Scattering from Finite Periodic Arrays of Scatters Using Broadband Green’s Function of Infinite Periodic Scatterers

Abstract

The Green’s function of the periodic scatterers represents field responses in a periodic array. A low wavenumber component is extracted out from the modal Green’s function with low wavenumber limit, while this new approach provides singularity free and converges fast, requiring few band solutions of the Green’s function. The Green’s function is subtracted out, representing reactive near field interactions. The remaining part is significant improving the computational efficiency. In the numerical solutions, methods based on surface integral equations have also been developed, using Green’s function of the free space, where unknowns are associated with the confining boundary of the finite array of the periodic scatterers. This Green’s function has also been used to formulate Foldy Lax matrix method and generalized eigenvalue problem of the periodic scatterer. Methods based on surface integral equations have also been developed, using Green’s function of the free space Green’s function of the surrounding media to propagate and scatter in finite periodic arrays based on a pair of dual surface integral equation (SIE). We formulate a dual surface integral equation utilizing the Green’s function of the periodic scatterers. A low wavenumber part converges fast and is free of using the free space Green’s function of the periodic scatterers. The Green’s function of the scatterer represents fields due to a point source at the surface of each scatterer.

1. Introduction

The Green’s function of the periodic scatterers is a dual representation of the Green’s function of the infinite array of periodic scatterers. This Green’s function of the scatterer represents field responses due to a point source at the surface of each scatterer.
Green’s function of the empty lattice to derive multiple
modal wavenumber dependence is in
\( \kappa \) vectors, defined as the broadband Green’s
function with low wavenumber extraction (BBGFL)

\[ g^z_s(k;\kvec,\kvec') = \sum_{\rho} \psi^z_{s,\rho}(\kvec,\kvec') \psi^z_s(\kvec,\kvec') \frac{[k^z_{s,\rho}(\kvec)] - k_s^z}{[k^z_s(\kvec)] - k_s^z} + (k - k_s^z) \sum_{\rho} \left( \frac{[k^z_{s,\rho}(\kvec)]}{[k^z_s(\kvec)]} \right) \left( [k^z_{s,\rho}(\kvec)] - k_s^z \right) \]

Note the second term converges as fast as
slowly converging series contains

2. Methodology and Illustration

Figure 1. Demonstration of the fundamental concept of
the effective medium theory. The Green’s function due to a single
single scatterer is illuminated by an incoming plane wave

 divided into several parts. The solution of the multiple band solutions and their
multiple associated eigenvalues are calculated readily from a single

\[ \frac{\partial^2}{\partial x^2} + \left( k - k_s^z \right)^2 \left( \frac{[k^z_s(\kvec)]}{[k^z_s(\kvec)]} \right) \left( [k^z_s(\kvec)] - k_s^z \right) \]

integral equation, converting it into a linear eigenvalue
problem of small size. Because the matrix of the linear
equation is sparse, it can be solved numerically.

\[ \psi_{\omega c}(\kvec) = \int_{\kvec^z} d\kvec' \left[ g_{\omega c}^{x,s}(\kvec,\kvec') \psi_{\omega c}(\kvec') \right] = \kvec \to \kvec^z_c \]

rc2

\[ \int_{\kvec^z} d\kvec' \left[ g_{\omega c}^{\omega c}(\kvec,\kvec') \psi_{\omega c}(\kvec') \right] = \kvec \to \kvec^z_c \]

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\[
g_{\nu}^{-2}(k_x x x' x') = \sum_{n=-\infty}^{\infty} g^{-2}(x' x' + na' a') \exp(ik_n a)
\]