


Mathematician suggests a scheme for solving telegraph equations


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Space source problems for elliptic-telegraph equations

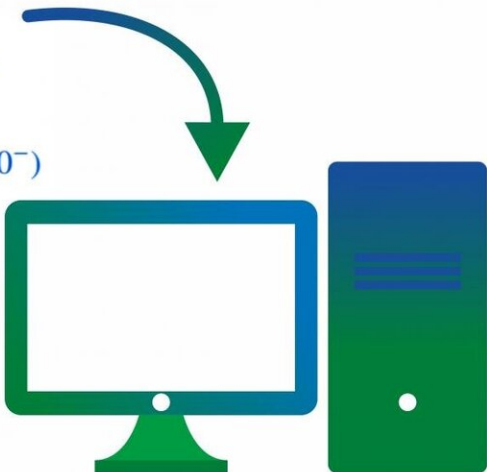
$$\begin{cases} u_{tt}(t) + \alpha u_t(t) + Au(t) = p + f(t), 0 < t < 1, \\ -u_{tt}(t) + Au(t) = p + g(t), -1 < t < 0, \\ u(-1) = \psi, u(1) = \xi, u(0) = \varphi, u_t(0^+) = u_t(0^-) \end{cases}$$



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**Absolute stable
difference scheme**



A mathematician from RUDN University suggested a stable difference scheme for solving inverse problems for elliptic-telegraph and differential equations that are used to describe biological, physical, and sociological processes. Credit: RUDN University

A mathematician from RUDN University suggested a stable difference scheme for solving inverse problems for elliptic-telegraph and differential equations that are used to describe biological, physical, and

sociological processes. The results of the study were published in the *Numerical Methods for Partial Differential Equations* journal.

Elliptic equations are a class of [differential equations](#) in partial derivatives that are used, among other things, to model time-independent processes. Telegraph equations are presented in a nonstationary form. They were initially obtained for a telegraph communication line, but today they are also used to model the movement of insects, the flow of blood through veins, and the changes undergone by building materials. Moreover, they can be inversed, i.e. used to find a source of changes based on known process characteristics, for example, to identify a cause of material damage or to create an optic tomography image for the purposes of medical diagnostics. It is often difficult to obtain accurate solutions for problems like these; therefore, the initial problem is reduced to a system of simpler equations that provide an answer with a certain degree of approximation to the correct one. A mathematician from RUDN University suggested an algorithm to obtain inverse problem solutions for elliptic-telegraph equations using a computer.

"The more complex a modeled system, the more unknown parameters it contains, and the more difficult are the calculations. However, despite the complexity of the task, modern computers can be used to search for approximate solutions to differential equations. We aimed to obtain absolute stable difference schemes for the approximate solution of the space identification problem for the elliptic-telegraph equations. Our work could help further implement these methods into the modeling of various processes," said Prof. Allaberen Ashyralyev, a Ph.D. in Physics and Mathematics from the Department of Higher Mathematics, RUDN University.

One way to obtain an approximate [solution](#) is to replace the initial problem with difference schemes. The studied area is turned into a grid with a given step size, and functions are replaced with node values. The

mathematician suggested a difference scheme and then studied it both analytically and numerically. The first method was used to confirm the absolute stability of the scheme, and the second (a numerical experiment, i.e. an [equation](#) that the scheme was applied to)—to support the results of the analysis. The scientist managed to demonstrate that the scheme was absolutely stable and independent from the chosen calculation step size.

"Similar elliptic-telegraph equations are used to model [biological systems](#), sociological phenomena, and engineering processes. An absolute stable difference scheme could help specialists better study these issues," added Prof. Allaberen Ashyralyev from RUDN University.

More information: Allaberen Ashyralyev et al, On the absolute stable difference scheme for the space-wise dependent source identification problem for elliptic-telegraph equation, *Numerical Methods for Partial Differential Equations* (2020). [DOI: 10.1002/num.22561](https://doi.org/10.1002/num.22561)

Provided by RUDN University

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