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The reconstruction of the heat transfer coefficient in the fractional Stefan problem

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Abstract: The paper presents the algorithm for solving the inverse fractional Stefan problem. The considered inverse problem consists in determining the heat transfer coefficient on one of the boundaries of the considered region. The additional information necessary for solving the inverse problem is the set of temperature values in selected points of the region. The fractional derivative with respect to time used in the considered Stefan problem is of the Caputo type. The direct problem was solved by using the alternating phase truncation method adapted to the model with the fractional derivative. Using the given temperature values and the values computed by solving the direct problem for the chosen value of the heat transfer coefficient the functional representing the error of the approximate solution was constructed. The sought solution of the considered inverse problem was the argument for which the functional gained its minimum. The functional was minimized by the use of the ant colony algorithm. It is the probabilistic artificial intelligence algorithm inspired by the behaviour of the ants swarm. The paper contains an example illustrating the accuracy and the stability of the presented algorithm.

Keywords: optimization, artificial intelligence, inverse problem, fractional derivative, solidification