

CONTROL-POINT PLACEMENT AS A LIMITING FACTOR IN κ RECONSTRUCTION FOR INVERSE HEAT CONDUCTION PROBLEMS

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In inverse heat conduction problems, the quality of parameter reconstruction depends not only on the optimization algorithm used but also on the quality and structure of the input information. This second aspect is often treated as secondary, even though it can practically determine the success of the entire identification procedure.[1,2,3]. In this work, this problem was addressed using the example of reconstructing the heat transfer coefficient κ under a fourth-kind boundary condition, which describes imperfect thermal contact between the casting and the mold.[4,5,6] The main objective of the research is to answer whether the mere arrangement of control points, where temperatures are recorded, can limit or improve the quality of reproducing the sought-after parameter.

Three variants of control point locations were analyzed: a configuration with points placed directly at the contact boundary and two configurations set back from it. To reconstruct the coefficient κ , two swarm algorithms, Artificial Bee Colony (ABC) and Ant Colony Optimization (ACO) [7,8], were used, implemented in an original computational environment based on the finite element method. The studies were conducted for different population sizes, numbers of iterations, and levels of reference data disturbances. As evaluation measures, the parameter reconstruction error and the error functional value were used, allowing simultaneous analysis of the accuracy and stability of the results.

The novelty of the proposed approach lies in shifting the focus from the algorithm itself to the design of the measurement information. Instead of asking solely which algorithm works better, the work poses a more fundamental question: from which system points should data be collected for the algorithm to have any chance of functioning effectively [9]. The results are expected to confirm the significant impact of control-point location on identification accuracy and to show that points located directly at the contact boundary may not be optimal. Such a result would have significant practical implications, as the improvement in reconstruction quali-

ty could stem not from further increases in computational costs, but from better design of the measurement setup. In this sense, the work provides useful recommendations for tasks involving the reconstruction of thermal parameters. It can serve as a starting point for more consciously integrating numerical modeling with experimental design.

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