Efficient 3D-SCN-TLM Diakoptics for Waveguide Components

(Mario Righi and Wolfgang J.R. Hoefer)

The procedure recently introduced to generate high quality absorbing boundary conditions (ABCs) capable of matching in the time domain all the modes excited by a two-dimensional discontinuity of general shape has been extended to three-dimensional discontinuities in waveguide. The procedure is based on the expansion of the time-domain Green's function for separable homogeneous waveguides into eigenfunctions. The possibility to obtain ABCs for higher order modes in the structure (whether propagating or evanescent) allows us to place the ABCs very close to the discontinuity, thus reducing the computational domain and the computation time.

In addition the modal approach leads to the generalized scattering matrix of the discontinuity, thus opening the door to hybrid analysis of waveguide components, where TLM and circuit theory can be combined to analyze and cascade waveguide discontinuities.

The procedure has been applied to the analysis of a capacitive iris, a resonant iris, and a discontinuity of very general shape, showing how absorbing boundaries generated with the modal diakoptic procedure provide wideband matching for the fundamental mode as well as for all TE and TM modes excited by the discontinuity. The structure under study is a rectangular waveguide, shown in Fig. 1, that has been discretized with a mesh of symmetrical condensed 3D-TLM nodes.

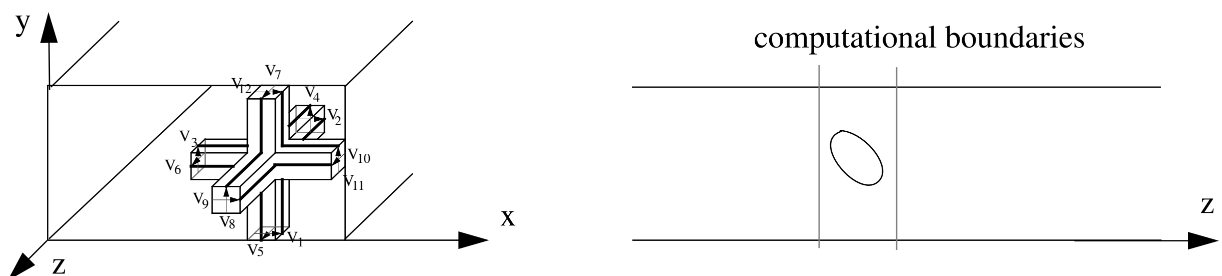


Fig. 1 Geometry of the rectangular waveguide

The fundamental mode has been excited in the mesh with the new ABC placed 8 cells away from each side of the discontinuity. The mesh used in two examples was 80 by 40 cells in the transverse direction. The computational time required for the analysis of these discontinuities was of the order of 30 minutes on an HP 735 workstation leading to a saving of one-to-two orders of magnitude as compared to simulations using single mode ABCs. The results for the magnitude of the S-parameters of three analyzed discontinuities are shown in Fig. 2, Fig. 3 and Fig. 4.

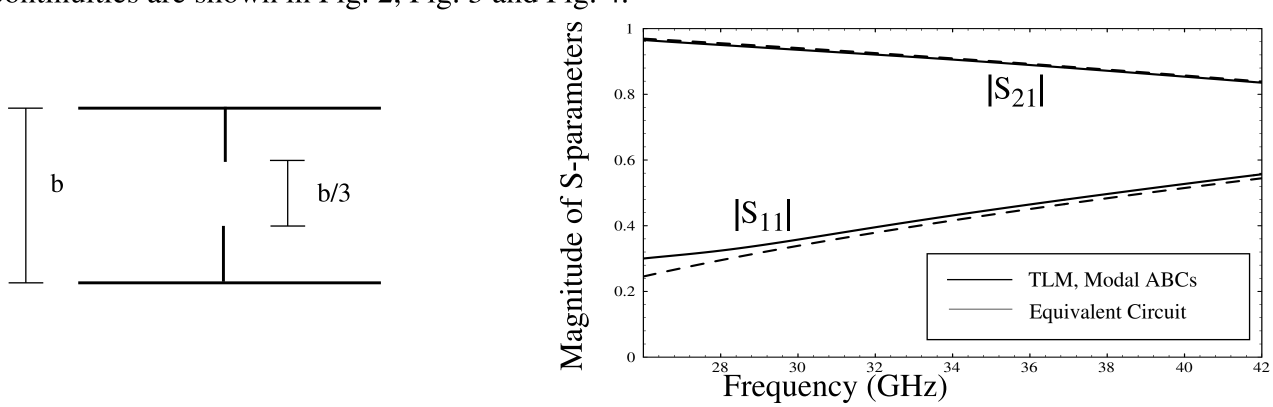
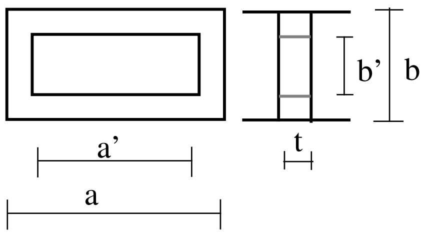


