Abstracts

Examination, Clarification, and Simplification of Modal Decoupling Method for Multiconductor Transmission Lines

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In the application of the modal decoupling method, questions arise as to why the nonnormal matrices LC and CL are diagonalizable. Is the definition of the characteristic impedance matrix Z/sub c/ unique? Is it possible to normalize current and voltage eigenvectors simultaneously, yet assure the correct construction of the Z/sub c/ matrix? Under what conditions do M/sup t over i M/sub v/ = I and Z/sub c/ = M/sub v/M/sub i//sup -1/? In this paper, these questions are thoroughly addressed. We will prove the diagonalizability of matrices LC and CL for lossless transmission lines (though the diagonalizability of their complex analogues, ZY and YZ matrices, is not guaranteed for lossy lines), and will demonstrate the properties of their eigenvalues. We have developed an algorithm to decouple one type of matrix differential equation, and to construct the characteristic impedance matrix Z/sub c/ explicitly and efficiently. Based on this work, the congruence and similarity transformations, which have caused considerable confusion and not a few errors in the decoupling and solution of the matrix telegrapher's equations, will be analyzed and summarized. In addition, we will also demonstrate that under certain conditions, the diagonalization of two or more matrices by means of the congruence or similarity transformations may lead to coordinate system "mismatch" and introduce erroneous results.

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