A numerical solution on inverse fuzzy convection-diffusion heat transfer problem

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Abstract

This paper presents a numerical method to estimate fuzzy thermal parameters and initial conditions for transient convection–diffusion heat transfer problem when uncertainty of thermal parameters and initial conditions are characterized by the fuzzy numbers. The direct fuzzy transient convection–diffusion heat transfer problem is solved by utilizing Finite Element Method(FEM), a temporally piecewise adaptive algorithm[1] and the General Transformation Method (GTM) [2].On the basis of the solution of direct problem, the fuzzy estimation can be realized using an inverse fuzzy arithmetic[3] and an evolutionary algorithm of Differential Evolution(DE)[4].

A numerical example is provided to verify the proposed approach, and a good accordance can be observed in the comparison of the prescribed and estimated results.

The impact of alpha-cut segments and the size of time step on the result is also discussed.

Keywords: Inverse problem, Uncertainty, fuzzy arithmetic, Heat transfer, Convectiondiffusion, Transformation method.

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