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Mosazadeh, Seyfollah (IR-UKM-PM);
Neamaty, Abdolali [Neamaty Hosseinabady, A.] (IR-UMZ-M);
Bagherzadeh, Maedeh (IR-UMZ-M)

On the numerical solution of an inverse spectral problem with a singular potential. (English summary)

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This paper deals with a self-adjoint eigenvalue problem generated by the differential equation

$$ly := -y'' + p(x)y = \mu y, \tag{1}$$

on the interval $[0, T]$, where μ is the eigenvalue parameter, and the potential function $p(\cdot)$ is real and has a regular singular point. This differential equation is considered with the following boundary conditions:

$$y'(0,\mu) - \alpha y(0,\mu) = 0, \quad y'(T,\mu) + \beta y(T,\mu) = 0,$$

where α and β are real or complex coefficients. It is assumed that the potential function $p(\cdot)$ in equation (1) has the form

$$p(x) = \frac{B}{(x-x_0)^2} + p^0(x),$$

where $B = \frac{1}{4}(\nu^2 - 1)$, $\nu = 2k - \frac{1}{3}$ or $\nu = 2k + \frac{1}{3}$, k is an integer, $0 < x_0 < T$ and $x \mapsto p^0(x)|x - x_0|^{1-|\nu|}$ belongs to $L_1(0, T)$.

It is shown that the coefficients in the problem can be determined from the spectral data. A uniqueness theorem for the solution of the inverse problem is given. A numerical algorithm for solving the inverse spectral problem of recovering the potential function on a finite interval is presented. Also, some numerical results are provided, and an approximate solution of the inverse problem is obtained. *F. Ayca Cetinkaya*