A COMPARISON OF METHODS FOR COMPUTING THE MATRIX EXPONENTIAL APPEARS IN SYSTEMS OF DIFFERENTIAL EQUATIONS

Dashti Ahmed Ali[1]

[1]*Koya University, Koya, Kurdistan Region, Iraq*

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Abstract

The matrix exponential commonly arises in the applications of various scientific fields due to the fact that it can provide the solution of the systems of linear differential equations arising in the mathematical modelling of scientific problems. There are a number of methods to compute the matrix exponential e^A for any given square matrix A. However, none of them are completely satisfactory. This paper aims to investigate and analyse a certain number of these methods, in terms of accuracy and efficiency, such as Taylor series method, Padé approximant, the scaling and squaring algorithm, and the spectral decomposition technique. All of the methods have been implemented in MATLAB environment, and then a number of experiments have been carried out on these methods. As a result of the accuracy and efficiency tests, we have found that the scaling and squaring algorithm, is the most accurate and cost-efficient method.

Keywords: Matrix Exponential, Taylor Series, Padé Approximant, Accuracy, Efficiency

[1]First Author's e-mail: dashti.ahmed@koyauniversity.org