ISSN: 1391-8796
Proceedings of 6th Ruhuna International Science & Technology Conference
University of Ruhuna, Matara, Sri Lanka
January 30, 2019

An efficient numerical scheme for time fractional reaction diffusion equations

Somathilake L.W. *

Department of Mathematics, University of Ruhuna, Matara, Sri Lanka

The aim of this paper is to introduce a more accurate and efficient discrete fractional order derivative to integrate non-linear time fractional order reaction diffusion equations. The Fixed Memory method (Short Memory method (SMM)) and the Full Memory method (FMM) are two established discrete fractional order derivatives (DFODs). In the fixed memory method, the tail of the memory at each time step is cut off and hence uncontrollable error occurs. Also, FMM is not efficient for long time integration of large systems of fractional differential equations because of higher computational cost. To overcome these barriers, author propose a new discrete fractional order derivative. In this method, the number of memory points in the past are reduced by choosing only a part of the memory points randomly and decreasing along the tail of the memory (call this *the Decreasing Random Memory Method* (DRMM)). Author constructed three semi implicit numerical schemes, semi implicit scheme with full memory method (SI-FMM), semi implicit scheme with short memory method (SI-SMM) and semi implicit scheme with decreasing random memory method (SI-DRMM) and compare accuracies and computational costs (CT) of these three numerical schemes. To do this comparison, author applied these three numerical schemes for three fractional reaction diffusion equations whose exact solutions are known. Numerical experiments show that the error occurr in proposed SI-DRMM is less than that of SI-SMM. Furthermore, SI-DRMM is computationally cheaper than the SI-FMM. Therefore, the proposed DRMM is more accurate than SMM and more efficient than FMM.

Keywords: discrete fractional order derivatives, time fractional reaction diffusion equations, short memory method, full memory method

Acknowledgements: Authors wish to thank Professor Kevin Burrage, School of Mathematical Sciences, Queensland University of Technology, Brisbane, Australia for giving suggestions.

*Corresponding Author: lwsoma@gmail.com