Analysis of three-dimensional acoustic scattering from doubly periodic structures using a source model

Amir Boag, Yehuda Leviatan, and Alona Boag
Department of Electrical Engineering, Technion-Israel Institute of Technology, Haifa 32000, Israel

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A novel solution is presented for the problem of three-dimensional acoustic scattering of a time-harmonic plane wave from doubly periodic structures. The general problem is first reduced to a consideration of the fields over a suitably defined unit cell. Sets of fictitious doubly periodic and properly modulated patch sources are used to simulate the fields in the homogeneous regions crossed by the unit cell boundaries. Sets of fictitious point sources are used to simulate the fields inside the regions completely enclosed within the unit cell. The complex amplitudes of the fictitious sources are adjusted to satisfy the boundary conditions at a selected set of points on the boundaries between the regions. The suggested solution procedure is simple to implement and is applicable to doubly periodic structures composed of homogeneous regions of arbitrary shape. Structures comprising acoustically rigid and soft boundaries can also be handled by the procedure. The method has been tested for accuracy by studying the cases of scattering from arrays of spherical scatterers and from doubly periodic sinusoidal surfaces.

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