Slice Absorption Method

for Rigorous Electromagnetic Analysis of Volumetrically Complex Periodic Structures

The slice absorption method (SAM) is specifically tailored to model periodic structures that are volumetrically complex. It was inspired by semi-analytical methods in its ability to model structures one layer at a time, but is fully numerical and avoids the computationally expensive eigen-system computation.

Real-Space Formulation

Step 1: Calculate the A matrix for three consecutive slices.

\[
\mathbf{A}_z = \mathbf{A}_y \mathbf{A}_x
\]

Step 2: Reorder the A matrix.

\[
\mathbf{A}_{\text{reorder}} = \mathbf{A}_z \mathbf{A}_y \mathbf{A}_x
\]

Incorporating a Plane Wave Source

Absorbing the \(i\)th Slice

\[
\mathbf{a}_i \mathbf{E}_i + \mathbf{b}_i \mathbf{E}_{i+1} + \mathbf{c}_i \mathbf{E}_{i-1} = \mathbf{E}_i
\]

Absorbing a Stack of Slices

Cascading and Doubling Algorithm

Calculating Transmitted and Reflected Power

\[
P_{\text{transmitted}} = \left| \mathbf{F} \mathbf{K} \mathbf{F}^\dagger \mathbf{e} \right|^2
\]

Calculating the Slice Data

Fourier-Space Formulation

Step 1: Calculate the Fourier transform operator

\[
\mathbf{f} = \mathbf{F} \mathbf{e}
\]

Step 2: Calculate Fourier transform operator

\[
\mathbf{F} = \mathbf{F} \mathbf{F}^\dagger
\]

Incorporating Transparent Boundary Conditions

Real-Space Propagation

\[
\mathbf{E}_r = \mathbf{E}_i + \mathbf{K} \mathbf{E}_r
\]

Fourier-Space Propagation

\[
\mathbf{E}_r = \mathbf{E}_i
\]