ASSIGNABILITY OF IMPROPERNESS COEFFICIENTS OF DISCRETE LINEAR TIME-VARYING SYSTEMS

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We consider the discrete linear time-varying system

$$x(n+1) = A(n)x(n) + B(n)u(n), \tag{1}$$

where $A = (A(n))_{n\in\mathbb{N}}$, $B = (B(n))_{n\in\mathbb{N}}$ are sequences of s by s and s by t real matrices, respectively. Moreover, the control sequence $u = (u(n))_{n\in\mathbb{N}}$ is $t-$ dimensional. If the control u has a form of a linear time-varying feedback, i.e.

$$u(n) = U(n)x(n),$$

then we obtain closed system

$$x(n+1) = (A(n) + B(n)U(n))x(n). \tag{2}$$

With homogeneous system we associate the so-called: Lyapunov regularity coefficients $\sigma_L(A)$, Perron regularity coefficient $\sigma_P(A)$ and Grobman regularity coefficient $\sigma_G(A)$ (see [1–4]). In this paper we investigate the problem of assignability of these characteristics. Continuous time-version of this problem has been investigated in [5]. The main result of this paper is given by the following theorem

Theorem. *If system (1) is uniformly completely controllable then for each $\sigma \geqslant 0$ there exists admissible feedback control $U = (U(n))_{n\in\mathbb{N}}$ such that the for the closed loop system (2) we have*

$$\sigma = \sigma_L(A+BU) = \sigma_P(A+BU) = \sigma_G(A+BU).$$

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References

1. Lyapunov A. M. *Collected Papers.* Moscow: Akad. Nauk SSSR, 1956.

2. Perron O. *Die rdnungszahlen linearer Differentialgleichungssysteme* // Math. Zeitschr. 1930. Bd 31. S. 748–766.

3. Grobman D. M. *Characteristic exponents of systems near to linear ones* // Mat. Sb. 1952. V. 72. Iss. 1. P. 121–166.

4. Czornik A. *Perturbation Theory for Lyapunov Exponents of Discrete Linear Systems.* Komitet Automatyki i Robotyki Polskiej Akademii Nauk, Wydawnictwa AGH, 2012.

5. Popova S. N. *Global reducibility of linear control systems to systems of scalar type* // Differ. Equat. 2004. V. 40. № 1. P. 43–49.