Review of progress on intermediate level circuit modelling techniques

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Abstract

The technique of intermediate level circuit modeling (ILCM) attempts to reduce a complex electromagnetic problem to that of an equivalent and much simpler circuit problem. If it can be devised, the equivalent circuit for a given electromagnetic problem will often consist of only a few tens of nodes at most, and is therefore easily and rapidly solved using a circuit simulator such as SPICE or by direct matrix nodal analysis using MATLAB. The speed of solution using ILCM techniques is often three orders of magnitude faster than traditional numerical techniques such as TLM, FDTD or MoM, whilst offering similar levels of accuracy (indeed, the ILCM technique can sometimes result in greater accuracy). This paper reviews some of the physical scenarios that can be modelled at present using ILCM techniques, comparing ILCM results with those of experiment or numerical simulation. Whilst it is true that the ILCM technique is mainly applicable only to 'regular' structures (e.g. rectangular or cylindrical boxes and apertures, dipoles, monopoles, transmission lines, loops etc.), and will never be able to model the fields inside an arbitrarily shaped container (which numerical techniques can happily cope with), many practical problems do consist of 'regular' components or at least can be approximated by them. Many of the results are taken from the literature, and appropriate references are given for the reader who wishes to further research the particular ILCM method for a given physical scenario.