

Comparison of selected artificial intelligence algorithms to determine the thermal conductivity coefficient of a porous material

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Abstract: The paper considers the inverse problem of determining the thermal conductivity coefficient of a porous material. The two-dimensional anomalous diffusion equation with Riemann-Liouville fractional derivative is adopted as the model of the direct problem. Presented model (equations and initial-boundary conditions) can be used to describe anomalous diffusion, for example the heat conductivity in porous materials. To solve the direct problem, the finite differences method supplemented by the scheme based on the alternating direction implicit method (ADIM) is used. The input data for the inverse problem are temperature measurements at selected points in the area. Using the input data and the solution of the direct problem, a functional describing the error of the approximate solution is built. Two artificial intelligence algorithms, the ant colony optimization (ACO) and artificial bee colony (ABC), are used to minimize this functional. In the presented numerical example, these algorithms are compared in terms of accuracy, stability and speed of operation.

Keywords: inverse problem, fractional derivative, parameter identification, anomalous diffusion, optimization, artificial intelligence