Inverse analysis of heat transfer across a multilayer composite wall with Cauchy boundary conditions

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The paper proposes a method to solve Cauchy inverse problems of heat transfer across a multilayer composite wall. The corresponding forward model uses a meshfree method based on radial basis functions approximation in both time and space in a unified fashion. The Tikhonov regularization technique is used to mitigate the ill-posedness of the inverse problem to ensure a stable and reliable solution. Because the time is also considered as a dimension in our scheme, a parameter is adjusted to deal with the relationship between the time and the space discretization. In addition, because unified space-time approximation scheme does not use the usual layer-by-layer recursion procedure, possible error accumulation is naturally avoided. For a better accuracy, a procedure is adapted to minimize the error on the given boundary by selecting a shape parameter c for the RBF in each layer. Intensive numerical experiments are conducted to demonstrate accuracy, effectiveness and stability.

Key Words: inhomogeneous heat transfer, meshfree, radial basis function, inverse problem