Accelerating the method of... 1 / 28 205% Add to Library

BIT Numerical Mathematics (2026) 66:57
https://doi.org/10.1007/s10543-026-01151-7

BIT

Check for updates

Accelerating the method of reflections with domain decomposition techniques for boundary integral equations in multiple scattering

Stéphanie Chaillat[1] · Marion Darbas[2] · Martin J. Gander[3] · Laurence Halpern[2]

Received: 13 April 2026 / Accepted: 28 August 2026
© The Author(s), under exclusive licence to Springer Nature B.V. 2026

Abstract

The Method of Reflections was historically introduced to obtain approximate solutions as series expansions for the motion of particles in suspension. It can however equally well be used for solving multiple scattering problems numerically. We show for Helmholtz multiple scattering problems that the Method of Reflections, whether applied in its alternating or parallel version, suffers from convergence problems when scatterers are close. We use boundary integral equations to formulate the methods, and then identify their discretization as algebraic Schwarz methods, thereby interpreting them as boundary domain decomposition techniques. This connection allows us to introduce remedies such as overlap (which can be partial, covering only the illuminating region of the obstacles) and coarse spaces from domain decomposition into the Method of Reflections. This leads to substantially accelerated variants, and also naturally makes them suitable preconditioners for GMRES. These new approaches are