Numerical Methods of Solution for Singular Nonlinear Integral Differential Equations

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Abstract: Consider systems of integral differential equations

\[ A(t)\dot{x}(t) + B(t)x(t) + F(t, x, Vx) = 0, \]

\[ Vx = \int_0^t K(t, s, x(s))ds, \quad t \in [0, 1] = T, \]

with the initial data

\[ x(0) = x_0, \]

where \( A(t), B(t) \) are \((n \times n)\)-matrices, \( F(t, x, z), K(t, s, y) \) are \(n\)-dimension vector-functions, \( x(t) \) is a desirable vector-function, and \( x_0 \) is a given vector from \( \mathbb{R}^n \). It is assumed that the input data is sufficiently smooth in the domain and

\[ \det A(t) = 0 \quad \forall t \in T. \]

Problems (1)–(2) satisfying condition (3) arise in modeling of physical processes with aftereffect, for instance, processes in electrical circuits. In the paper the non-local theorem for problems (1)–(2) has been proved and the numerical method of solution based on back differentiation formula and the Adams quadrature formula has been proposed.

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