Multiconductor Transmission Line Analysis Using Surface Ribbon Method

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by

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The theoretical background of the new and efficient series impedance technique, surface ribbon method (SRM), is presented. This new technique uses a new impedance boundary condition. The localized characteristics of this new impedance boundary condition, effective internal impedance (EII), are found for the circular conductors and the rectangular conductors. The EII can be approximated easily using transverse resonance technique or plane wave model. Therefore, the SRM can efficiently extract frequency dependent series impedance without solving complex impedance boundary conditions. Also, the SRM has been applied to the arbitrary cross-sectional conductors.

An equivalent circuit modeling for the interconnect using resistor, inductor, and capacitor is useful to predict the behavior of a complex system. The inductance is becoming an important factor in determining the overall delays or signal integrity analysis even for the on-chip interconnect. At the package level, the frequency dependent effects such as skin effect and proximity effect have to be included in the model to accurately predict the characteristics of the package. However, the number of the elements in the model has to be reduced to achieve an efficient simulation. A compact equivalent circuit model based on the SRM is introduced to capture all the frequency dependent effects in time domain simulation. In this equivalent circuit, a

simple RL ladder that can be modeled instantly for a given geometry is used to model the skin effect while coupled inductors are used to model the proximity effect. To accelerate the simulation of this equivalent circuit, moment based circuit simulators can be used. In this dissertation, the method of characteristics and the finite difference method have been applied to speed up the simulation.

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