Constructive methods of investigation of the differential-algebraic Cauchy problem with concentrated delay

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We investigate the problem of the determination of conditions for the existence of solution [1]

$$z(t) \in \mathbb{C}[0,T], \quad z(t) \in \mathbb{C}^1\{[0,T] \setminus \{k\Delta\}_I\}, \quad k = 1,\ 2,\ \ldots\ ,\ q$$

of the linear differential-algebraic Cauchy problem with concentrated delay [2]

$$A(t)z'(t) = B(t)z(t) + C(t)z(t-\Delta) + f(t),\ t \in [\Delta, T] \quad (1)$$

with initial function $z(t) = \varphi(t) \in \mathbb{C}^1[0,\Delta]$. The matrices

$$A(t),\ B(t),\ C(t) \in \mathbb{C}_{m\times n}[0,T] := \mathbb{C}[a,b] \otimes \mathbb{R}^{m\times n}, \quad m \neq n$$

and the vector function $f(t) \in \mathbb{C}[0,T]$ are assumed to be continuous on the segment $[a,b]$. We assume that the matrix $A(t)$ is, generally speaking, rectangular: $m \neq n$. It can be square, but singular.

The conditions of solvability and the structure of a generalized Green operator of the Cauchy problem for a linear differential-algebraic system with concentrated delay are found. The sufficient conditions of reducibility of a differential-algebraic equation with concentrated delay to a sequence of systems joining functional-differential and algebraic equations are constructed.

This work was financially supported by the State Foundation for Basic Research. Number of state Registered 0109U000381.

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