Local Nonlinear Orthogonal Transformation for Acoustic Waveguides

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Some nonlinear local transformations are developed for solving the two dimensional Helmholtz equation in a region bounded by a flat top and a curved bottom. These transformations can be used to flatten the curved bottom of acoustic waveguides. The one-way re-formulation based on the Dirichlet-to-Neumann (DtN) map is then used to reduce the boundary value problem to an initial value problem. Numerical implementation of the resulting operator Riccati equation uses a large range step method for discretizing the range variable and a truncated local eigenfunction expansion for approximating the operators. Numerical simulations show that the solutions of Helmholtz equation solved by these nonlinear transformations are better than the one solved by the common linear transformation. These methods are particularly useful for solving long range wave propagation propagation problems in slowly varying waveguides.