Numerical solutions of source identification problem for hyperbolic-parabolic equations

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Abstract: Numerical methods for partial differential equations with unknown source terms have been studied recently by many researchers (see for instance [1–3] and the references therein).

In this work, a numerical study is presented of boundary value problem for hyperbolic-parabolic equations

$$(1)\quad \begin{cases} u_{tt}(t,x) - \big(a(x)u_x(t,x)\big)_x = p(x) + f(t,x), \quad 0 < x < 1,\ 0 < t < 1, \\ u_t(t,x) - \big(a(x)u_x(t,x)\big)_x = p(x) + g(t,x), \quad 0 < x < 1,\ -1 < t < 0, \\ u(0+,x) = u(0-,x),\ u_t(0+,x) = u_t(0-,x), \quad 0 \le x \le 1, \\ u(-1,x) = \varphi(x),\ u(1,x) = \psi(x), \quad 0 \le x \le 1, \\ u(t,0) = u(t,1) = 0, \quad -1 \le t \le 1. \end{cases}$$

where $p(x)$ is an unknown source term. The first and second order of accuracy difference schemes for the approximate solution of problem (1) are constructed and the numerical procedure for implementation of these schemes is discussed. These difference schemes are implemented for a simple test problem and the numerical results are presented.

Keywords: Difference scheme, source identification problem, hyperbolic-parabolic equation

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