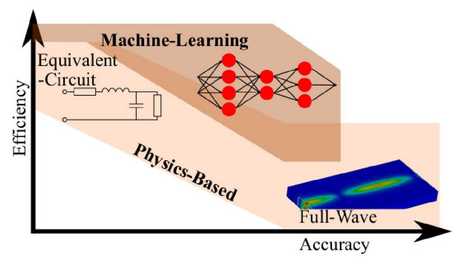


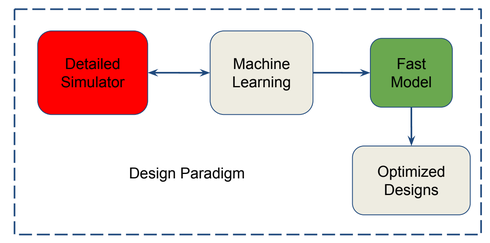


Machine Learning in EMC Engineering

Machine learning tools and techniques in the signal integrity (SI), power integrity (PI) and electromagnetic compatibility (EMC)

Investigation of machine learning tools in the complex domains of SI, PI and EMC for more efficient engineering. Contributions are made to the SI/PI-Database with the generated data to the service of the EMC community [2].

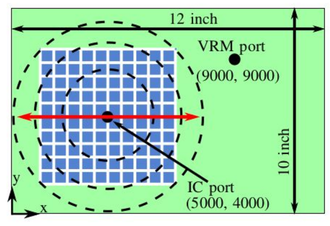




Prediction of Target Impedance Violation of PCBs

Support Vector Machines (SVMs) and ANNs for prediction of PCB based PDN target impedance violation

For different decoupling capacitor distributions on a PCB, the impedance of the PDN is evaluated. The target impedance violation is predicted [3].



Type	linear-spacing	same-area-spacing	log-spacing
SVM Prediction Accuracy	91.61 %	89.59 %	91.74 %
ANN Prediction Accuracy	91.3 %	88.9 %	92.39 %

References

[1] https://www.tet.tuhh.de/en/concept-2/multilayer-substrate-analysis/

[2] M. Schierholz *et al.*, "SI/PI-Database of PCB-Based Interconnects for Machine Learning Applications," in *IEEE Access*, vol. 9, pp. 34423-34432, 2021, doi: 10.1109/ACCESS.2021.3061788.

[3] M. Schierholz, Y. Hassab, C. Yang and C. Schuster, "Evaluation of Support Vector Machines for PCB based Power Delivery Network Classification," *2021 IEEE 30th Conference on Electrical Performance of Electronic Packaging and Systems (EPEPS)*, Austin, TX, USA, 2021, pp. 1-3, doi: 10.1109/EPEPS51341.2021.9609190.

[4] M. Schierholz, I. Erdin, J. Balachandran, C. Yang and C. Schuster, "Parametric S-Parameters for PCB based Power Delivery Network Design Using Machine Learning," *2022 IEEE 26th Workshop on Signal and Power Integrity (SPI)*, Siegen, Germany, 2022, pp. 1-4, doi: 10.1109/SPI54345.2022.9874946.

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