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Successes and Failures of Numerical Solutions to the 1-Dimentional Marchenko Integral Equation for Quantum Inverse Scattering

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<p>The origin of numerical errors, which in certain cases lead to complete failure of the direct method for solving the 1-dimensional Marchenko integral equation, are investigated. Bargmann and block potentials, for which exact analytical expressions exist, are used to compare the accuracy of numerical results. In particular, numerical results from the Nystrom method are compared to those of two novel collocation methods. The results indicate that, for roughly the same computational effort, the three method may be ranked in order of increasing accuracy: Nystrom method, equidistant collocation method and non-equidistant collocation method. In all three cases the origin of the failure, which occurs for barrier-like potentials of relatively large width and height, may be attributed to the numerical instability introduced in both the Fourier inversion and the linearization steps. Subsequently these errors produce perturbations on the matrix elements of the inversion matrix, a matrix which is found to become increasingly ill-conditioned as the height and width of the potential increases. At the current limits of successful inversion, we attribute the ”early” onset of inversion failures, to the aforementioned matrix element perturbations. However at still higher potential height and width, the inherent ill-conditioning of the inversion matrix alone, accounts for the inversion failures. We therefore conclude that there is an inherent upper-bound on the application of the direct inversion method for inverting relatively high and wide potentials.

Level (Hons, MSc,
   PhD, other)?

Hons

Consider for a student
   award (Yes / No)?

Yes

Would you like to
 submit a short paper
 for the Conference
 Proceedings (Yes / No)?

Yes

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