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Solitons, boundary value problems and a nonlinear method of images.

We discuss the solution of initial-boundary-value problems (IBVPs) for the nonlinear Schroedinger (NLS) and its integrable discrete analogue, the Ablowitz-Ladik (AL) system. We consider such equations on semi-infinite spatial domains and with linearizable boundary conditions (BCs). We show how such kinds of IBVPs can be effectively solved by extending the solution to an infinite domain and using the inverse scattering transform (IST) machinery available for the corresponding initial value problem (IVP). We then discuss the symmetries in the discrete and continuous spectrum induced by the BCs, and we use these symmetries to characterize the soliton solutions. In particular, we show that, for both the NLS equation and the AL system, the reflection at the boundary experienced by the solitons is due to the presence of an equal number of mirror solitons located beyond the boundary of the physical domain. These results provide a nonlinear analogue to the method of images for linear partial differential equations. (Received September 22, 2009)