Space-time pseudospectral method for the variable-order space-time fractional diffusion equation

Rupali Gupta
Sardar Vallabhbhai National Institute of Technology Surat, India
rupaligupta971@gmail.com

Even though constant order fractional calculus is sufficient to cover most physical problems, it lacks when the fractional order behavior of the system changes with time or space or both. Variable order fractional calculus is the advancement of constant order fractional calculus. Finding the analytical solution is still tricky despite its significant importance in real-life modeling problems. Hence several computational and approximation methods are proposed to achieve the approximate solution. We discuss a numerical method for solving the space-time variable order fractional diffusion equations with various boundary conditions.

We used the pseudospectral method with Chebyshev polynomial as an orthogonal basis function which converts the considered problem into a set of linear algebraic equations. Then it can be solved for the unknowns to get the numerical solution. We solved a few examples to show that the proposed method is reliable and efficient. The convergence of the method is also presented. Error analysis is done theoretically and then verified through graphs of the numerical solutions. We also observed that using variable order derivatives requires fewer basis functions for a more accurate solution.

Joint work with Sushil Kumar(Sardar Vallabhbhai National Institute of Technology Surat, Surat, India).