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The computation of resonances in open systems using a perfectly matched layer.

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ABSTRACT

In this talk, I will consider the problem of computing resonances in open systems. Such resonances are characterized in terms of (improper) eigenfunctions of the Helmholtz operator on an unbounded domain. The perfectly matched layer (PML) technique has been successfully applied to the computation of scattering problems. We shall see that the application of PML converts the resonance problem to a standard eigenvalue problem (still on an infinite domain). This new eigenvalue problem involves an operator which resembles the original Helmholtz equation transformed by a "complex shift in coordinate system." Our goal will be to approximate the shifted operator by replacing the infinite domain by a finite (computational) domain with a convenient boundary condition and applying finite elements. We shall discuss theoretical results guaranteeing eigenvalue convergence which is free from spurious computational eigenvalues provided that the size of computational domain is sufficiently large and the discretization parameter is sufficiently small. We shall also discuss some of the challenges that these problems pose for iterative eigenvalue software. Finally, numerical experiments in one and two spatial dimensions will be given.