Fig. 2 Magnitude of Scattering parameters for a capacitive iris in WR (28) waveguide



Resonant iris geometry in WR(62) waveguide.
a=15.8 mm, a'=a/√2, b=7.9 mm, b'=b/√2, t=2 mm.
The dimensions used in the simulation are accurate within 1%

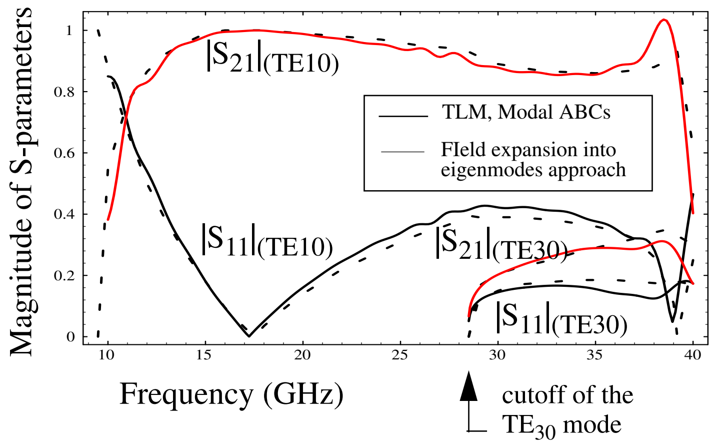
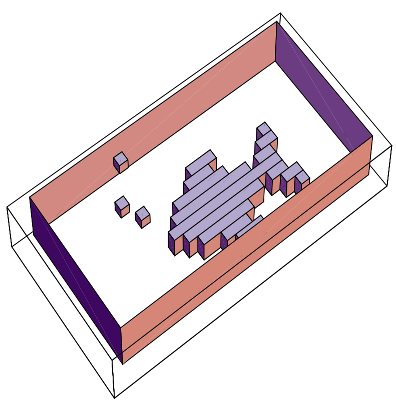


Fig. 3 Magnitude of the generalized S-parameters for a resonant iris in WR(62) waveguide, compared with those obtained by field expansion into eigenmodes. The S-parameters for the dominant and for the next higher mode excited by the iris are shown. The incident mode is the dominant TE_{10} mode.



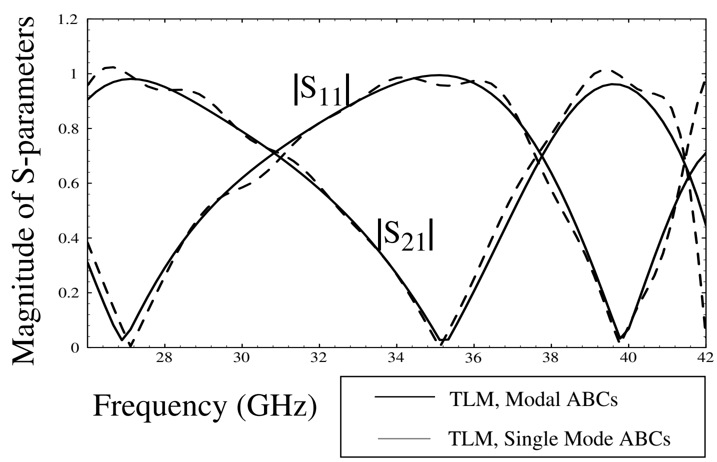


Fig. 4 Magnitude of S-parameters for a *Goldfish* discontinuity in WR (28) waveguide

Detail of this project can be found in the following papers:

[1]M. Righi and W.J.R Hoefer, “Efficient 3D-SCN-TLM Diakoptics for Waveguide Components” to be presented to the 1994 MTT-S International Microwave Conference

[2]M. Righi and W.J.R Hoefer, “Efficient 3D-SCN-TLM Diakoptics for Waveguide Components” submitted to IEEE MTT Transactions on Microwave Theory and Tech.