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Book of Abstracts

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2. *if the function* $f \in C_b(\mathbb{R}_+, \mathfrak{B})$ *is asymptotically stationary (respectively,* τ*-periodic, quasi-periodic, Bohr almost periodic, Bohr almost automorphic, Birkhoff recurrent, positively Lagrange stable), then equation (1) has a unique solution* $\varphi_\varepsilon \in C_b(\mathbb{R}_+, \mathfrak{B})$ *with* $\mathcal{P}\varphi_\varepsilon(0) = 0$ *which is asymptotically stationary (respectively,* τ*-periodic, quasi-periodic, Bohr almost periodic, Bohr almost automorphic, Birkhoff recurrent, positively Lagrange stable);*

3. $$\lim_{\varepsilon\to 0} \sup_{t\in\mathbb{R}_+} |\psi_\varepsilon(t) - \bar{\psi}| = 0,$$

   where $\bar{\psi}$ *is a unique stationary solution of equation (5).*

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About stability of linear systems with delay

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This paper investigates the application of approximation schemes for differen-tial-difference equations [1-3] to construct algorithms for the approximate fin-ding of nonsymptotic roots of quasipolynomials and their application to study the stability of solutions of systems of linear differential equations with delay.

Consider the initial problem for a system of differential-difference equations

$$\frac{dx}{dt} = Ax(t) + \sum_{i=1}^{k} B_i x(t - \tau_i), \tag{1}$$

$$x(t) = \varphi(t), t \in [-\tau, 0], \tag{2}$$

where $A, B_i, i = \overline{1,k}$ fixed $n \times n$ matrix, $x \in R^n, 0 < \tau_1 < \tau_2 < ... < \tau_k = \tau$.

Let us correspond to the initial problem (1) - (2) the system of ordinary differential equations [1-2]

$$\begin{aligned} \frac{dz_0(t)}{dt} &= A(t)z_0(t) + \sum_{i=1}^{k} B_i z_{l_i}(t), \qquad l_i = [\frac{\tau_i m}{\tau}], \\ \frac{dz_j(t)}{dt} &= \mu(z_{j-1}(t) - z_j(t)), \quad j = \overline{1,m}, \quad \mu = \frac{m}{\tau}, m \in N, \end{aligned} \tag{3}$$

$$z_j(0) = \varphi(-\frac{\tau j}{m}), \quad j = \overline{0,m}. \tag{4}$$

Theorem 1 [2]. *Solution of the Cauchy problem (3)-(4) approximates the solution of the initial problem (1)-(2) at $t \in [0, T]$ if $m \to \infty$.*

Theorem 2 [1]. *If the zero solution of the system with delay (1) is exponentially stable (not stable), then there is $m_0 > 0$ such that for all $m > m_0$, the zero solution of the approximating system (3) is also exponentially stable (not stable). If for all $m > m_0$ the zero solution of the approximation system (3) is exponentially stable (not stable) then the zero solution of the system with a delay (1) is exponentially stable (not stable).*

It follows from Theorem 2 that the asymptotic stability of the solutions of the delayed linear equations approximating system of ordinary differential equations for sufficiently large values of m are equivalent. This fact will be used to study the stability of linear differential-difference equations [3].

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Solving boundary value problems for linear neutral delay differential-difference equations using a spline collocation method

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In this work, an iterative scheme using cubic splines with defect two is considered for a boundary value problem for neutral delay linear differential-difference equations. The conditions for the boundary