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Neutron optics: new algorithm based on Green's functions for simulating waveguides with Dirichlet boundary conditions. (English) Zbl 1481.78013

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Summary: We present a new, efficient and robust method for computing scalar wave propagation for those cases in which Dirichlet boundary conditions play a key role. The algorithm is versatile and it allows to treat reflection, diffraction, waveguiding regime, scattering and free propagation. The analysis is based upon a representation for a slow neutron wavefunction in terms of the incoming wave and integrals, along the boundaries of an unbounded domain, involving a Green's function and certain auxiliary functions (warranting the Dirichlet boundary conditions). The analysis involves Fourier and Hilbert transforms defined only on the boundaries and enables to exploit the detailed advantages of Fast Fourier Transform (FFT) to perform simulations. Our algorithm proves to be highly effective both in terms in running time and memory load, compared to those based on Finite Differences Methods (FDM). Moreover, since the value of the field at each point may be calculated independently, this algorithm allows parallelization in a natural way.

MSC:

78A50 Antennas, waveguides in optics and electromagnetic theory
35Q60 PDEs in connection with optics and electromagnetic theory

Keywords:

neutron optics; waveguides; Green's functions; Dirichlet boundary conditions; unbounded domain; meshless algorithm

Software:

FFTW

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