

Multi-domain pseudo spectral relaxation method for systems of nonlinear initial value differential equations

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Keywords: multi-domain, pseudo-spectral, relaxation, population dynamics.

In this article, a novel approach for solving system of nonlinear population dynamic equations over a large time domain are presented. The novel approach is termed the multi-domain pseudo-spectral relaxation method (MPSRM). This method makes use of Legendre-Gauss-Lobatto grid points, Gauss-Seidel relaxation technique, and the pseudo-spectral collocation method to approximate functions defined by Lagrange interpolation. The method is developed for a general system of n nonlinear population dynamic differential equations.

We demonstrate the use of the MPSRM technique by solving systems of nonlinear population dynamic differential equations. Numerical experiments are conducted on the phytoplankton-nutrient model, whooping cough epidemic model, tuberculosis epidemic model and combined Langerhans and $CD4^+$ T Cells and HIV Infection model to show applicability and accuracy of the method. Grid independence tests are carried out to establish their accuracy, convergence and validity. Tables are generated to demonstrate the time taken to find an approximate solution.