An efficient interpolation for calculation of the response of composite layered material and its implementation in MUSIC imaging

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Electromagnetic modeling and preliminary numerical results

New recurrence relations based on the propagator matrix method [8]

- To efficiently calculate the spectral response of the laminate
- Capable of stably dealing with distributed source along z
- More efficient compared to the traditional Green’s function method
- To numerically solve the state equation

\[ \frac{d}{dz} \Phi(z) = \tilde{X}(z) \Phi(z) \] with \( \tilde{X}(z) \) containing the tangential components of the fields and \( \Phi(z) \) being the source term

\[ \frac{d^2}{dz^2} \Phi(x, y) = \Delta(\Phi(x, y)) \]

- Goal is to compute the 1-F of fast oscillating spectrum in the \( k_x-k_y \) plane

\[ G(x, y) = \frac{1}{2\pi} \int G(k_x, k_y) \Delta(\Phi(x, y)) \, dk_x \, dk_y \] (1)

- Interpolation of the non-oscillating part at the Padua points with Chebyshev’s polynomial interpolant

\[ C_n G_n(k_x, k_y) = \sum_{i=0}^{n} \phi_i(x, y) T_n(k_x) \] with weights \( \phi_i(x, y) \) computed using [4]

- Fourier transform of Chebyshev polynomials given by

\[ \tilde{F}(k_x) \exp(-ik_x x) \, dk_x \] are managed using [6] among other good options.

MUSIC images of anisotropic layered media affected by two defects

- Standard MUSIC imaging method [1]

\[ \Phi(\omega) = \sum_{i=1}^{n} \sum_{j=1}^{m} \tilde{G}(\omega) \tilde{G}^*(\omega) \]

- Enhanced MUSIC imaging method [5]

\[ \Phi(\omega) = \sum_{i=1}^{n} \sum_{j=1}^{m} \tilde{G}(\omega) \tilde{G}^*(\omega) \]

with \( \omega = \arg \max \{ \tilde{G}(\omega) \tilde{G}^*(\omega) \} \)

Conclusions & perspectives

- Green’s function constructed by the proposed method is applied in MUSIC imaging.
- Preliminary numerical results show the efficiency of the proposed method in a fully complex anisotropic configuration