Application of Single Layer Reduction Technique in Multilayer Transmission Lines

Payal Majumdar
Department of Electronic Science, UDSC,New Delhi-110021, India.

The multilayer planar line structures are used for microwave and RF integrated circuits to significantly increase the density of modules, reduce weight, improve reliability and reduce system cost. It is also used to improve functionality of the circuit. Modern designers of MMIC, MIC and printed circuit antenna require a convenient and efficient CAD tool for the synthesis of a frequency dependent multilayer planar transmission lines. However, the closed-form models are normally applicable to the single-layer standard planar transmission lines only. Moreover, the curve-fitting becomes a hopelessly difficult task for the models of the multilayer structures. An investigator is forced to adopt more sophisticated full-wave electromagnetic methods like - the spectral domain method, method of moments, finite element method etc. However, these methods are not suitable for the analysis and synthesis of planar transmission lines in circuit simulators, which are based on the closed-form models.

This paper discusses Single Layer Reduction (SLR) technique which is necessary to extend the closed-form models developed for single-layer, for computations of line parameters of different lines, to multilayer structure. The SLR method is used to reduce the multilayer substrate to an equivalent single-layer substrate with equivalent relative permittivity using the variational expression of the line capacitance, Transverse Transmission Line (TTL) technique and the conformal mapping technique. The total substrate thickness and strip width remain unchanged in the SLR process. Over the equivalent single-layer substrate, existing closed-form models are used to compute propagation characteristics of multilayer structure. This makes the SLR formulation an attractive closed-form engineering CAD tool for MIC/MMIC designers.The SLR formulation of multilayer Coplanar waveguide (CPW) is shown in Fig.1.

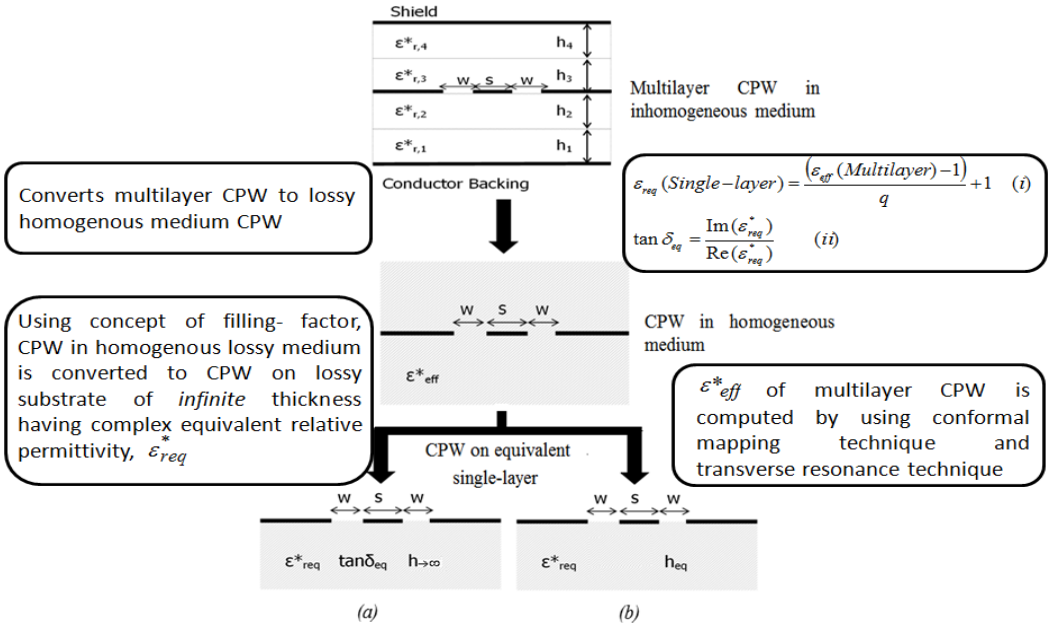

Figure 1. Multilayer CPW structure and SLR Process.