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ABSOLUTE STABILITY OF ADJUSTABLE SYSTEMS WITH LIMITED RESOURCES IN A SIMPLE CRITICAL CASE

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A new effective algebraic criterion of absolute stability of the equilibrium position of nonlinear adjustable systems in a simple critical case is developed on the basis of the evaluation of improper integrals along the solution of the system.

Statement of problem: The equation of the motion of a nonlinear system of automatic control in a simple critical case has the form:

$$\dot{x} = Ax + B\varphi(\sigma), \dot{\eta} = \varphi(\sigma), \sigma = Dx + E\eta, x(0) = x_0, \eta(0) = \eta_0, t \in I = [0, \infty), \quad (1)$$

where A, B, D, E - permanent matrix, the order of the matrix is $n \times n, n \times 1, 1 \times n, 1 \times 1$ appropriately, matrix A - Hurwitz matrix, that is to say $Re\lambda_j(A) < 0, j = \overline{1, n}, \lambda_j(A)$ - eigenvalues of the matrix A .

$$\varphi(\sigma) \in \Phi_0 = \{\varphi(\sigma) \in C(R^1, R^1) \mid \varphi(\sigma) = \varepsilon\sigma + \bar{\varphi}(\sigma), 0 \leq \bar{\varphi}(\sigma)\sigma \leq \mu_0\sigma^2, \bar{\varphi}(0) = 0, |\bar{\varphi}(\sigma)| \leq \bar{\varphi}_*, 0 < \bar{\varphi}_* < \infty, \forall \sigma, \sigma \in R^1\}, \quad (2)$$

where $\varepsilon > 0$ - an arbitrarily small number.

Equilibrium of the system (1), (2) is determined by solving algebraic equations

$$Ax_* + B\varphi(\sigma_*) = 0, \varphi(\sigma_*) = 0, \sigma_* = Dx_* + E\eta_*.$$

As A - Hurwitz matrix, $\varphi(\sigma_*) = 0$ when $\sigma_* = 0$, so system (1), (2) has unique equilibrium state $(x_* = 0, \eta_* = 0)$ for $E \neq 0$.

The equilibrium state $(x_* = 0, \eta_* = 0)$ of the system (1), (2) is called absolutely stable if the matrix $A, A_1(\mu) = \begin{pmatrix} A + B\mu D & B\mu E \\ \mu D & \mu E \end{pmatrix}, 0 < \varepsilon \leq \mu < \bar{\mu}_0, \mu_0 \leq \bar{\mu}_0$ - Hurwitz matrix, and for all $\varphi(\sigma) \in \Phi_0$ solution off differential equation (1) has property $\lim_{t \rightarrow \infty} x(t; 0, x_0, \eta_0, \varphi) = x_* = 0, \lim_{t \rightarrow \infty} \eta(t; 0, x_0, \eta_0, \varphi) = \eta_* = 0$ for any $x_0, \eta_0, |x_0| < \infty, |\eta_0| < \infty$.

Criterion of absolute stability for the system (1), (2) is called the algebraic relations, linking matrix (A, B, D, E, μ_0) under which the equilibrium state $(x_* = 0, \eta_* = 0)$ is absolutely stable.

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ON THE BOUNDEDNESS OF PARAMETRIC MARCINKIEWICZ OPERATORS IN GENERALIZED MORREY SPACES

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We study the boundedness of the parametric Marcinkiewicz operators μ_{Ω}^{ρ} on generalized Morrey spaces $M_{p,\varphi}$. We find the sufficient conditions on the pair (φ_1, φ_2) which ensures the boundedness of the operators μ_{Ω}^{ρ} from one generalized Morrey space M_{p,φ_1} to another M_{p,φ_2} , $1 < p < \infty$ and from the space M_{1,φ_1} to the weak space WM_{1,φ_2} .

In 1960, Hörmander considered the L_p boundedness for a class of parametric Marcinkiewicz integral $\mu_{\Omega}f(x)$, which is defined by

$$\mu_{\Omega}^{\rho}(f)(x) = \left(\int_0^{\infty} \left| \frac{1}{t^{\rho}} \int_{|x-y|\leq t} \frac{\Omega(x-y)}{|x-y|^{n-\rho}} f(y) dy \right|^2 \frac{dt}{t} \right)^{1/2},$$

where $0 < \rho < n$. It is easy to see that when $\rho = 1$, μ_{Ω}^{ρ} is just μ_{Ω} introduced by Stein in 1958.

Let $1 \leq p < \infty$ and $B(x, r)$ denotes the open ball centered at x with radius r . We denote by $M_{p,\varphi}(\mathbb{R}^n)$ the generalized Morrey space, the space of all functions $f \in L_p^{\text{loc}}(\mathbb{R}^n)$ with finite quasinorm $\|f\|_{M_{p,\varphi,P}} =$

$\sup_{x \in \mathbb{R}^n, r > 0} \varphi(x, r)^{-1} r^{-\frac{n}{p}} \|f\|_{L_p(B(x,r))}$. Also by $WM_{p,\varphi}(\mathbb{R}^n)$ we denote the weak

generalized Morrey space of all functions $f \in WL_p^{\text{loc}}(\mathbb{R}^n)$ for which $\|f\|_{WM_{p,\varphi}} =$

$\sup_{x \in \mathbb{R}^n, r > 0} \varphi(x, r)^{-1} r^{-\frac{n}{p}} \|f\|_{WL_p(B(x,r))} < \infty$. Here $\varphi(x, r)$ be a positive measurable function on $\mathbb{R}^n \times (0, \infty)$.

We proved the following theorem is valid.

Theorem. *Let $0 < \rho < n$, $1 \leq p < \infty$ and (φ_1, φ_2) satisfies the condition*

$$\int_r^{\infty} \frac{\varphi_1(x, t)}{t} dt \leq C \varphi_2(x, r),$$

where C does not depend on x and r . Let also Ω is a homogeneous function of degree zero on \mathbb{R}^n , has mean zero on S^{n-1} , and $\Omega \in \text{Lip}_{\alpha}(S^{n-1})$, $0 < \alpha \leq 1$. Then the operator μ_{Ω}^{ρ} is bounded from M_{p,φ_1} to M_{p,φ_2} for $p > 1$ and from M_{1,φ_1} to WM_{1,φ_2} .

Note that, the boundedness of the Marcinkiewicz operator μ_{Ω} on generalized Morrey spaces $M_{p,\varphi}$ was study in [1].

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