Binary correspondences and an algorithm for solving an inverse problem of chemical kinetics

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Binary correspondences are used for formalization of problems, their basic components, properties, and constructions [1–3]. As an illustration, a singularly perturbed system of ordinary differential equations is considered which describes a process in chemical kinetics [4, 5]:

$$\begin{aligned} \dot{x}(t) &= f\big(x(t), y(t), t, \varepsilon\big), \\ \varepsilon\, \dot{y}(t) &= g\big(x(t), y(t), t, \varepsilon\big), \end{aligned}$$

where $x \in \mathbb{R}^m$, $y \in \mathbb{R}^n$, $t \in \mathbb{R}$, ε is a small parameter, f, g are sufficiently smooth functions. Formulas for the solution of the inverse problem are presented for the case $\varepsilon = 0$, the conditions of unique solvability are indicated, and realizability of the conditions is clarified.

An iteration algorithm is proposed for finding an approximate solution to the inverse problem for the case $\varepsilon \neq 0$. At each step of the algorithm, the solution of the inverse problem for the above-considered case $\varepsilon = 0$ is combined with the solution of the direct problem which is reduced to the proof of the existence and uniqueness of a solution in the case $\varepsilon \neq 0$. The conjecture is stated on convergence of the algorithm and an approach to its justification is developed which is based on the Banach fixed-point theorem.

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