Energy Band Analysis for Periodical Wave-guides

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ABSTRACT

The Hamiltonian system method is applied to electro-magnetic wave-guides to permit symplectic analysis to be applied to arbitrary anisotropic materials and to permit the interface conditions between segments of a periodical wave-guide to be treated. The transverse electric and magnetic fields compose the dual vectors. An electro-magnetic stiffness matrix is introduced which relates to the electric field vectors at both its ends. The pass- and stop-band solutions are given for a constant cross-section segment of a plane wave-guide and then the equations needed to combine two segments with different cross-sections are derived. The energy variational principle is applied to electro-magnetic stiffness matrix of a fundamental period of the wave-guide, which is computed by combining segments recursively until the shortest repeating length of the wave-guide has been assembled. Finally, the pass-band eigenvalues of the energy band are found by using the Wittrick-Williams algorithm throughout the calculations, starting with the combination of segments step.