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Modellistica Elettromagnetica di Strutture Periodiche ad Onde Millimetriche

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Periodic structures find application in a wide frequency range: for example metallic periodic surfaces are used as dichroic mirrors in deep-space antennas operating in the microwave band and dielectric periodic surfaces are the main components of photonic crystal (PhC) waveguides at optical frequencies. My research interest is in the electromagnetic modeling of both kinds of structures. In particular, in the microwave and in the millimeter-wave case, I have investigated the convergence properties of an integral numerical method for the analysis of frequency selective surfaces. In the optical range, I have studied the propagation of the electromagnetic field in standard linear PhC waveguides defined in silicon membranes[1], especially from the point of view of the coupling between the periodic PhC and the possible interconnections in a complete circuit. I considered the scattering of the fields due to these discontinuities and I observed that, for the linear PhC waveguides I analyzed, the propagation from the input slab to the output one, through the periodic lattice, follows the theoretical prediction. This detailed study of the electromagnetic field configuration in the dielectric permits to extend the development of classic circuit components like filters, couplers, power splitters, etc., to the optical telecommunication frequency range by starting from the standard microwave approach. In this way, PhC circuits could be associated to metallic waveguide or microstrip lines equivalent ones, but also to substrate integrated waveguide structures, where the guided field propagates in a dielectric substrate metalized on both sides.

References:

1. M. Galli, D. Bajoni, M. Patrini, G. Guizzetti, D. Gerace, L. C. Andreani, M. Bellotti, Y. Chen, Single-mode versus multimode behavior in silicon photonic crystal waveguides measured by attenuated total reflectance, Physical Review B 72, (2005) 125322.