

Product Integral for Lossless NMTLs

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In solving the product integral for nonuniform multiconductor transmission lines (NMTLs), there are various special cases leading to special solutions with special properties. For simple lossless NMTLs this paper develops a power (Taylor) series in complex frequency for the product integral, including for each of its four matrix blocks. The coefficients involve only the spatial form of the NMTL. This result is appropriate for low-frequency evaluation of the product integral.

This paper extends some of the results in [C.E. Baum, "Reciprocity, Energy, and Norms for Propagation on Nonuniform Multiconductor Transmission Lines, Interaction Note 583, April 2003. (Section 6)] concerning the blocks of the product integral (or matrizant) for lossless nonuniform multiconductor transmission lines. There it is shown that the diagonal blocks are even functions of the complex frequency, s , and the off-diagonal blocks are odd functions of s .

A previous paper [C.E. Baum, "High-Frequency Propagation on Nonuniform Multiconductor Transmission Lines," Interaction Note 589, October 2003.] considers an appropriate high-frequency solution of the NMTL equations, giving a generalized WKB solution. For low frequencies we can think of a power (Taylor) series around $s = 0$. There are various ways to approach this problem (perhaps all equivalent). For present purposes let us use the matrizant series.

Now we have the even/odd properties of the matrix blocks of the product integral for lossless NMTLs explicitly in terms of power series involving even/odd powers of s , as appropriate. This form is particularly suitable for low-frequency evaluation of the product integral. This complements the high-frequency form.

These results are suggestive of solutions for other special cases of NMTLs, some of which may appear in the future.