Method Adams type for solving singular IDE

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Keywords: *integro-differential equation, multi-step methods*

Abstract

In this paper, we consider a class of linear singular IDE:

$$A(t)x'(t) + B(t)x(t) + \int_0^t K(t,s)x(s)ds = f(t), \tag{1}$$

where $A(t), B(t), K(t,s) - (n \times n)$-matrix, $t \in [0,1]$, $\det A(t) \equiv 0$, with given condition

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

The construction of numerical algorithms for such systems is connected with great difficulties:

- due to the singular of the matrix A (t) explicit methods are not applicable;
- semi-explicit method is not always applicable, as matrix beam $\lambda A + B$ or $\lambda A + K$, may be singular;
- In addition, this class of equation includes integral equations of the first kind of Volterra with a kernel on the diagonal is not equal to zero. And many implicit multistep methods produce unstable process.

We propose to build a multi-step methods based on explicit Adams quadrature formula for the integral component and the extrapolation formulas for the first two components. Form of the method:

$$A_{i+1}\sum_{j=0}^{k}\alpha_j x_{i-j} + hB_{i+1}\sum_{j=0}^{k-1}\beta_j x_{i-j} + h^2\sum_{l=0}^{i}\omega_{i+1l}K_{i+1l}x_l = hf_{i+1} \tag{3}$$