Fourth order solutions of singularly perturbed boundary value problems by quarter-sweep iteration

ABSTRACT

In previous studies, the effectiveness of the second-order quarter-sweep finite difference approximation equations has been shown in solving singularly perturbed boundary value problems. In this paper, however, we investigate the application of the fourth-order quarter-sweep finite difference approximation equation based on the fourth-order standard central difference scheme. To solve the problems numerically, discretization of the singularly perturbed problems via second-order and fourth-order finite difference schemes is proposed to form the corresponding system of linear algebraic equations. For comparison purpose, we also discuss on how to derive the basic formulation and implementation for the family of Successive Over-Relaxation (SOR) iterative methods such as FSSOR, HSSOR and QSSOR in solving the corresponding linear systems generated from the fourth-order discretization schemes based on full, half- and quarter-sweep cases. Some numerical tests were conducted to show that the accuracy of fourth-order finite difference schemes via the corresponding GS methods is more accurate than second-order schemes.

Keyword: Quarter-sweep reduction technique; SOR iteration; Standard finite difference scheme