An algorithm for solving a nonlocal problem for hyperbolic equations with piecewise constant argument of generalized type

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The theory of differential equations with piecewise constant argument has been developed in the context of mathematical modeling of various processes in biology, chemistry, mechanics, electronics, etc. A new class of differential equations with piecewise constant argument was proposed by M. Akhmet. He suggested the delay argument to be an arbitrary piecewise constant function as opposed to the greatest integer function. Differential equations with piecewise constant argument of generalized type have proven to be more suitable models for studying and solving various application problems, including neural networks, discontinuous dynamical systems, hybrid systems, etc.

We present an algorithm for solving a nonlocal problem for a system of second-order hyperbolic equations with piecewise constant time argument of generalized type. The method we use is based on the introduction of functional parameters that are set as the values of the desired solution along the lines of the domain partition with respect to the time variable. With the aid of the functional parameters and new unknown functions, the considered problem is reduced to an equivalent problem for a system of hyperbolic equations with data on the interior partition lines and functional relations with respect to the introduced parameters. We developed a two-stage procedure to approximately solve the latter problem: firstly, we solve an initial-value problem for a system of differential equations in functional parameters; then, we solve a problem for a system of hyperbolic equations in new unknown functions with data on the interior partition lines. We derived some conditions for the convergence of approximate solutions to the exact solution of the problem under study in terms of input data and proved that these conditions guarantee the existence of a unique solution of the equivalent problem. Finally, we established coefficient conditions for the unique solvability of the nonlocal problem.

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