On a regularization method for solving difference boundary value problem

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We investigate the problem of the determination of conditions for the existence of bounded solution [1] $z(k) \in \mathbb{R}^n$ of the linear difference boundary-value problem [2]

$$z(k+1) = A(k)z(k) + f(k), \quad \ell z(\cdot) = \alpha \in \mathbb{R}^m. \tag{1}$$

The matrix $A(k) \in \mathbb{R}^{n\times n}$ and the vector function $f(k) \in \mathbb{R}^n$ are assumed to be bounded on set $k \in \Omega := \{0,\ 1,\ 2,\ \dots\ ,\ \omega\}$; $\ell z(\cdot)$ is linear vector-functional $\ell z(\cdot) : \mathbb{R}^n \to \mathbb{R}^m$, bounded on set Ω. The proposed regularization conditions, as well as the scheme for finding of bounded solutions to linear Noetherian boundary value problems for a system of difference equations in the critical case, are illustrated in details with examples. In contrast to the earlier articles of the authors [3], the regularization problem for a linear Noether boundary value problem for a system of difference equations in the critical case has been resolved constructively, and sufficient conditions has been obtained for the existence of a bounded solution to the regularization problem.

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