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On the regularization of the Cauchy problem for a system of linear difference equations.

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Summary: The article proposes unusual regularization conditions as well as a scheme for finding solutions of the linear Cauchy problem for a system of difference equations in the critical case, significantly using the Moore-Penrose matrix pseudo-inversion technology. The problem posed in the article continues the study of the regularization conditions for linear Noetherian boundary value problems in the critical case given in the monographs by *S. G. Krein* [Differ. Uravn. 21, No. 10, 1814–1817 (1985; [Zbl 0636.34056](#))], *N. Azbelev* et al. [Introduction to the theory of linear functional differential equations. Transl. from the Russian. Atlanta, GA: World Federation Publishers Company (1995; [Zbl 0867.34051](#))], *A. M. Samoilenko* and *A. A. Boichuk* [Ukr. Math. J. 44, No. 4, 504–508 (1992; [Zbl 0782.34018](#))]. The general case is studied in which a linear bounded operator corresponding to a homogeneous part of a linear Cauchy problem has no inverse. In the article, a generalized Green operator is constructed and the type of a linear perturbation of a regularized linear Cauchy problem for a system of difference equations in the critical case is found. The proposed regularization conditions, as well as the scheme for finding solutions to linear Cauchy 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, the regularization problem for a linear Cauchy 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 solution to the regularization problem.

MSC:

[39A27](#) Boundary value problems for difference equations

[15A10](#) Applications of generalized inverses

[39A06](#) Linear difference equations

Keywords:

regularization scheme; Cauchy problem; linear difference equations; pseudoinverse matrices

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