Reliable Solutions of problems with uncertain hysteresis operators

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Modelling of many problems in technology leads to initial boundary value problems for partial differential equations. Material properties are described by constitutive relations containing the so-called data, i.e. coefficients or functions obtained by measurements in experiments. Thus these data are uncertain, i. e. are known in some extent only. Taking mean values of the data in numerical modelling caused several serious failures in technology.

The problem of finding reliable solution is solved by the so-called worst scenario method introduced by Ivo Babuška and Ivan Hlaváček. The method consists in looking for the worst situation that can appear on the so-called admissible data, the badness of situation is estimated by means of a critical functional evaluating critical parts of the material.

In the contribution the worst scenario method is applied to boundary value problems for nonlinear equation with scalar hysteresis operator $\mathcal{F}$ or its inverse $\mathcal{G}$ of Prandtl-Ishlinskii type. The method demands special estimates of the hysteresis operators. Existence of reliable solutions are proved for initial boundary value problem for scalar wave equation

$$c\,u_{tt} = (\mathcal{F}_\eta[u_x])_x + f$$

and for diffusion and heat equation

$$c\,u_t = (\mathcal{F}_\eta[u_x])_x + f\,.$$

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