Comparison of spatial harmonics in infinite and finite Bragg stacks for metamaterial homogenization

Metamaterial homogenization may be based on the dominance of a single Floquet-Bloch spatial harmonic in an infinite periodic structure - with the dominance quantified in terms of the relative magnitude of the associated spatial harmonic Poynting vector. For the corresponding finite structure the field is not quasi-periodic and cannot be expanded in Floquet-Bloch spatial harmonics; however, a set of pseudo spatial harmonics can be defined and the dominance of a single such harmonic likewise be used to determine whether the structure can be homogenized. For three different lossless Bragg stack configurations (one of which is magneto-dielectric), we show, using spectral representation, that the field in the finite structure can be accurately expanded in terms of these pseudo spatial harmonics and that the distribution of these agrees very well with the distribution of Floquet-Bloch spatial harmonics of the corresponding infinite Bragg stack. This is even the case for finite Bragg stacks having only two unit cells; thus, the number of unit cells does not influence the homogenizability of this type of configuration.

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