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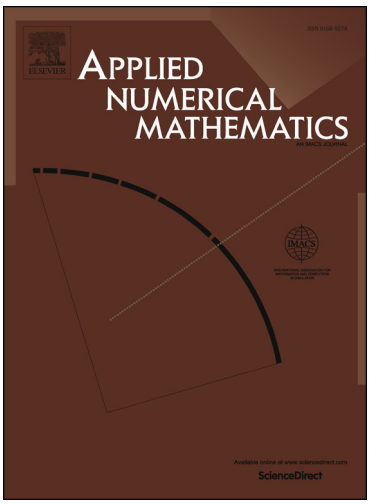

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On self-regularization properties of a difference scheme for linear differential-algebraic equations☆

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Abstract

In this article a class of linear differential-algebraic equations with an initial condition is identified. This class has a unique continuously differentiable solution that depends on the first derivatives of the right-hand part. Assuming that the right-hand part is given with the known level of the error, it is shown that a difference scheme of the first order generates a regularization algorithm. The integration step that depends on the perturbation of the right-hand part is the regularization parameter. The survey of regularization methods for differential-algebraic equations and related problems is given.

Keywords: differential-algebraic equations, difference scheme, ill-posed problem, regularization algorithm
2010 MSC: 65L80

1. Introduction

Interrelated systems of ordinary differential and algebraic equations often occur as mathematical models in multibody mechanics, electrical networks, chemical processes, and others. Examples of such problems can be found in [3], [4], [5], [18].

A linear system has a form

$$A(t)x'(t) + B(t)x(t) = f(t),\ t \in [0,1], \tag{1}$$

$$x(0) = x_0, \tag{2}$$

where $A(t)$, $B(t)$ are $(n \times n)$-matrices, $f(t)$ and $x(t)$ are the given and unknown n-dimensional vector-functions, respectively.

If

$$detA(t) \equiv 0, \tag{3}$$

then systems (1) are called differential-algebraic equations (DAEs). It is assumed that the initial condition (2) is given in such way that the problem under consideration has

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