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Determination of Source Functions in Composite Type System of Equations

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The problem of identification of the source function for semievolutionary system of two partial differential equations is considered in the paper. The investigated system of equations is obtained from the original system by adding the time derivative containing a small parameter $\varepsilon > 0$ to the elliptic equation. The Cauchy problem and the second boundary-value problem are considered.

Keywords: identification, inverse problem, parabolic equation, the method of weak approximation, small parameter, convergence.

We obtain a priori (uniform in $\varepsilon > 0$) estimates of solutions of approximate problems. We prove convergence of solutions approximating the inverse problems to solutions of original problems when $\varepsilon \to 0$ on the basis of the obtained a priori estimates. We obtain that the rate of convergence of solutions of approximate problems is $O(\varepsilon^{1/2})$ in class of continuous functions. The case of the first boundary-value problem has been studied by Yu.Ya.Belov.

An identification problem of source functions in the composite type system is considered in [1–3].

1. Formulation of the problem and reduction it to the direct problem

Consider in the strip $G_{[0,T]} = \{(t,x) \mid 0 \leqslant t \leqslant T, \ \ x \in E_1\}$ the problem of determining real-valued functions $\Big(\overset{\varepsilon}{u}(t,x), \overset{\varepsilon}{v}(t,x), \overset{\varepsilon}{g}(t)\Big)$, satisfying the system of equations

$$\begin{cases} \overset{\varepsilon}{u}_t(t,x) + a_{11}(t)\overset{\varepsilon}{u}(t,x) + a_{12}(t)\overset{\varepsilon}{v}(t,x) = \mu_1 \overset{\varepsilon}{u}_{xx}(t,x) + \overset{\varepsilon}{g}(t) f(t,x), \\ \varepsilon \overset{\varepsilon}{v}_t(t,x) + a_{21}(t)\overset{\varepsilon}{u}(t,x) + a_{22}(t)\overset{\varepsilon}{v}(t,x) = \mu_2 \overset{\varepsilon}{v}_{xx}(t,x) + F(t,x), \end{cases} \tag{1}$$

where constant $\varepsilon \in (0,1]$. Initial conditions are

$$\overset{\varepsilon}{u}(0,x) = u_0(x), \quad \overset{\varepsilon}{v}(0,x) = v_0(x), \tag{2}$$

and the overdetermination condition are

$$\overset{\varepsilon}{u}\big(t,x^0\big) = \varphi(t), \quad \varphi \in C^2[0,T], \tag{3}$$

where $\varphi(t)$ is a given function, $0 \leqslant t \leqslant T$ and x^0 is some fixed point.

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